The Impact of TARP Capital Infusions on Bank Liquidity Creation: Does Bank Size Matter?

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Abstract

The literature of the effect of government capital support on bank liquidity creation is large. The empirical evidence on the relation between capital support and bank liquidity creation has been mixed and inconclusive. We argue that the mixed evidence is attributed to the fact that the role of bank size has not been properly accounted for in the literature. Using the comprehensive measure of bank liquidity creation developed by Berger and Bouwman (2009), and the largest government rescue program in U.S. history – the Troubled Asset Relief Program (TARP) as a laboratory, this paper finds evidence consistent with the argument. Specifically, for small banks, the relationship between TARP and liquidity creation is positive; for large banks, the relationship between TARP and liquidity creation is insignificant. The findings can be of importance to policymakers and supervisory authorities for assessing government-supported schemes and designing the most effective regulatory framework.

Key words: Liquidity creation; TARP; Government bailout; Bank size

JEL classification: G01, G21, G28

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1. Introduction

The financial turmoil that started in the summer of 2007 brought the U.S. financial system to the verge of collapse. In response to the worst economic downturn in the U.S. since the Great Depression, the Troubled Asset Relief Program (TARP), the largest government rescue program in U.S. history, was facilitated by the Emergency Economic Stabilization Act of 2008 (EESA) on October 3, 2008. The TARP was created to stabilize the financial system by providing capital to viable financial institutions; and to increase availability of credit to businesses and consumers to improve real economic conditions. The Capital Purchase Program (CPP), the largest bank investment program, is the cornerstone of the TARP. It entailed the direct injection of up to $250 billion of the TARP funds into qualifying financial institutions (QFIs).[1]

Given two stated policy objectives of TARP program (to strengthen the capital base of economically sound banks, and to stimulate lending and restore credit flowing in the economy), an interesting question is how TARP recipients deployed their new capital during the crisis and post-crisis period. Will they use it to create additional loans, or will they retain it to improve their capital positions? To shed light on these questions, we investigate whether and how TARP capital injections affect bank liquidity creation. Liquidity creation is a major function of banks in the economy and can be regarded as the best available measure of total bank output that includes all assets, liabilities, equity, and off-balance sheet guarantees and derivatives. Banks create liquidity on the balance sheet by financing relatively long-term illiquid assets with relatively short-term liquid liabilities (Bryant, 1980; Diamond and Dybvig, 1983). Banks also create liquidity by way of off-balance sheet activities, such as providing standby letters of credit

[1] Qualifying financial institutions (QFIs) included bank holding companies, financial holding companies, insured depository institutions, and savings and loan holding companies that were established and operating in the U.S. and that were not controlled by a foreign bank or company.

and loan commitments to their customers (Holmström and Tirole, 1998; Kashyap et al., 2002 and Thakor, 2005).

On the one hand, TARP was designed to stabilize the financial sector through the increased capitalization of banks. Hence, TARP recipients may use TARP funds to strengthen their capital base following government capital injections. In this case, TARP may have little effect on bank liquidity creation. One the other hand, TARP banks were encouraged to support new lending during an economic downturn, so TARP may have a positive and significant impact on liquidity creation. Our study is closely related to the line of research that investigates the impact of TARP on bank lending[2], which is one element of liquidity creation. However, previous empirical evidence regarding this strand of literature is mixed and inconclusive. Some studies document the positive effects of TARP investments on bank loan supply. For example, Li (2013) uses four political and regulatory connection variables as instruments for TARP participation and finds that the program increased bank loan supply by a large amount, $404 billion. Applying difference-in-difference methodology to loan-level data, Berger et al. (2018) find that TARP resulted in more favourable loan contract terms in five dimensions - spread, amount, maturity, collateral, and covenants for recipient banks' business customers. Chu et al. (2019), Chavaz and Rose (2016) and Puddu and Waelchli (2015) also find evidence that TARP banks increased credit supply to business. But, other studies have found little increase in lending as a result of TARP capital support. For example, Duchin and Sosyura (2014) find that TARP investments have little effect on aggregate credit supply despite using the similar political connection variable that was used by Li (2013) as an instrument for bailout approvals.

[2] Existing empirical literature relating to the TARP can be grouped into four areas. Firstly, some papers focus on the determinants of the TARP capital allocation and repayment (Duchin and Sosyura 2012; Li 2013; Blau et al. 2013; Bayazitova and Shivdasani 2012; Wilson and Wu 2012; Wilson 2013; Cadman et al. 2012; Liu et al. 2013; Cornett et al. 2013). Secondly, another area of focus in empirical literature is the stock market valuation effects of the TARP (Jordan et al. 2011; Elyasiani et al. 2014; Farruggio et al. 2013; Bayazitova and Shivdasani 2012; Veronesi and Zingales 2010; Kim and Stock 2012; Liu et al. 2013; Ng et al. 2016). Thirdly, the impact of the TARP on bank risk-taking and/or bank lending is investigated (Black and Hazelwood 2013; Duchin and Sosyura 2014; Li 2013; Wilson and Wu 2010; Semaan and Drake 2016; Bassett et al. 2017; Berger et al. 2017). Finally, a small but growing set of studies have explored the relation between the TARP investments and bank efficiency (Harris et al. 2013), stock market volatility (Huerta et al. 2011; Nguyen and Enomoto 2009), economic condition (Berger and Roman 2017), financial stability (Berger and Bouwman 2017; Berger et al. 2019), and bank competition (Berger and Roman 2015).

Taliaferro (2009) argues that due to severe capital losses of banks during the crisis, TARP banks used much of their TARP funds to shore up their capital ratios and repair their weak balance sheets, rather than support new lending. Bassett et al. (2017) assess five government support programs including TARP and find no evidence of a change in credit supply. Using a banking sector dataset in Germany, Berger et al. (2016) find that capital support does not affect liquidity creation.

We argue that the impact of TARP on bank liquidity creation depends critically on bank size. There are two views of the impact of TARP on bank liquidity creation in the literature. The first view ("precautionary motive") predicts that government support, if intended to help strengthen banks through capitalization, can discourage banks from hoarding liquidity (Castiglionesi et al., 2014). This is because government capital support may provide banks with the assurance of safety and thereby reduce precautionary liquidity hoarding incentives (i.e., banks would not have to hold as much liquidity for survival) and encourage bank lending/liquidity creation. We argue that if TARP capital support can alleviate banks' precautionary motive for liquidity holdings and promote bank liquidity creation, the effect should be more pronounced for small banks than large banks since "precautionary motive" is relatively strong for small banks but weak for large banks (Allen et al., 1989). The second view ("moral hazard effect") predicts that government capital support may have no significant impact on bank liquidity creation. Previous empirical studies show that the expectation of financial safety nets (e.g., deposit insurance scheme, capital bailout, liquidity provision policies, loan guarantees, nationalizations, and many others) can create moral hazard in the form of excessive risk-taking behaviour (e.g., Dam and Koetter, 2012). Further, existing literature find that financial firms tend to take on excessive risks mainly through increased leverage/lower capital (Bhagat et al., 2015) and banks with lower capital buffer are more likely to fail (Cole and White, 2012; Berger and Bouwman, 2013). Moreover, in response to the Global Financial Crisis

(GFC), one goal of post-crisis capital regulation reforms proposed in Basel III is to reduce the risk-taking incentives of banks by imposing stricter capital requirement. Therefore, it is likely that banks might use TARP funds to repair their weak balance sheets (e.g., capital losses) during the crisis period and meet stringent capital requirements during the post-crisis period. In this case, TARP capital injections may have insignificant effects on bank liquidity creation. We expect that the "moral hazard effect" is more pronounced in large banks than in small banks since large banks presumably benefit from either explicit or implicit government guarantees and have been shown to follow riskier strategies than small banks (Gropp et al., 2011). As such, they may build up capital buffer for compensating the capital shortage due to their pre-crisis excessive risk-taking.

This paper makes four contributions to the literature. First, while the literature has devoted extensive efforts to evaluating the impact of TARP on bank lending, the effects of TARP on bank liquidity creation, which includes much more than lending, as lending is only one component of asset-side liquidity creation, remains largely unanswered. A key motivation for the focus on the function of banks as liquidity creators is the argument from Berger and Sedunov (2017) that bank lending alone is not an optimal measure of bank output, and liquidity creation can be regarded as the best available measure of total bank output that includes all assets, liabilities, equity, and off-balance sheet guarantees and derivatives. Second, previous literature has investigated the effects of TARP capital injections on bank lending, but their findings are mixed and inconclusive. This is the first study that integrates bank size as a primary component in the analysis of the impact of TARP on bank liquidity creation. We find that TARP has a positive and significant effect on liquidity creation for small banks, whereas the effect is not significant for large banks. These findings are aligned with the theoretical argument of precautionary motive and moral hazard effects in the literature.

Third, this paper provides additional evaluation of the effectiveness of the TARP program, and will be of particular importance to policymakers and supervisory authorities for assessing government-supported schemes and designing the most effective regulatory framework. The results clearly indicate that one size does not fit all when it comes to government bailout. Our results show that the effects are concentrated in small banks, indicating that following the TARP, the amount of liquidity creation by small TARP banks is significantly higher than those not receiving TARP funds. This suggests that, from the bank liquidity creation perspective, government capital injections should target a large fraction of small banks. However, it doesn't imply that government capital support is of no importance for large banks, as it can strengthen their capital position. Prior literature shows that the main design challenge of TARP was its conflicting goals for bank recapitalization and bank lending (e.g., Black and Hazelwood, 2013), therefore to design more effective government bailout program in future it is critically important to consider different sizes of banks. Fourth, this paper makes an important contribution to the literature on bank capital and bank liquidity creation. Theories are split on the impact of bank capital on liquidity creation. One set of theories, which is referred to as "financial fragility-crowding out" hypothesis, posits a negative effect whereas a contrasting theory (known as "risk absorption" hypothesis) predicts a positive effect.[3] Complementing this strand of literature, our paper explores a related but different theoretical motivation as to how capital support or government aid affects bank liquidity creation. It is worthwhile to consider different theoretical predictions because government capital support may come with specific goals (e.g., the twin goals of financial stability and economic growth of TARP) which are distinct from those of bank capital adjustment needed for the normal business operation of

[3] For an in-depth discussion of "financial fragility-crowding out" and "risk absorption" theories, see Berger and Bouwman (2009). On the empirical side, Berger and Bouwman (2009) find empirical support for both hypotheses using a sample of US commercial banks. For large banks, which create by far most of the liquidity, they find a positive relationship, consistent with the "risk absorption" effect, whereas for small banks, the relationship is negative, consistent with the "financial fragility-crowding out" effect. In the context of UK and French banking industry, Mazioud Chaabouni et al. (2018) find a negative and significant effect of bank capital on liquidity creation, which is in line with "financial fragility-crowding out" hypothesis.

banks. Specifically, we argue that "precautionary motive" and "moral hazard effect" theories are more relevant to and applicable in the context of government capital bailout during the crisis period due to the following reasons. With respect to "precautionary motive", it has been documented that a well-functioning interbank market during normal times provides effective liquidity coinsurance by channelling liquidity between banks with liquidity surpluses and shortages, which in turn minimizes holding of costly liquid assets by banks for which the returns are low. However, there is ample evidence that banks stopped creating liquidity and started hoarding liquidity rapidly for precautionary purposes since September 2008 following the collapse of Lehman Brothers (more precisely, when the interbank market stopped functioning as an effective channel for liquidity reallocation among banks). As discussed previously, government capital support may provide banks with the assurance of safety and thereby reduce precautionary liquidity hoarding incentives. In regard to "moral hazard effect", as noted above, moral hazard in the form of excessive risk-taking behaviour may create huge capital losses for banks, which would in turn lead to higher probability of bank failure during the crisis period. Hence, to meet the stringent capital requirements following the crisis, banks may use TARP funding to strengthen their solvency and repair their weak balance sheets (e.g., capital losses), resulting in little change in bank liquidity creation. Although there has been a significant amount of research on TARP, to our knowledge, there is no academic research directly supporting either of these views. One goal of our paper is to fill this gap in the literature.

The remainder of this paper is organized as follows: Section 2 provides some details about the Capital Purchase Program (CPP) and introduces testable predictions. Section 3 presents the data, variables, and composition of the sample. Section 4 contains the econometric model, empirical analysis with the main findings and addresses the endogeneity concern, followed by a series of related additional analysis and robustness checks. Section 5 provides the conclusions.

2. Institutional background and theoretical motivation

2.1 Background to CPP

The CPP, the first and largest TARP initiative, is the cornerstone of the TARP. On October 14, 2008, U.S. Treasury Secretary Henry Paulson announced a revision to the implementation of the TARP. It entailed the decision by Treasury to directly inject up to $250 billion of TARP funds into qualifying financial institutions (QFIs) under the CPP in order to improve the capital positions of banks and to encourage them to resume lending, thereby easing the tight credit market conditions. CPP investment is in the form of preferred equity injections as opposed to loans. In exchange for the CPP capital, banks provided the Treasury with non-voting preferred stock, which paid quarterly dividends at an annual yield of 5% for the first five years and 9% thereafter, and ten-year life warrants, to purchase common stock for an amount equal to 15% of the preferred equity infusion. This gave taxpayers the opportunity to benefit from the banks' future growth. The amount of the CPP capital that a QFI could apply for was restricted to between 1% and 3% of the QFI's risk-weighted assets or $25 billion, whichever was smaller.

Initiated in October 2008 and terminated in December 2009, the CPP invested $204.9 billion with 707 financial institutions. The largest investment was $25 billion and the smallest was $301,000. Under the CPP, the first nine large banks were forced to participate in the CPP due to their status as the largest financial institutions and did not follow the formal CPP evaluation process, whereas the other recipient banks participated voluntarily in the CPP. These banks followed the formal process and applied for the CPP funds from the U.S. Treasury. The Treasury established different application deadlines for different types of financial institutions. November 14, 2008, December 8, 2008, February 13, 2009, May 14, 2009, and November 11, 2009 were deadlines for public, private, S-corporations, mutual, and small community banks, respectively. To apply for the CPP funds, QFIs needed to submit two-page applications to their primary banking regulator: the Fed, FDIC, OCC or OTS. Bank holding companies were asked to submit their applications to both the Fed (their primary regulator) and the primary regulator of their largest subsidiary. If the initial application review by the banking regulator was successful, the application was forwarded to the Treasury, which made the final decision on the investment. The application process was kept confidential because regulators were concerned that depositors might interpret the non-award of TARP funds as a signal of poor financial standing. Such interpretation could result in a run on banks by depositors. They did not disclose which banks applied for the CPP funds, nor did they disclose which banks withdrew their applications or were rejected.

In addition, the CPP participants were subject to compensation restrictions. The initial restrictions were outlined at the program inception in October 2008. In February 2009, the American Recovery and Reinvestment Act (ARRA) became a law, amending the EESA and imposing more stringent executive compensation restrictions on the CPP recipients. ARRA also allowed for early CPP repayment and withdrawal from the program without financial penalty. Thus, banks started repaying the CPP funds from March 2009, with the largest repayments in June and December 2009. The first CPP repayments were made on March 31, 2009 by four banks, which expressed concerns over the dividend and compensation restrictions associated with CPP infusions. In the following months, many other banks submitted applications to repay CPP infusions. For simplicity, the term TARP is used henceforth to refer to CPP throughout the remainder of the paper.

2.2 Theoretical motivation and hypothesis development

Building on two theories in the literature (i.e., precautionary motive and moral hazard effect), we test empirically the impact of TARP on bank liquidity creation to understand which view finds empirical support. “Precautionary motive” refers to the hoarding of liquidity by banks for self-insurance purposes, such as insurance against counterparty risk and liquidity risk. As such, Acharya and Merrouche (2013) find that large U.K. settlement banks started hoarding cash to cover their transactional needs immediately following the freeze of the money market. Similarly, studies about the precautionary motive suggest that during the recent financial crisis, banks hoarded liquidity to protect themselves against future liquidity shocks, i.e. credit line drawdowns and unexpected demand deposit withdrawals (Cornett et al., 2011; Ashcraft et al., 2011) and in anticipation of future expected losses from security write-downs (Berrospide, 2013).

However, precautionary liquidity holding behaviour may hamper a bank’s ability to create liquidity. One the empirical side, Berrospide (2013) find that more than one-fourth of the reduction in bank lending during the crisis was due to the precautionary motive. According to Berger and Sedunov (2017), higher levels of liquidity holdings, for example, cash and marketable securities held by a bank decrease liquidity creation since the holding of it restrains the transfer of liquid assets to the public. On the theoretical side, Gale and Yorulmazer (2013) model the precautionary motive for holding cash and show that liquidity-hoarding banks lend less than the maximum possible amount. They find that the inefficiency of liquidity hoarding caused by incomplete markets always occurs with positive probability in a laisser-faire equilibrium. The central bank, the lender of last resort, can implement a constrained-efficient liquidity allocation to restore efficiency. In particular, they argue that if the central bank intervenes very aggressively, it can discourage bankers from holding liquidity. Along the same line, Castiglionesi et al. (2014) explain that banks enter the interbank market to hedge away bank-specific risk. However, when the interbank market stops to provide this function (as it did during the financial crisis), banks have two alternatives. One is issuing capital, which they argue is costly, and the other is liquidity hoarding. This theory predicts that government support, if intended to help strengthen banks through capitalization, can discourage banks from hoarding liquidity. We therefore hypothesize that government capital support may provide banks with the assurance of safety, and thereby reduce precautionary liquidity holding incentives (i.e., banks would not have to hold as much liquidity for survival) and encourage bank lending/liquidity creation.

It is widely recognized that the "precautionary motive" is relatively strong for small banks but weak for large banks. Allen et al. (1989) find that small banks tend to act as lenders while large banks tend to act as borrowers in the interbank market. They argue that small banks face greater information asymmetry which makes it costly for them to access the interbank market, and thereby they have an incentive to keep some cash at hand. Also, in corporate finance, small firms face more borrowing constraints and higher costs of external financing than large firms. For example, Opler et al. (1999) find that small firms have restricted access to external capital markets. Consistent with this line of argument, small banks are expected to have strong incentives of hoarding liquidity in order to avoid financing constraints and costly default. In contrast, large banks can more easily access funding from national or international capital markets, so they are less likely to hoard cash; or they may use their diversification advantage to operate with lower levels of cash. Therefore, if TARP capital support can alleviate banks' precautionary motive for liquidity holdings and promote bank liquidity creation, the effect should be more pronounced for small banks than large banks.

"Moral hazard effect" refers to the excessive risk-taking incentives in the expectation of financial safety nets. Government safety net may create moral hazard because it erodes market discipline and creates incentives for increased risk-taking by protected banks. For example, investors in the bailed-out banks have lower incentives to monitor their banks' risk taking when they anticipate the bailout (Gropp et al., 2011). Further, financial firms take on excessive risks mainly through increased leverage/lower capital (Bhagat et al., 2015), and banks with lower capital buffer are more likely to fail (Cole and White, 2012; Berger and Bouwman, 2013). Financial turmoil began in August 2007 when asset-backed securities, particularly those backed by subprime mortgages, suddenly became illiquid and fell sharply in value as an unprecedented housing boom turned to a housing bust. Mortgage backed securities started experiencing huge losses and financial institutions eventually had to write down many of these losses, depleting their capital. Some banks were threatened with failure as they were unable to raise needed capital in public markets (Bayazitova and Shivdasani, 2012). Besides, in response to the GFC, one goal of post-crisis capital regulations which are implemented in Basel III is to reduce the risk-taking incentives of banks by imposing stricter capital requirement. Considering that TARP was designed to improve the safety and soundness of the banking system through increased capitalization, we predict that banks may retain/withhold TARP capital to strengthen their solvency and repair their weak balance sheet after they receive TARP funds during the crisis period and to meet higher capital requirements during the post-crisis period, rather than lending to consumers and businesses. In this case, TARP capital injection may have no significant impact on bank liquidity creation.

It is expected that the "moral hazard effect" is more pronounced in large banks than in small banks since large banks enjoy "too big to fail" subsidies and, in the event of distress, tend to receive government support. Governments are reluctant to close or unwind a large bank because its failure may present a threat to the proper functioning of the financial intermediation process, increase the probability of financial contagion and of bank run, and pose greater systemic risk. When banks are perceived to be "too big to fail", they would pay less attention to the risks they take, making them more vulnerable to liquidity shocks and market failures during a crisis period. In this regard, the existing studies find that bank size is positively correlated with risk-taking measures and failure probabilities (e.g., Bhagat et al., 2015; Boyd and Runkle, 1993), and excessive risk-taking in good times could lead to high losses in the wake of the crisis (Beltratti and Stulz, 2012; Fahlenbrach and Stulz, 2011). Laeven et al. (2016) also document that large banks tend to be financed more with short-term debt and have lower capital ratios. Therefore, we predict that after receiving TARP capital support, large banks are more likely to build up capital buffer for compensating severe capital shortage/losses due to their pre-crisis excessive risk-taking behaviour. They do so for two possible reasons. First, as is well documented in the literature, capital acts as a protective cushion in the case of default (e.g., Berger and Bouwman, 2013). Second, large banks are believed to be subject to closer regulatory scrutiny, hence post-crisis stringent capital regulation induces these banks to increase capital to avoid the penalties associated with a regulatory capital shortfall (Khan et al., 2017). Consistent with the empirical findings in Khan et al. (2017), the theoretical model in Mankart et al. (2019) shows that banks respond to tighter capital requirements by increasing precautionary equity buffers. Taken together, large TARP banks could use TARP funding to strengthen their capital position and curtail new lending, which results in an insignificant impact of TARP on the amount of liquidity created by large banks.

In summary, this discussion leads to the following empirical predictions:

H1: Consistent with "precautionary motive" view in the literature, TARP capital injection has a positive and significant effect on liquidity creation of small banks.

H2: Consistent with "moral hazard effect" view in the literature, TARP capital injection has no significant effect on liquidity creation of large banks.

Note that since medium banks fall somewhere in the middle, we expect that either effect may dominate for these banks. In other words, TARP capital injection has either a positive and significant effect or an insignificant effect on liquidity creation of medium banks.

3. Data collection, sample construction and measurement of variables

3.1 Bank sample and TARP data

Data on TARP is publicly available on the website of the U.S. Treasury. The Treasury's TARP Transaction Report includes the identity and location of the institution, the date the institution received TARP funds, and the amount of the funds received. Due to concerns that investors may interpret the non-award of TARP capital as a negative signal that may trigger bank runs on such applicants, the TARP program did not publicly disclose identities of unsuccessful applicants. Initiated in October 2008 and terminated in December 2009, TARP invested $204.9 billion in 707 financial institutions – 31 financial institutions received TARP capital injection twice and 676 financial institutions received once-off TARP funds.

The bank sample was retrieved from the Statistics on Depository Institutions (SDI) database, maintained by the Federal Deposit Insurance Corporation (FDIC). The SDI repository includes all FDIC-insured institutions and it contains detailed on- and off-balance sheet information for all banks.[4] According to industry definitions, we define small banks as those with total assets of less than $1 billion, medium banks as those with total assets between $1 billion and $3 billion, and large banks as those with total assets of more than $3 billion.[5] Bank data retrieved from the FDIC are merged with the TARP bank data. The initial TARP dataset consists of 738 TARP bank observations. However, 20 bank observations in the TARP Transaction Report are excluded because, due to a lack of specific TARP and/or SDI identity number, they cannot be matched with the banks in the SDI dataset. As a last step, two TARP amounts received by the same bank holding companies (BHCs) and independent banks are

[4] Depending on their bank holding company (BHC) status, there are three types of banks in our dataset, i.e., multibank holding company members, one-bank holding company members and independent banks. In the case of multibank holding company, we aggregate the SDI data of all subsidiary banks in the same BHC at the holding company level because TARP applications in the case of subsidiaries were conducted via the BHCs. If the bank is a one-bank holding company or an independent bank, we keep the data for the bank.

[5] During the process of our research, we found a similar paper by Bowe et al. (2019) that shows that small TARP banks create a lower amount of liquidity than their non-TARP peers. Our conclusions are not directly comparable to Bowe et al.'s (2019) findings in that we include banks with total assets of less than $1 billion and examine TARP capital infusions at the commercial bank level, however they remove such banks from their sample and examine the infusions into bank holding companies. It is important to consider these "community banks" since a large fraction of U.S. banking institutions consists of small banks. For example, in Berger and Bouwman (2009), small banks comprise 98% of the sample observations. Similarly, in our study, 93.5% of observations are small banks.

combined (31 bank observations), and extreme observations are winsorized at the top and bottom 1%. Using this procedure, we have 599 BHC and 88 independent banks.

3.2 Variables

3.2.1 Dependent variables and main independent variables

Bank liquidity creation is the dependent variable in our study. We use the measures proposed in the ground-breaking work of Berger and Bouwman (2009) (hereafter referred to as BB measure).[6] The BB measure is a comprehensive single measure of bank liquidity creation that considers all the bank's on- and off-balance sheet activities. To summarize briefly, BB measure is the weighted sum of all assets, liabilities, equity, and off-balance sheet activities. Since liquidity is created when banks finance illiquid assets (e.g., business loans) with liquid liabilities (e.g., transaction deposits), a positive weight of 1/2 is given to both illiquid assets and liquid liabilities. Thus, transforming $1 of illiquid commercial loan into $1 of liquid transaction deposit creates $1 of liquidity for the public. Similarly, since banks destroy liquidity when they use illiquid liabilities (e.g., subordinated debt) or equity to finance liquid assets (e.g., cash, treasury securities), a negative weight of -1/2 is given to liquid assets, illiquid liabilities, and equity. Thus, taking $1 of liquid asset from the public and giving the public $1 of illiquid subordinated debt or equity destroys $1 of liquidity. All semi-liquid assets and liabilities (e.g., residential real estate loans) are assigned a neutral weight of zero. Off-balance sheet activities are assigned weights consistent with those assigned to functionally similar on-balance sheet activities. Berger and Bouwman (2009) compute four measures of liquidity creation. The first two are based on loan categories (*cat*) with the inclusion (*fat*) or exclusion (*nonfat*) of off-balance sheet activities. The third and fourth measures are based on maturities (*mat*) with the

[6] We are grateful to Christa Bouwman for providing the bank liquidity creation data. It is downloadable from Christa Bouwman's personal website (https://sites.google.com/a/tamu.edu/bouwman/data).

inclusion (*fat*) or exclusion (*nonfat*) of off-balance sheet activities. They argue that the two liquidity creation measures based on category (*catfat* and *catnonfat*) are preferred to the liquidity creation measures based on maturity (*matfat* and *matnonfat*) because they are better indicators of the ease, cost and time for banks to dispose of their obligations to obtain liquid funds. Therefore, in our study, we use two of the BB measures: *catfat* and *catnonfat: catfat* is the sum of on- and off-balance sheet liquidity creation and *catnonfat* measures liquidity created on the balance sheet only. As is standard in the bank liquidity creation literature, these measures are normalized by gross total assets (GTA)[7] so that the measures are comparable across banks, rather than dominated by the largest banks. The *catfat* and *catnonfat* measures are calculated as follows:

$$\begin{aligned} catfat &= 0.5 \times (illiquid\ assets\ + liquid\ liabilities\ + illiquid\ guarantees) + 0 \\ &\times (semiliquid\ assets\ + semiliquid\ liabilities\ + semiliquid\ guarantees) - 0.5 \\ &\times (liquid\ assets\ + illiquid\ liabilities\ + equity + liquid\ guarantees \\ &+ liquid\ derivatives) \end{aligned} \tag{1}$$

$$\begin{aligned} catnonfat &= 0.5 \times (illiquid\ assets\ +\ liquid\ liabilities) + 0 \times (semiliquid\ assets \\ &+\ semiliquid\ liabilities) - 0.5 \times (liquid\ assets\ +\ illiquid\ liabilities \\ &+\ equity) \end{aligned} \tag{2}$$

We use *TARP Recipient*$_i$, and the interaction term *Post TARP*$_t$×*TARP Recipient*$_i$ as the key independent variables for our regression analysis. *TARP Recipient*$_i$ equals one for banks that were TARP recipients and zero for banks that were not TARP recipients; *Post TARP*$_t$ equals one in the periods 2009: Q1 to 2014: Q4 after the TARP program initiation and zero otherwise.

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[7] Gross total asset (GTA) equals total assets plus allowance for loan and lease losses and the allocated transfer risk reserve.

3.2.2 Bank characteristics

This study controls for CAMELS-type variables because the CAMELS rating is often used by U.S. regulators to evaluate the safety and soundness of commercial banks and assess the applications for TARP funds. It is expected that a bank's overall financial condition will affect its ability to create liquidity. The values of CAMELS ratings are confidential and not available for this study, following the previous literature (Duchin and Sosyura, 2012, 2014; Li, 2013), we use the following proxy variables for CAMELS: the ratio of Tier 1 (core) capital to risk-weighted assets as a proxy of capital adequacy (*ca*), the ratio of all nonperforming loans to total assets as a proxy of asset quality (*aq*), the age of a bank as the proxy for management quality (*mq*), the ratio of net income to total equity as a proxy of earnings (*roe*), the sum of cash and balances due from other financial institutions, fed funds sold and securities purchased under resale agreements, and available-for-sale securities, scaled by total assets as a proxy for liquidity (*liq*); and the loans-to-deposits ratio to capture a bank's sensitivity to the funding market risk (*ltd*).[8]

Besides the proxy variables for CAMELS defined above, we also control for bank holding company (*bhc*) status because the same BHC may serve as internal capital market to provide capital/liquidity to its different subsidiaries (Houston and James, 1998). Loan loss provisions (*llp*), measured as the ratio of loan loss provision expense to total loans and leases, is a forward-looking measure of expected loan losses (Bayazitova and Shivdasani, 2012). Liquidity risk (*ucrt*) and credit risk (*crerisk*) are used because they are important determinants for managing bank liquidity (Cornett et al., 2011; Berger and Bouwman, 2009); they are measured as the ratio of unused loan commitments to total loans, and as the bank's Basel I risk-weighted assets divided by total assets, respectively. Finally, two dummy variables, *DW* and

[8] Each acronym of CAMELS stands for capital adequacy, asset quality, management capability, earnings, liquidity, and sensitivity to market risk.

TAF, are used to capture Discount Window loans and Term Auction Facility funding that banks used during the crisis, because these funds increased the lending of banks significantly (Berger et al., 2017).

3.2.3 Macroeconomic and local economic conditions

This study employs "yield spread" (*spread*), measured as the difference between long-term interest rates (10-year Treasury yield) and short-term interest rates (3-month Treasury yield), as a predictor of future real economic activity, for which the data is obtained from Federal Reserve Bank of New York. This study also employs the natural logarithm of Gross Domestic Product (*lngdp*) as a macro control, which is sourced from the St. Louis Federal Reserve "FRED" public database. In addition, local economic data (e.g., per capita personal income (*lnperinc*), total employment (*lnemploy*)) are sourced from the Bureau of Economic Analysis (BEA). The Herfindahl-Hirschman Index (*hhi_dep*) is used to measure the level of competition for deposits among banks in local markets. Finally, we control for the recent financial crisis period, *crisisdummy*. This variable has a value of one from the third quarter of 2007 to the fourth quarter of 2009, and zero otherwise.

3.2.4 Univariate tests

Table 1 presents descriptive statistics for key variables used in our analysis. See Appendix 1 for their definitions and abbreviations. Panel A shows that the mean value of total bank liquidity creation (*catfat_gta*) is 0.299, 0.423 and 0.447 for small, medium and large banks, respectively. This finding is consistent with the earlier literature (e.g., Berger and Bouwman, 2017) showing that most of the liquidity in the banking sector is created by large banks. Further, the mean value of *TARP amount* variable is 1.283, 6.618 and 10.040 for small, medium and large banks, respectively. This result is consistent with the view that large banks tend to enjoy "too big to fail" subsidies and hence receive the most TARP capital injections.

The mean value of capital adequacy (*ca*) and asset quality (*aq*) suggests that small banks have stronger capital positions and higher quality assets than medium and large banks in our sample. The univariate tests in Panel B report the difference-in-means estimates to compare characteristics of TARP banks and non-TARP banks for small, medium and large bank subsamples. As shown, TARP banks create more liquidity than non-TARP banks in all subsamples, although the difference magnitude is larger for small banks. For example, the mean *catfat_gta* for small, medium and large TARP banks is 0.392, 0.433 and 0.480 but is 0.290, 0.417 and 0.406 for non-TARP banks, respectively. We also find that the non-TARP banks, on average, tend to have high capital and less troubled assets, earn higher returns on equity and are more sensitive to market risk than TARP banks. A two-tailed t-test for the difference between the two groups yields a p-value less than 0.001.

[Insert Table 1 about here]

4. Empirical methodology and results

4.1 Main results

We use a difference-in-difference (DID) regression model to examine the effects of government capital support (TARP) on the liquidity creation of banks. The first difference is from before to after the TARP, and the second difference is between TARP recipients and non-TARP recipients. A DID estimator allows the comparison of banks that received the TARP funds (a treatment group) with a set of banks that did not receive any TARP funds (a control group) before and after TARP funding (treatment) was provided. The DID regression model, applied over the sample period of 2003: Q1 to 2014: Q4, is specified as follows:

$$\begin{aligned}&Bank\ Liquidity\ Creation_{i,t}\\&= \beta_0 + \beta_1 TARP\ Recipient_i + \beta_2\, Post\ TARP_t\ \times\ TARP\ Recipient_i + \beta_3\, X_{i,t} + \beta_4\, Time_t\\&+ \varepsilon_{i,t} \qquad (3)\end{aligned}$$

The dependent variable *Bank Liquidity Creation*$_{i,t}$ denotes the liquidity creation of bank *i* at time *t*. *TARP Recipient*$_i$ is a dummy variable that is equal to one if the bank received TARP funding and zero otherwise. *Post TARP*$_t$ is a dummy variable that is equal one in 2009: Q1 - 2014: Q4, the period after the TARP program initiation and zero otherwise. *Post TARP*$_t$×*TARP Recipient*$_i$ is the DID term and captures any shift of liquidity creation specific to TARP recipients induced by the implementation of the TARP. The term *Post TARP*$_t$ is not included in the model by itself because it is subsumed by the time fixed effects. $X_{i,t}$ are control variables, *Time*$_t$ represents year and quarter fixed effects, and $\varepsilon_{i,t}$ represents a white noise error term. The key independent variable of interest is the interaction term *Post TARP*$_t$×*TARP Recipient*$_i$. It shows the marginal effect of the TARP on liquidity creation of the TARP recipients relative to non-TARP recipients.

Table 2 presents the DID estimation results for Eq. (3). For small banks, regression estimates show that the coefficients of the DID interaction term, *Post TARP×TARP Recipient,* are positive and statistically significant at the 1% level for both aggregate bank liquidity creation (*catfat_gta*) in Column (1) and on-balance sheet liquidity creation only (*catnonfat_gta*) in Column (4). In terms of economic magnitudes, the coefficients of *Post TARP×TARP Recipient* of 0.009 and 0.011 in Columns (1) and (4) suggest that TARP capital support increases liquidity creation by 3.01% and 4.47%, when applied to the average total liquidity creation of 0.299 and on-balance sheet liquidity creation of 0.246 for small banks, respectively. However, the results presented in Columns (2), (3), (5) and (6) indicate insignificant coefficients of the DID interaction term with respect to the medium and large bank groups. These results lend support to the views that TARP capital injections encourage small banks to create more liquidity but have no significant effects on liquidity creation of medium and large banks.

[Insert Table 2 about here]

4.2 Concerns of endogeneity

A concern exists that the *TARP Recipient* variable could bias our findings by way of potential reverse causality. For example, as discussed above, TARP capital may have been provided to more viable and healthier banks (Berger and Roman, 2017). These stronger banks may be more likely to create more liquidity than weaker banks do, yielding a spurious relationship. In addition, the TARP capital injections were not randomly assigned to banks. Under the TARP, banks could decide whether to apply for the TARP funds. The U.S. Treasury could choose whether to approve or disapprove the application, and once approved, banks could decide whether to accept or reject the TARP funds. The non-randomness of the TARP allocation may give rise to a sample selection bias problem. In other words, the impact of TARP capital injections on liquidity creation can only be observed for those banks that received the funds. To mitigate these concerns, we perform several tests, including an instrumental variable approach; a two-part model; a propensity score matching analysis; and a placebo experiment.

4.2.1 Instrumental Variable (IV) approach

Prior research on TARP find that political connections of banks can affect their probability of receiving TARP funds (e.g., Li, 2013; Berger et al., 2017; Berger et al., 2018; Berger and Roman, 2017). Following this line of literature, we use *Subcommittee on Financial Institutions and Consumer Credit* (*Subcomm on FI*) that supervises all federal banking regulators as an instrument for the *TARP Recipient* variable. It takes the form of a dummy variable with the value of one if a local representative of the bank that applies for TARP serves on the *Subcomm on FI* and zero otherwise. It is based on the possibility that the elected representative may influence federal banking regulator decisions if he/she serves on this subcommittee.[9] This dummy variable is therefore expected to be positively related to TARP approval decisions about banks in the representative's local area, but it is unlikely to be under the control of individual banks. Thus, this instrumental variable is likely to satisfy both the relevance condition and the exclusion condition.

Because the *TARP Recipient* variable is binary, we follow Wooldridge's (2002) procedure to estimate a dummy endogenous variable model (also see Berger and Roman, 2015, 2017; Berger et al., 2018). For the first stage, we use a probit model in which *TARP Recipient* dummy is regressed on the political instrument, *Subcomm on FI*, along with all other control variables from the main regression model for predicting the probability of receiving TARP. We then use the predicted probability obtained from the first stage as an instrument for the second stage and estimate the model via a 2SLS method. We instrument *TARP Recipient* variable by the *TARP Recipient* fitted value and *Post TARP×TARP Recipient* by the product of the *Post TARP* dummy and the *TARP Recipient* dummy fitted value.

The results of the IV regressions are reported in Table 3. We report the first-stage regression results in Panel A. The second-stage results for the IV specification are contained in Panel B. The first-stage results in Panel A indicate that the instrumental variable, *Subcomm on FI*, has a positive and significant effect on the probability of receiving TARP injections, and the first-stage *F*-test suggests that the instrument is valid. The second-stage results in Panel B show that after controlling for endogeneity, the coefficients of the DID terms are statistically positive significant for the BB measures for small banks, weakly significant for medium banks, and insignificant for large banks. Therefore, we find consistent evidence that small TARP

[9] We use a bank's connection to the Federal Reserve Banks as an alternative instrument. The Fed evaluated TARP applications of its member banks and all bank holding companies. A bank with some Fed-connection might have been treated more favourably in the Fed's evaluation process. This instrument is a dummy variable (*Fed Director*) which takes the value of one if an executive of the bank served as a director of a branch of the Fed and zero otherwise. The results are robust (not shown). We are grateful for Lei Li for offering this data.

banks, after receiving TARP funding, significantly increase their liquidity creation relative to non-TARP banks. The economic magnitude of the coefficients of the DID terms is larger in absolute value terms than the OLS estimates, consistent with other finding in the literature (e.g., Berger and Bouwman, 2009; Berger and Sedunov, 2017).

[Insert Table 3 about here]

4.2.2 Two-part model

The two-part model is employed to address the fact that the decision for banks to apply for TARP is a choice variable. We use a logit model in the first part and an OLS regression model for the second part. Specifically, the first part models the probability of receiving TARP funds using a logit regression model with a binary outcome. The first part equation is:

$$TARP_i = \begin{cases} 1, & if\ \ \beta_0 + \beta'_{BC}X_{BC} + \beta'_{MLE}X_{MLE} + \beta'_{PR}X_{PR} + u_{1i} > 0 \\ 0, & otherwise \end{cases} \qquad (4)$$

where Eq. (4) is the logit model of the TARP dummy. TARP equals 1 if bank i is a TARP recipient and 0 otherwise; X_{BC} consists of bank characteristics; X_{MLE} controls for macroeconomic and local economic conditions; and X_{PR} includes the political connection variable.

The equation used in the second part models the distribution of the TARP amount received by banks (applied for and approved) by using an OLS regression framework with a continuous outcome. The variables that are used for the specification of the first part are also used for the specification of the second part, including bank characteristics, macroeconomic and local economic conditions, and the political connection variable. The second part equation is:

$$TARP\ amount_i = \beta_0 + \beta'_{BC}X_{BC} + \beta'_{MLE}X_{MLE} + \beta'_{PR}X_{PR} + u_{2i} \qquad (5)$$

The predicted residual, "$\widehat{Residual}$", estimated after the two-part model, is added as an additional regressor in the DID estimation. Because the predicted residual is a generated regressor (i.e., with estimation errors) that influences the computation of the standard error of the regression coefficient, bootstrapping is applied to deal with this issue (1,000 bootstrap replications are performed).

The estimation results, shown in Panel A of Table 4, are qualitatively similar to the findings in the main analysis and indicate a strong positive effect of TARP on liquidity creation by small TARP banks (see Columns (1) and (4)). Further, the evidence shows no significant effects of TARP on liquidity creation by medium and large TARP banks, as indicated by the economically small and statistically insignificant coefficients of the interaction term *Post TARP×TARP Recipient* (see Columns (2), (3), (5) and (6)). These results reinforce our main findings. Meanwhile, the coefficients of the DID terms maintain an economic magnitude similar to that found in the previous baseline regressions.[10]

4.2.3 Propensity score matching analysis

To further address the potential sample selection bias caused by the non-random TARP assignment, we use a propensity score matching analysis. This procedure can mitigate the concern that our results spuriously reflect differences in the characteristics of *TARP Recipient* and non-*TARP Recipient* rather than the effect of TARP per se. The propensity score is the probability of a bank receiving TARP funds, based on the bank's characteristics before TARP allocation. We select one TARP bank that is closest to the non-TARP bank according to observable characteristics. The matching bank selected is the bank with the closest propensity

[10] In an unreported robustness check, we also employ Heckman's (1979) two-stage selection model as an alternative to the two-part model. In the first step, we use the same probit model from the IV estimation in Panel A of Table 3 to regress the *TARP Recipient* dummy on all control variables from our main specification and our instrumental variable. In the second stage, the inverse Mills ratio estimated from the first stage is then included in our model as an explanatory variable to control for potential selection bias. The coefficients on the inverse Mills ratio are weakly significant or not statistically significant, suggesting that sample selection bias is not a major issue. More importantly, we find that the results from the Heckman selection model are qualitatively similar to those reported in the two-part model.

score, estimated from a probit regression of *TARP Recipient* on the proxy variables for CAMELS. We also estimate the propensity scores of all banks using bank characteristics other than CAMELS, i.e., bank holding company status (*bhc*), bank size (*banksize*), liquidity risk (*ucrt*), credit risk (*crerisk*), and funding from other government support programs used by banks during the crisis (*dw* and *taf*). Following prior research (see, e.g., Berger and Roman, 2015), we use the nearest neighbour matching method to construct three matched samples of TARP and non-TARP banks. The first sample matches each TARP bank to the nearest non-TARP bank (N=1), the second one matches each TARP bank with two non-TARP banks with the closest propensity scores (N=2), and the third one matches each TARP bank with three non-TARP banks with the closest propensity scores (N=3). We rerun all main regressions using these matched samples, and obtain similar results. For the sake of brevity, the results for N=2 and N=3 are not shown but are available upon request.

Panels B1 and B2 of Table 4 show that the coefficients of the DID interaction term (i.e., *Post TARP×TARP Recipient*) are still positive and statistically significant for the BB measures in small bank subsamples, with magnitudes comparable to those observed in the baseline test. This is consistent with the view that after TARP, small TARP banks tend to create more liquidity than non-TARP banks. However, the coefficients of the DID interaction term are weakly significant or insignificant for medium and large bank subsamples, indicating TARP capital infusion has no significant impact on bank liquidity creation of these banks.

4.2.4 Placebo experiment

As discussed above, we find that TARP capital injection has a positive effect on liquidity creation of small banks. It is also possible that alternative confounding forces that affect TARP and non-TARP banks differently may drive our results. To alleviate this potential problem, we conduct a placebo experiment following Puddu and Waelchli (2015) and Berger and Roman (2015, 2017) for small bank subsamples. We use a six-year period immediately preceding the TARP program from 2003-2008 and assume that the fictional *Post TARP* period begins three years before the actual program, but we still distinguish between TARP and non-TARP banks according to the "true" TARP program. Therefore, we rerun the regressions using the placebo sample (2003-2008) and define *Placebo Post TARP* as a dummy equal to one in 2006-2008, the period after the fictional TARP program initiation, and zero otherwise. If our main results reflect the true program, we should not find significant positive coefficient of the DID term for the BB measures.

The placebo experiment results are reported in Panel C of Table 4. We find no statistically significant coefficients of the DID terms for the fictional TARP program. Thus, our main results do not appear to be driven by alternative confounding forces.

[Insert Table 4 about here]

4.3 Additional analysis

Our main results in Section 4.1 show that small TARP banks increased their liquidity creation after they received TARP funds. In this section, we determine whether the increase in liquidity creation by small TARP banks comes at a cost of excessive risk-taking by them. According to the modern theory of financial intermediation, the two major roles of banks in the economy are risk transformation and liquidity creation (Berger and Bouwman, 2009). Prior studies indicate that these two roles often coincide, i.e., a bank's risk-taking behaviour is linked to the bank's liquidity creation, although the amount of liquidity created may not move in perfect tandem with the amount of risk emanating from the process (e.g., Berger and Bouwman, 2009; Andreou et al., 2016). Risk-taking activities such as maturity mismatch (i.e., when banks take short term deposits from lenders and make long term investments), is inherent in liquidity creation. To investigate whether the increase in liquidity creation results in excessive risk-taking, we apply the following regression model:

$$Bank\ Risk\ Taking_{i,t}$$
$$= \beta_0 + \beta_1 TARP\ Recipient_{i,t} + \beta_2\ Liquidity\ Creation_{i,t}$$
$$+ \beta_3\ TARP\ Recipient_{i,t}\ \times\ Liquidity\ Creation_{i,t} + \beta_4\ X_{i,t} + \Sigma Time\ Fixed\ Effects_t$$
$$+ \varepsilon_{i,t} \qquad (6)$$

Our primary measure of bank risk taking is the *z_score* of each bank, which equals the sum of the return on assets and the ratio of total equity to total assets divided by the standard deviation of the return on assets. Specifically, *z_score* = (*roa* + *car*)/σ (*roa*), where *roa* is the return on assets, *car* is the ratio of equity to assets, and σ (*roa*) is the standard deviation of *roa*. For the derivation of σ (*roa*), we use the standard deviation of a bank's *roa* over the previous twelve quarters. Intuitively, the measure represents the number of standard deviations that a bank's *roa* must decline from its expected value to become insolvent because equity is depleted (Roy, 1952). Accordingly, a high *z_score* indicates low bank risk. Because the *z_score* is highly skewed, we follow the literature (e.g., Laeven and Levine, 2009) and use the natural logarithm of the *z_score* as the risk measure. For brevity, we use the label "*z_score*" in referring to the natural logarithm of the *z_score* in the remainder of the paper. *TARP Recipient*, *Liquidity Creation* (*catfat_gta* and *catnonfat_gta*) and control variables *X* are defined in Section 3 above.

Table 5 displays the results from the regression of the *z_score* with the interaction terms, *TARP Recipient*×*Liquidity Creation*, as well as different sets of control variables to examine robustness. The results show that the positive coefficients of the interaction term, *TARP Recipient*×*Liquidity Creation*, are statistically and economically significant in all six cases, suggesting that for small TARP banks higher liquidity creation (*catfat_gta* and *catnonfat_gta*) are associated with higher *z_score*, i.e., lower bank risk taking. In other words, we find no evidence that increases in liquidity creation for small TARP banks result in excessive risk-taking. There are two possible explanations for the result. First, TARP capital infusion may discourage excessive risk taking because extra explicit or implicit government restrictions are imposed on the bailed-out banks, such as limits on executive compensation or lending requirements (e.g., Calomiris and Herring, 2013). Second, the extra capital from the TARP bailout may increase charter value for protected banks due to lower refinancing costs. In turn, the higher charter value, which a bank would lose in case of failure, deters risk taking (e.g., Keeley, 1990). Further, consistent with prior literature, the negative and significant coefficients of bank liquidity creation variables (*catfat_gta* and *catnonfat_gta*) in all specifications indicate that liquidity transformation process involves banks taking more risk.

[Insert Table 5 about here]

4.4 Robustness tests

4.4.1 Does the relationship between TARP and liquidity creation vary with bank capital?

Tier 1 capital ratio of banks improved considerably with the TARP injection because the preferred stocks purchased by the Treasury Department were classified as Tier 1 capital for regulatory purposes. One may wonder to what extent the main results are specific to our choice of the definition of capital, that is, Tier 1 risk-based capital ratio. To examine this issue, we rerun our regressions using two other regulatory capital ratios: the total risk-based capital ratio and the leverage ratio. The total risk-based capital ratio is measured as core capital (tier 1) plus supplementary capital (tier 2) over risk-weighted assets. The leverage ratio is calculated by dividing core capital (tier 1) by total assets rather than risk-weighted assets. Table 6, Panels A and B show the result. Consistent with our main findings, the coefficients of the DID term, *Post TARP×TARP Recipient*, are positive and statistically significant for the BB measures in small bank subsamples whereas they are insignificant in medium and large bank subsamples. The magnitude of the coefficient estimate is comparable to that reported in Table 2, suggesting that our results are robust to different measures of bank capital ratios.

To further address whether healthy or unhealthy banks react more intensively to TARP capital support, we split the sample at the median capital ratio and test whether the effect of TARP differs between high- and low-capitalized banks. High-capitalized (low-capitalized) subsamples include banks with the capital ratio above (equal or below) the median. We find that our main conclusions hold in both subsamples for different measures of bank capital ratios. In other words, we find no evidence that poorly capitalized banks behave differently from well-capitalized banks when receiving TARP. Panels C-E of Table 6 present these results.

[Insert Table 6 about here]

4.4.2 Splitting the sample of banks into different size categories

To test the robustness of our findings, we do additional tests by classifying our sample of banks in three different ways in terms of size. We perform separate analyses of differences between small and large banks for each of the size classification methods applied. First, we use alternative cut-offs ($5 billion and $10 billion, respectively) separating medium and large banks while the small bank definition remains at the $1 billion cut-off. Second, we split our sample of banks using a cut-off of $1 billion dollars in assets, because banks with sizes below $1 billion are generally considered to be community banks. Furthermore, $1 billion is also used as the traditional dividing line to distinguish between small and large banks in major empirical banking literature (Berger and Sedunov, 2017). Third, we run regressions categorising all banks as either small or large using a cut-off of $10 billion dollars in assets. Finally, very large banks may be considered too-big-to-fail (TBTF), and in the event of distress, they tend to receive government support. To make sure that our large bank results are not overly influenced by TBTF banks, we re-run our $10 billion cut-off analysis while excluding these banks. Following the 2010 Dodd-Frank Act, we define TBTF banks as those with total assets exceeding $50 billion.

The results are shown in Table 7. The highly significant and positive coefficients of the DID term *Post TARP×TARP Recipient* for the small bank category with all the size classification methods suggest that the effects are concentrated for small banks. The small TARP banks significantly created more liquidity after receiving TARP relative to non-TARP banks. However, we find no significant effects of TARP on liquidity creation at medium and large TARP banks, compared to their non-TARP peers. This supports our previous findings that use $1 billion and $3 billion dollars in assets as the cut-off for small, medium and large banks.

[Insert Table 7 about here]

4.4.3 Using sub-components of bank liquidity creation measure

To better understand the driving forces behind the total liquidity creation, we examine off-balance sheet liquidity creation (*lc_obs_gta*) and further decompose on-balance sheet liquidity creation into asset-side liquidity creation (*lc_a_gta*) and liability-side liquidity creation (*lc_l_gta*). Our results are presented in Panel A, Table 8. For small banks, as reported in Column (1), we find that the estimated coefficient of the DID term, *Post TARP×TARP Recipient,* is significantly positively related to asset-side liquidity creation (*lc_a_gta*). Further, Column (3) shows that the estimated coefficient of the DID term is negative and significant for off-balance sheet liquidity creation (*lc_obs_gta*). However, the magnitude of the coefficient estimate is much smaller than the one found using asset-side liquidity creation (*lc_a_gta*). In other words, TARP capital support significantly increases asset-side liquidity creation but marginally reduces off-balance sheet liquidity creation, explaining why we find an overall positive effect of TARP capital support on the total liquidity creation of small banks. We also find that the effect of TARP is insignificant for liability-side liquidity creation (*lc_l_gta*). For medium and large banks, the coefficients of the DID term, *Post TARP×TARP Recipient,* are insignificant in all cases, supporting our hypothesis that TARP capital injection has no significant impact on liquidity creation of these banks.

4.4.4 Alternative measure of TARP

In Panel B of Table 8, we test the robustness of our main results to the use of an alternative measure of TARP, *Ln(1+Bailout Amount)*. Our main results continue to hold: the DID term has a positive and statistically significant coefficient for small banks whereas it has an insignificant coefficient for medium and large banks, although the magnitude is much smaller than that of the similar main findings.

4.4.5 Excluding involuntary TARP participants

On the very day that the TARP program was announced, Citigroup, JP Morgan, Bank of America (including Merrill Lynch), Goldman Sachs, Morgan Stanley, State Street, Bank of New York Mellon, and Wells Fargo (including Wachovia), were reportedly called into Treasury and told that they would receive a capital injection whether they wanted it or not. We follow a conservative approach and re-estimate the results from a sample that eliminates involuntary participants in the TARP program to mitigate the concern that the Treasury Department might have different motivations when approving TARP funds for these banks. As shown in Table 8 Panel C, we continue to find support for our results.

4.4.6 Excluding TARP participants subject to the "stress test"

Following prior literature, we exclude the largest 19 banks from our sample that were subject to the "stress test" (called the Supervisory Capital Assessment Program, or SCAP) because its institutional design was different from TARP (Duchin and Sosyura, 2014). For example, in contrast to TARP, the capital raised under SCAP was in the form of common stock rather than preferred stock. Table 8 Panel D shows that our results are robust to excluding these banks.

4.4.7 Dynamics of the effects of TARP on bank liquidity creation

Following Berger et al. (2019), we investigate the dynamic effects of TARP on liquidity creation by replacing the DID term, *Post TARP×TARP Recipient*, with a series of DID terms, interacting *TARP Recipient* with dummies for each year after the TARP was implemented (2009, 2010, 2011, 2012, 2013, and 2014) to trace out the timing of the effects of TARP. As can be seen from Panel E, for small banks, we find that the coefficients of the DID terms are insignificant or only marginally significant at the 10% level in the short term, as opposed to the 1% level in the long term, and the magnitude is much larger in the long term than that in the short term, suggesting that TARP capital injection has no significant immediate impact on liquidity creation undertaken by small banks and the effect is more pronounced in the long run. Further, regardless of short term or long term, we still observe a statistically insignificant sign for all DID terms in medium and large bank subsamples, indicating that TARP has little effects on the amount of liquidity created by these banks.

[Insert Table 8 about here]

5. Conclusion

In this paper, we argue that the effect of TARP, the largest government intervention in the U.S. financial sector, on bank liquidity creation depends crucially on bank size. On the one hand, government capital support may provide banks with the assurance of safety, and thereby reduce precautionary liquidity holding incentives (i.e., banks would not have to hold as much cash for survival) and encourage bank lending/liquidity creation. We argue that the "precautionary motive" effects are particularly pronounced for small banks due to various reasons such as external financing constraints, information asymmetry, etc. On the other hand, moral hazard due to the expectation of government safety nets for financial firms may trigger excessive risk-taking and result in huge capital losses. Thus, after receiving TARP capital support, banks may use TARP funds to repair their weak balance sheet and boost their capital ratios, either because capital acts as a buffer protecting a bank's solvency against financial losses or because banks try to avoid incurring penalties for violating minimum capital standards. This view predicts that TARP does not play a significant role in bank liquidity creation. We argue that the "moral hazard" effects are relatively prominent with large banks because large banks tend to have lower capital ratios, less stable funding and more exposure to potentially risky activities (Laeven et al., 2016). Consistent with "precautionary motive" and "moral hazard" views in the literature, we find strong evidence that TARP capital infusions have a significantly positive stimulus effect on liquidity creation by small banks, while we do not find a significant impact of TARP on liquidity creation by medium and large banks. The findings are robust to alternative model specifications, different variable measurements, estimation techniques, and endogeneity issues.

We contribute to the literature along several dimensions. First, while there is an extensive empirical literature examining the effects of TARP on bank lending, little is known about how TARP capital injections affect banks' ability to create liquidity for the public, a major function of banks which supports the macroeconomy. We extend this strand of the literature by broadening the focus to bank liquidity creation, which includes much more than lending, as lending is only one component of asset-side liquidity creation. A key motivation for the focus on the function of banks as liquidity creators is the argument from Berger and Sedunov (2017) that bank lending alone is not an optimal measure of bank output. In fact, liquidity creation can be regarded as the best available measure of total bank output that includes all assets, liabilities, equity, and off-balance sheet guarantees and derivatives. Second, previous findings concerning the effects of TARP on bank lending is mixed and inconclusive. This is the first study that integrates bank size as a primary component in the analysis of the impact of TARP on bank liquidity creation. This is important because the effects of TARP on liquidity creation vary with different sizes of banks. Our findings are aligned with the theoretical argument of precautionary motive and moral hazard effects in the literature. Third, this study also has important policy implications for policymakers and bank regulators as it sheds new light on how the design features of future government bailout program can promote bank liquidity creation. The results clearly show that one size does not fit all when it comes to government capital support. Our findings are heavily concentrated among the usual notion of "community banks" with assets less than $1 million, indicating that small banks create more liquidity after they receive government support. This suggests that, from the bank liquidity creation perspective, government capital injections should target a large fraction of small banks. Therefore, our study complements the existing empirical bailout literature and adds to the broad research and policy debate on the benefits and costs of bank bailouts. Last but not least, our study explores related but different theoretical motivation (i.e., precautionary motive and moral hazard effects) as to how capital support or government aid affects bank liquidity creation. This fill a gap in the literature that investigates the relationship between bank capital and bank liquidity creation.

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Appendix 1 Variable Definitions

Variable	Definition
Panel A: Bank liquidity creation and TARP variables	
catfat_gta	Dollar amount of "*catfat*" liquidity creation normalized by gross total assets. The "*catfat*" measures the liquidity created on- and off-balance sheet, following Berger and Bouwman (2009)
catnonfat_gta	Dollar amount of "*catnonfat*" liquidity creation normalized by gross total asset. The "*catnonfat*" measures the liquidity created on the balance sheet only, following Berger and Bouwman (2009)
lc_obs_gta	Dollar amount of "*lc_obs_gta*" liquidity creation normalized by gross total assets. The "*lc_obs_gta*" measures the liquidity created off the balance sheet, following Berger and Bouwman (2009)
TARP amount	The natural logarithm of one plus the bailout amount
TARP dummy	Takes the value of one if a bank was TARP recipient and zero otherwise
Panel B: Bank-specific variables	
ca	The ratio of tier 1 capital to total risk-weighted assets
aq	The ratio of all nonperforming loans (all loans 90 days past due plus all loans charged off) to total assets
mq	The number of years that a bank had been in existence as of 2014
roe	The ratio of net income to total equity
liq	The sum of cash and balances due from other financial institutions, fed funds sold and securities purchased under resale agreements, and available-for-sale securities, scaled by total assets
ltd	The ratio of loans to deposits
bhc	A dummy variable that takes one if bank holding company (BHC) status applies and zero if otherwise
ucrt	The ratio of unused loan commitments to total loans
crerisk	The bank's Basel I risk-weighted assets divided by total assets
llp	The ratio of loan loss provision expenses to total loans and leases
size	The natural logarithm of total assets
dw	A dummy variable equal to one if a bank received discount window loans during the crisis, and zero otherwise
taf	A dummy variable equal to one if a bank received term auction facility funding during the crisis, and zero otherwise

Panel C: Political and regulatory connection variables	
SubcommonFI	Takes the value of one if a representative sat on the Subcommittee on Financial Institutions and Consumer Credit, which supervises all federal banking regulators, and zero otherwise
Feddirector	Takes the value of one if an executive of the bank served as a director of a branch of the Fed and zero otherwise
Panel D: Macroeconomic and local economic variables	
spread	The spread between 3-month US T-Bills and 10-year US Treasuries
lngdp	Natural logarithm of Gross Domestic Product
lnperinc	Natural logarithm of per capita personal income in a county
lnemploy	Natural logarithm of total employment in a county
crisisdummy	A dummy variable that equals one from the third quarter of 2007 to the fourth quarter of 2009 and zero otherwise
hhi_dep	Bank-level HHI of deposit concentration for the local markets in which the bank is operating. The local market is defined as the county in which bank headquarter is located

Table 1 Descriptive Statistics

This table reports statistics that describe the sample. Panel A shows the summary statistics of key variables. Panel B reports the difference-in-means estimates to compare characteristics of TARP banks and non-TARP banks. See Appendix 1 for variable definitions. *, **, and *** denote 10%, 5%, and 1% significance level for the difference between TARP and non-TARP banks, respectively.

Panel A: Summary statistics by bank size

Small banks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	N	mean	sd	min	p25	p50	p75	max
catfat_gta	251,408	0.299	0.175	-0.158	0.184	0.309	0.420	0.713
catnonfat_gta	251,408	0.246	0.154	-0.178	0.148	0.259	0.356	0.567
TARP dummy	251,408	0.081	0.273	0	0	0	0	1
TARP amount	251,408	1.283	4.329	0.000	0.000	0.000	0.000	18.470
ca	251,408	0.105	0.036	0.047	0.084	0.096	0.116	0.279
aq	251,408	0.003	0.005	-0.001	0.000	0.001	0.004	0.030
mq	251,408	74.920	42.580	7.326	30.560	85.560	110.100	151.600
roe	251,408	0.047	0.076	-0.362	0.021	0.046	0.083	0.228
liq	251,408	0.067	0.063	0.008	0.027	0.044	0.082	0.340
ltd	251,408	1.441	0.545	0.804	1.111	1.287	1.560	4.164
bhc	251,408	0.832	0.374	0	1	1	1	1
banksize	251,408	11.760	0.884	10.090	11.090	11.710	12.390	13.820
ucrt	251,408	0.154	0.102	0.001	0.083	0.134	0.202	0.619
crerisk	251,408	0.684	0.131	0.343	0.599	0.693	0.777	0.974
llp	251,408	0.003	0.006	-0.002	0.000	0.001	0.003	0.037
dw	251,408	0.166	0.372	0	0	0	0	1
taf	251,408	0.110	0.313	0	0	0	0	1
spread	251,408	2.048	1.133	-0.512	1.529	2.249	2.875	3.578
lngdp	251,408	9.587	0.112	9.339	9.532	9.593	9.667	9.786
lnperinc	251,309	10.440	0.257	9.900	10.260	10.420	10.600	11.240
lnemploy	251,309	10.490	1.884	7.333	9.075	10.030	11.740	15.500
crisisdummy	251,408	0.224	0.417	0	0	0	0	1
hhi_dep	251,408	-1.015	0.779	-3.592	-1.382	-0.931	-0.535	0.000
SubcommonFI	251,408	0.066	0.248	0	0	0	0	1

Medium banks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	N	mean	sd	min	p25	p50	p75	max
catfat_gta	11,416	0.423	0.148	-0.158	0.325	0.430	0.525	0.713
catnonfat_gta	11,416	0.334	0.124	-0.178	0.259	0.347	0.420	0.567
TARP dummy	11,416	0.382	0.486	0	0	0	1	1
TARP amount	11,416	6.618	8.429	0.000	0.000	0.000	17.040	18.470
ca	11,416	0.091	0.022	0.047	0.079	0.088	0.098	0.279
aq	11,416	0.004	0.006	-0.001	0.001	0.002	0.004	0.030
mq	11,416	70.260	43.110	7.326	31.010	59.500	109.400	151.600
roe	11,416	0.048	0.084	-0.362	0.023	0.050	0.089	0.228
liq	11,416	0.054	0.053	0.008	0.022	0.035	0.063	0.340
ltd	11,416	1.249	0.359	0.804	1.047	1.168	1.346	4.164
bhc	11,416	0.964	0.187	0	1	1	1	1
banksize	11,416	14.260	0.312	13.820	13.990	14.220	14.510	14.910
ucrt	11,416	0.238	0.117	0.001	0.159	0.219	0.299	0.619
crerisk	11,416	0.736	0.124	0.343	0.659	0.747	0.820	0.974
llp	11,416	0.004	0.007	-0.002	0.001	0.002	0.005	0.037
dw	11,416	0.184	0.388	0	0	0	0	1
taf	11,416	0.152	0.359	0	0	0	0	1
spread	11,416	2.109	1.081	-0.512	1.608	2.239	2.852	3.578
lngdp	11,416	9.612	0.106	9.339	9.571	9.605	9.694	9.786
lnperinc	11,416	10.600	0.268	9.900	10.420	10.570	10.750	11.240
lnemploy	11,416	12.240	1.705	8.141	10.970	12.270	13.340	15.500
crisisdummy	11,416	0.227	0.419	0	0	0	0	1
hhi_dep	11,416	-0.464	0.720	-2.585	-0.691	0.000	0.000	0.000
SubcommonFI	11,416	0.123	0.329	0	0	0	0	1

Large banks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	N	mean	sd	min	p25	p50	p75	max
catfat_gta	6,270	0.447	0.177	-0.158	0.351	0.462	0.563	0.713
catnonfat_gta	6,270	0.295	0.158	-0.178	0.230	0.320	0.402	0.567
TARP dummy	6,270	0.549	0.498	0	0	1	1	1
TARP amount	6,270	10.040	9.112	0.000	0.000	17.800	18.470	18.470
ca	6,270	0.093	0.030	0.047	0.075	0.086	0.102	0.279
aq	6,270	0.006	0.008	-0.001	0.001	0.002	0.007	0.030
mq	6,270	83.630	49.680	7.351	33.810	86.810	134.100	151.600
roe	6,270	0.049	0.084	-0.362	0.022	0.048	0.087	0.228
liq	6,270	0.056	0.061	0.008	0.022	0.034	0.062	0.340
ltd	6,270	1.255	0.529	0.804	0.990	1.123	1.318	4.164
bhc	6,270	0.980	0.139	0	1	1	1	1
banksize	6,270	15.710	0.430	14.910	15.300	15.930	16.110	16.110
ucrt	6,270	0.343	0.171	0.001	0.218	0.303	0.469	0.619
crerisk	6,270	0.737	0.138	0.343	0.659	0.748	0.829	0.974
llp	6,270	0.006	0.009	-0.002	0.001	0.002	0.006	0.037
dw	6,270	0.167	0.373	0	0	0	0	1
taf	6,270	0.434	0.496	0	0	0	1	1
spread	6,270	2.075	1.098	-0.512	1.608	2.249	2.829	3.578
lngdp	6,270	9.610	0.108	9.339	9.563	9.603	9.694	9.786
lnperinc	6,270	10.650	0.278	9.900	10.470	10.610	10.780	11.240
lnemploy	6,270	12.900	1.416	8.994	11.900	12.900	13.780	15.500
crisisdummy	6,270	0.235	0.424	0	0	0	0	1
hhi_dep	6,270	-0.442	0.514	-1.800	-0.851	-0.062	0.000	0.000
SubcommonFI	6,270	0.152	0.360	0	0	0	0	1

Panel B: Univariate tests by bank size

Small banks	(1) TARP banks	(2) Non-TARP banks	(3) Difference in means
catfat_gta	0.392	0.290	0.102***
catnonfat_gta	0.321	0.239	0.082***
ca	0.096	0.106	-0.010***
aq	0.003	0.003	0.000***
mq	52.629	76.882	-24.253***
roe	0.030	0.048	-0.018***
liq	0.056	0.068	-0.012***
ltd	1.215	1.461	-0.246***
bhc	0.884	0.827	0.057***
banksixe	12.415	11.699	0.716***
llp	0.004	0.003	0.001***
ucrt	0.192	0.151	0.041***
crerisk	0.744	0.678	0.066***
no. of bank-quarter observations	20,360	231,048	-

Medium banks	(1) TARP banks	(2) Non-TARP banks	(3) Difference in means
catfat_gta	0.433	0.417	0.016***
catnonfat_gta	0.344	0.328	0.016***
ca	0.090	0.091	-0.001***
aq	0.004	0.003	0.001***
mq	68.231	71.515	-3.284***
roe	0.040	0.052	-0.012***
liq	0.046	0.059	-0.013***
ltd	1.176	1.295	-0.119***
bhc	0.986	0.949	0.037***
banksixe	14.298	14.242	0.056***
llp	0.005	0.004	0.001***
ucrt	0.242	0.231	0.011***
crerisk	0.727	0.752	-0.025***
no. of bank-quarter observations	4,359	7,057	-

Large banks	(1) TARP banks	(2) Non-TARP banks	(3) Difference in means
catfat_gta	0.480	0.406	0.074***
catnonfat_gta	0.326	0.258	0.068***
ca	0.091	0.094	-0.003***
aq	0.007	0.005	0.002***
mq	85.522	81.329	4.193***
roe	0.050	0.049	0.001***
liq	0.050	0.064	-0.014***
ltd	1.185	1.340	-0.155***
bhc	0.982	0.978	0.004***
banksixe	15.750	15.668	0.082***
llp	0.006	0.005	0.001***
ucrt	0.342	0.344	-0.002***
crerisk	0.757	0.713	0.044***
no. of bank-quarter observations	3,440	2,830	-

Table 2 Effects of TARP on Bank Liquidity Creation: Main Results

This table reports estimates from difference-in-difference (DID) regression analysis with Eq. (3) for the impact of TARP on bank liquidity creation across different sizes of banks. *TARP Recipient* takes the value of one if a bank is TARP recipient and zero otherwise. *Post TARP* is a dummy equal to one in the 2009-2014 period after TARP program initiation and zero otherwise. *catfat_gta* is the sum of on-balance sheet and off-balance sheet liquidity creation; *catnonfat_gta* measures liquidity created on the balance sheet only. All models include time fixed effects. The estimation results are for 2003-2014. The variable descriptions are in Appendix 1. Robust standard errors clustered by bank are in parentheses. *, **, and *** denote significance at 10%, 5% and 1% level, respectively.

	Dependent Variables: Bank Liquidity Creation					
	Small banks	Medium banks	Large banks	Small banks	Medium banks	Large banks
		catfat_gta			*catnonfat_gta*	
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
Post TARP* × *TARP Recipient	**0.009*** **	**-0.007**	**0.001**	**0.011*** **	**-0.007**	**-0.010**
	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)
TARP Recipient	-0.009***	-0.003	0.023*	-0.010***	-0.003	0.029**
	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)
ca	-1.079***	-1.010***	-0.774***	-1.073***	-1.103***	-1.200***
	(0.03)	(0.24)	(0.19)	(0.02)	(0.25)	(0.23)
aq	-0.223	0.772	1.477**	-0.419**	0.126	-2.496**
	(0.14)	(0.69)	(0.73)	(0.17)	(0.70)	(1.03)
mq	-0.000***	-0.000***	-0.000**	-0.000***	-0.000***	0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
roe	0.122***	0.151***	0.180***	0.092***	0.117**	-0.178**
	(0.01)	(0.06)	(0.05)	(0.01)	(0.06)	(0.07)
liq	0.227***	0.218***	0.031	0.213***	0.207***	-0.240**
	(0.01)	(0.07)	(0.09)	(0.01)	(0.07)	(0.12)
ltd	-0.090***	-0.109***	-0.077***	-0.081***	-0.087***	-0.066***
	(0.00)	(0.02)	(0.02)	(0.00)	(0.02)	(0.02)
bhc	0.008***	0.050**	-0.058*	0.009***	0.046**	-0.002
	(0.00)	(0.02)	(0.03)	(0.00)	(0.02)	(0.05)
banksize	0.002*	0.018*	-0.017	0.001	0.018*	-0.041***
	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)
llp	0.224	-0.451	0.447	-0.001	-0.646	-2.979***
	(0.14)	(0.70)	(0.77)	(0.17)	(0.64)	(0.92)
ucrt	0.442***	0.372***	0.266***	0.141***	-0.007	-0.187***
	(0.01)	(0.03)	(0.05)	(0.01)	(0.03)	(0.05)
crerisk	0.679***	0.674***	0.797***	0.620***	0.614***	0.561***
	(0.02)	(0.05)	(0.06)	(0.02)	(0.05)	(0.07)
dw	0.002	0.012	-0.000	0.003	0.013	-0.000
	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)
taf	0.006	0.007	-0.025**	0.005	0.006	-0.010
	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)
spread	-0.003**	-0.004	0.018**	-0.004**	-0.003	-0.017*
	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)
lngdp	0.135***	0.209***	0.284***	0.140***	0.232***	0.410***
	(0.01)	(0.03)	(0.04)	(0.01)	(0.03)	(0.04)
lnperinc	0.024***	0.005	-0.087***	0.022***	0.001	-0.136***
	(0.00)	(0.02)	(0.03)	(0.00)	(0.02)	(0.03)
lnemploy	0.009***	0.005	0.009*	0.009***	0.006*	0.028***
	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.01)
crisisdummy	-0.022***	-0.010	-0.056***	-0.017***	-0.005	0.068***

	(0.00)	(0.02)	(0.02)	(0.00)	(0.01)	(0.02)
hhi_dep	0.010***	0.013**	0.014	0.010***	0.013**	0.036**
	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.02)
Constant	-1.651***	-2.316***	-1.679***	-1.631***	-2.479***	-1.977***
	(0.03)	(0.28)	(0.42)	(0.03)	(0.24)	(0.36)
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	251,309	11,416	6,270	251,309	11,416	6,270
Adjusted R^2	0.786	0.710	0.749	0.746	0.616	0.633

Table 3 Effects of TARP on Bank Liquidity Creation: Instrumental Variable (IV) Approach
This table shows difference-in-difference (DID) regression estimates for analysing the impact of TARP on bank liquidity creation using a Two-Stage Least Square (2SLS) IV approach. We use *Subcommittee on Financial Institutions and Consumer Credit* (*Subcomm on FI*) as an instrument for the potential endogenous explanatory variable *TARP Recipient*. This instrument is a dummy variable that takes the value of one if a local representative of the bank that applies for TARP serves on the *Subcomm on FI*, which supervises all federal banking regulators, and zero otherwise. *TARP Recipient* takes the value of one if a bank is TARP recipient and zero otherwise. *Post TARP* is a dummy equal to one in the 2009-2014 period after the TARP program initiation and zero otherwise. *catfat_gta* is the sum of on-balance sheet and off-balance sheet liquidity creation; *catnonfat_gta* measures liquidity created on the balance sheet only. All models include time fixed effects. The estimation results are for 2003-2014. The variable descriptions are in Appendix 1. Robust standard errors clustered by bank are in parentheses. *, **, and *** denote significance at 10%, 5% and 1% level, respectively.

Panel A First stage: probit model

	Dependent Variable: *TARP Recipient*		
	Small banks	Medium banks	Large banks
Independent Variables	(1)	(2)	(3)
Subcomm on FI	**0.168*** **	**0.165*** **	**0.460*** **
	(0.01)	(0.04)	(0.05)
Bank controls	Yes	Yes	Yes
Macro and local controls	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes
Observations	251,309	11,416	6,270
Pseudo R^2	0.166	0.085	0.121

Panel B Second stage: two-stage least square (2SLS) IV approach

	Dependent Variables: Bank Liquidity Creation					
	Small banks	Medium banks	Large banks	Small banks	Medium banks	Large banks
	catfat_gta			*catnonfat_gta*		
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
Post TARP × TARP Recipient	**0.045*** **	**0.059***	**-0.014**	**0.071*** **	**0.071** **	**0.009**
	(0.01)	(0.03)	(0.03)	(0.01)	(0.03)	(0.03)
TARP Recipient	0.048**	-0.091	0.057	-0.034	-0.181	0.284**
	(0.02)	(0.13)	(0.10)	(0.02)	(0.12)	(0.11)
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes
Macro and local controls	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	251,309	11,416	6,270	251,309	11,416	6,270
Adjusted R^2	0.787	0.711	0.746	0.746	0.618	0.640
First-stage Kleibergen-Paap rk Wald F-test	1708.19***	276.72***	747.93***	1708.19***	276.72***	747.93***

Table 4 Effects of TARP on Bank Liquidity Creation: Two-part Model, Propensity Score Matching Analysis, and Placebo Experiment

Panels A and B1-B2 of this table report estimates from the two-part model and propensity score matching analysis to address the potential selection bias caused by the non-random TARP funding. For the two-part model, the first part models the probability of receiving TARP funds using the logit model while the second part models the distribution of the TARP amount to be received if applied for it and if approved by using the OLS regression (not shown for brevity). The predicted residual value, *Residual*, estimated after the two-part model, is added as an additional regressor in the main DID estimation to examine the effects of TARP capital infusion on bank liquidity creation (Bootstrapping with 1,000 replications is used to estimate standard error). For the propensity score matching, we select one TARP bank that is closest to the non-TARP bank according to observable characteristics by using nearest neighbour matching N=1 in Panels B1 and B2 for two BB measures (*catfat_gta* and *catnonfat_gta*), respectively. *TARP Recipient* takes the value of one if a bank is TARP recipient and zero otherwise. *Post TARP* is a dummy equal to one in the 2009-2014 period after TARP program initiation and zero otherwise. *catfat_gta* is the sum of on-balance sheet and off-balance sheet liquidity creation; *catnonfat_gta* measures liquidity created on the balance sheet only. The estimation results are for 2003-2014. Panel C reports regression estimates using a placebo experiment for small banks, in which we fictionally assume that the TARP participation took place three years earlier; we distinguish between banks that received TARP and those that did not according to their "true" TARP program. Accordingly, we define *Placebo Post TARP* as a dummy equal to one in 2006-2008, the period after the fictional TARP program initiation. We rerun the regressions by using the placebo sample (2003-2008). All models include time fixed effects. The variable descriptions are in Appendix 1. Robust standard errors clustered by bank are in parentheses. *, **, and *** denote significance at 10%, 5% and 1% level, respectively.

Panel A: Two-part model

	Dependent Variables: Bank Liquidity Creation					
	Small banks	Medium banks	Large banks	Small banks	Medium banks	Large banks
	catfat_gta			*catnonfat_gta*		
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
Post TARP × TARP Recipient	**0.007*****	**-0.003**	**0.003**	**0.009*****	**-0.004**	**0.001**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
TARP Recipient	-0.010***	-0.017***	0.032***	-0.015***	-0.015***	0.044***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes
Macro and local controls	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	251,309	11,416	6,270	251,309	11,416	6,270
Adjusted R^2	0.784	0.710	0.753	0.743	0.614	0.654

Panel B1: Propensity score matching (PSM) sample analysis-nearest neighbour matching

	Dependent Variable: Bank Liquidity Creation (*catfat_gta*)					
	PSM based on CAMELS			PSM based on other bank controls		
	Small banks	Medium banks	Large banks	Small banks	Medium banks	Large banks
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
Post TARP × TARP Recipient	**0.007*** **	**-0.008** **	**-0.007**	**0.005*** **	**-0.007* **	**0.004**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)
TARP Recipient	-0.011***	0.001	0.025***	-0.008***	-0.004	0.018***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes
Macro and local controls	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	40,716	8,718	6,880	38,228	7,100	4,943
Adjusted R^2	0.727	0.686	0.748	0.733	0.708	0.756

Panel B2: Propensity score matching (PSM) sample analysis-nearest neighbour matching

	Dependent Variable: Bank Liquidity Creation (*catnonfat_gta*)					
	PSM based on CAMELS			PSM based on other bank controls		
	Small banks	Medium banks	Large banks	Small banks	Medium banks	Large banks
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
Post TARP × TARP Recipient	**0.007*** **	**-0.008** **	**-0.014*** **	**0.005*** **	**-0.005**	**-0.010* **
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)
TARP Recipient	-0.010***	0.001	0.031***	-0.008***	-0.004	0.027***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes
Macro and local controls	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	40,716	8,718	6,880	38,228	7,100	4,943
Adjusted R^2	0.659	0.574	0.639	0.665	0.606	0.640

Panel C: Placebo experiment for small banks

	Dependent Variables: Bank Liquidity Creation	
	catfat_gta	*catnonfat_gta*
Independent Variables	(1)	(2)
Post TARP × TARP Recipient	**0.001**	**-0.001**
	(0.00)	(0.00)
TARP Recipient	-0.007*	-0.006*
	(0.00)	(0.00)
Bank controls	Yes	Yes
Macro and local controls	Yes	Yes
Time fixed effects	Yes	Yes
Observations	129,042	129,042
Adjusted R^2	0.802	0.756

Table 5 Additional Analysis: TARP Capital Infusion, Liquidity Creation, and Bank Risk Taking

This table reports regression estimates analysis with Eq. (6) to further examine whether the increases in liquidity creation for small TARP banks come at the cost of excessive risk taking. In Panels A and B, we include different sets of controls to mitigate the potential "bad controls problem". The *z_score* is used as a measure of bank risk taking, which is calculated as the sum of the return on assets and the ratio of total equity to total assets divided by the standard deviation of the return on assets. *TARP Recipient* takes the value of one if a bank is TARP recipient and zero otherwise. *catfat_gta* is the sum of on-balance sheet and off-balance sheet liquidity creation; *catnonfat_gta* measures liquidity created on the balance sheet only. All models include time fixed effects. The estimation results are for 2003-2014. The variable descriptions are in Appendix 1. Robust standard errors clustered by bank are in parentheses. *, **, and *** denote significance at 10%, 5% and 1% level, respectively.

Panel A:	Dependent Variable: *z_score*					
	Main Specification		Excluding Macro Controls		Excluding Bank Controls	
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
catfat_gta* × *TARP Recipient	**0.410*****		**0.405*****		**0.890*****	
	(0.13)		(0.13)		(0.14)	
catnonfat_gta* × *TARP Recipient		**0.431*****		**0.420*****		**0.883*****
		(0.15)		(0.15)		(0.17)
catfat_gta	-0.233***		-0.204***		-0.724***	
	(0.07)		(0.07)		(0.04)	
catnonfat_gta		-0.269***		-0.236***		-0.889***
		(0.07)		(0.07)		(0.04)
TARP Recipient	0.019	0.039	0.026	0.047	-0.243***	-0.181***
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
ca	6.166***	6.127***	6.213***	6.179***		
	(0.23)	(0.23)	(0.23)	(0.23)		
aq	-13.828***	-13.876***	-13.983***	-14.029***		
	(0.98)	(0.98)	(0.98)	(0.98)		
mq	0.000***	0.000***	0.000	0.000		
	(0.00)	(0.00)	(0.00)	(0.00)		
roe	0.441***	0.438***	0.375***	0.371***		
	(0.12)	(0.12)	(0.12)	(0.12)		
liq	-0.315***	-0.312***	-0.289***	-0.286***		
	(0.08)	(0.08)	(0.08)	(0.08)		
ltd	-0.080***	-0.080***	-0.081***	-0.082***		
	(0.02)	(0.02)	(0.02)	(0.02)		
bhc	-0.028*	-0.027*	-0.037**	-0.037**		

	(0.02)	(0.02)	(0.02)	(0.02)		
banksize	-0.017**	-0.018**	-0.003	-0.003		
	(0.01)	(0.01)	(0.01)	(0.01)		
llp	-26.356***	-26.439***	-26.560***	-26.641***		
	(1.19)	(1.18)	(1.18)	(1.18)		
ucrt	0.356***	0.302***	0.310***	0.265***		
	(0.06)	(0.05)	(0.06)	(0.05)		
crerisk	-0.475***	-0.464***	-0.508***	-0.498***		
	(0.08)	(0.08)	(0.08)	(0.08)		
dw	-0.011	-0.010	-0.014	-0.014		
	(0.02)	(0.02)	(0.02)	(0.02)		
taf	-0.014	-0.014	-0.012	-0.012		
	(0.02)	(0.02)	(0.02)	(0.02)		
spread	0.255***	0.255***			0.297***	0.295***
	(0.01)	(0.01)			(0.01)	(0.01)
lngdp	-0.933***	-0.924***			-1.262***	-1.195***
	(0.08)	(0.08)			(0.08)	(0.08)
lnperinc	-0.059**	-0.058**			0.071**	0.056*
	(0.03)	(0.03)			(0.03)	(0.03)
lnemploy	0.025***	0.026***			-0.001	0.001
	(0.01)	(0.01)			(0.00)	(0.00)
crisisdummy	-0.500***	-0.498***			-0.994***	-0.983***
	(0.03)	(0.03)			(0.03)	(0.03)
hhi_dep	0.033***	0.033***			0.024**	0.025**
	(0.01)	(0.01)			(0.01)	(0.01)
Constant	12.677***	12.594***	3.421***	3.424***	14.861***	14.356***
	(0.73)	(0.73)	(0.11)	(0.11)	(0.65)	(0.65)
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	184,959	184,959	185,033	185,033	184,959	184,959
Adjusted R^2	0.235	0.235	0.233	0.233	0.053	0.058

Panel B:	Dependent Variable: *z_score*					
	Excluding All Controls		Including Proxies for CAMELS Only		Including Other Bank Controls Only	
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
catfat_gta* × *TARP Recipient	**0.900*****		**0.439*****		**0.640*****	
	(0.14)		(0.14)		(0.13)	
catnonfat_gta* × *TARP Recipient		**0.888*****		**0.427*****		**0.708*****
		(0.17)		(0.16)		(0.15)
catfat_gta	-0.721***		-0.356***		-0.778***	
	(0.03)		(0.05)		(0.06)	
catnonfat_gta		-0.886***		-0.465***		-0.879***
		(0.04)		(0.06)		(0.06)
TARP Recipient	-0.247***	-0.181***	0.003	0.034	-0.089	-0.068
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
ca			6.335***	6.224***		
			(0.22)	(0.23)		
aq			-26.825***	-26.768***		
			(0.98)	(0.98)		
mq			0.000**	0.000**		
			(0.00)	(0.00)		
roe			1.181***	1.176***		
			(0.10)	(0.10)		
liq			-0.090	-0.081		
			(0.08)	(0.08)		
ltd			-0.024	-0.038**		
			(0.02)	(0.02)		
bhc					-0.103***	-0.101***
					(0.02)	(0.02)
banksize					-0.013*	-0.013*
					(0.01)	(0.01)
llp					-40.897***	-41.016***
					(0.82)	(0.81)
ucrt					0.551***	0.348***
					(0.06)	(0.05)
creristak					0.167**	0.192**
					(0.07)	(0.07)

dw					-0.024	-0.024
					(0.02)	(0.02)
taf					-0.011	-0.011
					(0.02)	(0.02)
Constant	3.689***	3.689***	2.865***	2.906***	3.841***	3.837***
	(0.01)	(0.01)	(0.05)	(0.05)	(0.09)	(0.08)
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	185,033	185,033	185,033	185,033	185,033	185,033
Adjusted R^2	0.052	0.058	0.208	0.209	0.159	0.161

Table 6 Robustness Checks: TARP Capital Infusion, Liquidity Creation, and Bank Capital

This table reports estimates from difference-in-difference (DID) regression analysis with Eq. (3) for the impact of TARP on banks liquidity creation based on different measures of bank capital (Panels A and B) and bank capitalization levels (Panels C-E). Alternative measures of bank capital ratios are the total risk-based capital ratio and the leverage ratio. The *total risk-based capital ratio* is measured as core capital (tier 1) plus supplementary capital (tier 2) over risk-weighted assets. The *leverage ratio* is calculated by dividing core capital (tier 1) by total assets rather than risk-weighted assets. We also separate our sample into two subsamples: well-capitalized banks (with the capital ratio above the median level of the distribution) and poorly-capitalized banks (with the capital ratio below or equal to the median level of the distribution). All control variables in the baseline model are included across all specifications in this table, not shown for brevity's sake. *TARP Recipient* takes the value of one if a bank is TARP recipient and zero otherwise. *Post TARP* is a dummy equal to one in the 2009-2014 period after TARP program initiation and zero otherwise. *catfat_gta* is the sum of on-balance sheet and off-balance sheet liquidity creation; *catnonfat_gta* measures liquidity created on the balance sheet only. The variable descriptions are in Appendix 1. Robust standard errors clustered by bank are in parentheses. *, **, and *** denote significance at 10%, 5% and 1% level, respectively.

Panel A: Alternative measures of bank capital – total risk-based capital ratio

	Dependent Variables: Bank Liquidity Creation					
	Small banks	Medium banks	Large banks	Small banks	Medium banks	Large banks
		catfat_gta			*catnonfat_gta*	
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
Post TARP × TARP Recipient	**0.007*** **	**-0.010**	**-0.001**	**0.009*** **	**-0.010**	**-0.014**
	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.02)
TARP Recipient	-0.006*	-0.001	0.024*	-0.008**	-0.001	0.032**
	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)
Total risk-based capital ratio	-0.579***	-0.453***	-0.404***	-0.588***	-0.510***	-0.497***
	(0.02)	(0.17)	(0.14)	(0.02)	(0.18)	(0.18)
Other bank controls	Yes	Yes	Yes	Yes	Yes	Yes
Macro and local controls	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	251,309	11,416	6,270	251,309	11,416	6,270
Adjusted R^2	0.778	0.702	0.749	0.737	0.602	0.617

Panel B: Alternative measures of bank capital – leverage ratio

	Dependent Variables: Bank Liquidity Creation					
	Small banks	Medium banks	Large banks	Small banks	Medium banks	Large banks
		catfat_gta			*catnonfat_gta*	
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
Post TARP × TARP Recipient	**0.010*****	**-0.006**	**0.002**	**0.012*****	**-0.006**	**-0.007**
	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)
TARP Recipient	-0.010***	-0.004	0.021	-0.012***	-0.003	0.027*
	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)
Leverage ratio	-1.133***	-1.166***	-0.881***	-1.128***	-1.236***	-1.331***
	(0.03)	(0.24)	(0.20)	(0.03)	(0.25)	(0.24)
Other bank controls	Yes	Yes	Yes	Yes	Yes	Yes
Macro and local controls	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	251,309	11,416	6,270	251,309	11,416	6,270
Adjusted R^2	0.787	0.716	0.754	0.747	0.622	0.641

Panel C: Different levels of bank capitalization – small banks

	Dependent Variables: Bank Liquidity Creation											
	Well-capitalized banks						Poorly-capitalized banks					
	catfat_gta			*catnonfat_gta*			*catfat_gta*			*catnonfat_gta*		
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Post TARP × TARP Recipient	**0.009***	**0.017****	**0.011****	**0.011****	**0.017*****	**0.013****	**0.004**	**0.008****	**0.005**	**0.006***	**0.009****	**0.006***
	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
TARP Recipient	0.002	-0.007	-0.000	0.001	-0.006	-0.001	-0.012***	-0.015***	-0.013***	-0.014***	-0.015***	-0.014***
	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Tier 1 risk-based capital ratio	-1.064***			-1.049***			-0.946***			-0.997***		
	(0.03)			(0.03)			(0.08)			(0.07)		
Total risk-based capital ratio		-0.533***			-0.541			-0.850***			-0.820***	
		(0.02)			(0.02)			(0.05)			(0.05)	
Leverage ratio			-1.129***			-1.115***			-0.988***			-1.029***
			(0.04)			(0.04)			(0.08)			(0.07)
Other bank controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Macro and local controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	125,616	125,618	125,616	125,616	125,618	125,616	125,693	125,691	125,693	125,693	125,691	125,693
Adjusted R^2	0.794	0.742	0.793	0.755	0.702	0.755	0.753	0.649	0.753	0.699	0.540	0.699

Panel D: Different levels of bank capitalization – medium banks

	Dependent Variables: Bank Liquidity Creation											
	Well-capitalized banks						Poorly-capitalized banks					
	catfat_gta			*catnonfat_gta*			*catfat_gta*			*catnonfat_gta*		
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Post TARP* × *TARP Recipient	**-0.006**	**-0.007**	**-0.008**	**-0.002**	**-0.006**	**-0.003**	**-0.009**	**-0.015**	**-0.006**	**-0.012**	**-0.016**	**-0.009**
	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
TARP Recipient	-0.009	0.005	-0.006	-0.011	0.005	-0.008	0.001	-0.005	-0.001	0.002	-0.004	0.000
	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Tier 1 risk-based capital ratio	-1.298***			-1.424***			-0.300			-0.347		
	(0.32)			(0.31)			(0.35)			(0.35)		
Total risk-based capital ratio		-0.334*			-0.383*			-1.070***			-1.046***	
		(0.19)			(0.21)			(0.26)			(0.26)	
Leverage ratio			-1.423***			-1.510***			-0.350			-0.433
			(0.32)			(0.33)			(0.37)			(0.37)
Other bank controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Macro and local controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5,708	5,708	5,708	5,708	5,708	5,708	5,708	5,708	5,708	5,708	5,708	5,708
Adjusted R^2	0.693	0.685	0.700	0.591	0.612	0.598	0.749	0.674	0.750	0.680	0.514	0.678

Panel E: Different levels of bank capitalization – large banks

	Dependent Variables: Bank Liquidity Creation											
	Well-capitalized banks						Poorly-capitalized banks					
	catfat_gta			*catnonfat_gta*			*catfat_gta*			*catnonfat_gta*		
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Post TARP × TARP Recipient	**-0.007**	**0.007**	**0.002**	**-0.042***	**-0.011**	**-0.033**	**-0.001**	**-0.007**	**-0.004**	**0.001**	**-0.020**	**-0.004**
	(0.02)	(0.03)	(0.02)	(0.03)	(0.04)	(0.03)	(0.02)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)
TARP Recipient	0.031	0.023	0.028	0.061**	0.035	0.060**	0.023	0.022	0.022	0.025*	0.029**	0.023*
	(0.02)	(0.03)	(0.02)	(0.03)	(0.04)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Tier 1 risk-based capital ratio	-1.293***			-1.529***			0.958			0.470		
	(0.23)			(0.25)			(0.63)			(0.59)		
Total risk-based capital ratio		-0.492***			-0.499***			-0.315			-1.065***	
		(0.17)			(0.19)			(0.39)			(0.40)	
Leverage ratio			-1.370***			-1.659***			0.765			-0.302
			(0.24)			(0.26)			(0.65)			(0.59)
Other bank controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Macro and local controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,135	3,135	3,135	3,135	3,135	3,135	3,135	3,135	3,135	3,135	3,135	3,135
Adjusted R^2	0.775	0.762	0.770	0.658	0.598	0.664	0.735	0.731	0.745	0.698	0.659	0.699

Table 7 Robustness Checks: Splitting the Sample of Banks into Alternative Size Cut-offs
This table reports estimates from difference-in-difference (DID) regression analysis with Eq. (3) for the impact of TARP on bank liquidity creation by alternative measures of bank size. We sort the sample banks into large, medium and small banks based on different size cutoffs in Panels A, B and C. Bank liquidity creation is proxied by the BB measures (*catfat_gta* and *catnonfat_gta*). *TARP Recipient* takes the value of one if a bank is TARP recipient and zero otherwise. *Post TARP* is a dummy equal to one in the 2009-2014 period after TARP program initiation and zero otherwise. *catfat_gta* is the sum of on-balance sheet and off-balance sheet liquidity creation; *catnonfat_gta* measures liquidity created on the balance sheet only. All control variables in the baseline model are included across all specifications in this table, not shown for brevity. The variable descriptions are in Appendix 1. Robust standard errors clustered by bank are in parentheses. *, **, and *** denote significance at 10%, 5% and 1% level, respectively.

Panel A: $1 billion and $5 billion size cut-off

	Dependent Variables: Bank Liquidity Creation					
	catfat_gta			*catnonfat_gta*		
	Small Banks	Medium Banks	Large Banks	Small Banks	Medium Banks	Large Banks
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
Post TARP × TARP Recipient	**0.009*****	**-0.004**	**-0.010**	**0.011*****	**-0.003**	**-0.022**
	(0.00)	(0.01)	(0.02)	(0.00)	(0.01)	(0.02)
TARP Recipient	-0.009***	0.001	0.018	-0.010***	0.003	0.019
	(0.00)	(0.01)	(0.02)	(0.00)	(0.01)	(0.02)
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes
Macro and local controls	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	251,309	13,403	4,283	251,309	13,403	4,283
Adjusted R^2	0.786	0.719	0.745	0.746	0.604	0.636

Panel B: $1 billion and $10 billion size cut-off

	Dependent Variables: Bank Liquidity Creation					
	catfat_gta			*catnonfat_gta*		
	Small Banks	Medium Banks	Large Banks	Small Banks	Medium Banks	Large Banks
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
Post TARP × TARP Recipient	**0.009*****	**-0.007**	**0.004**	**0.011*****	**-0.006**	**0.000**
	(0.00)	(0.01)	(0.02)	(0.00)	(0.01)	(0.02)
TARP Recipient	-0.009***	0.006	0.009	-0.010***	0.008	-0.009
	(0.00)	(0.01)	(0.02)	(0.00)	(0.01)	(0.02)
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes
Macro and local controls	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	251,309	15,005	2,681	251,309	15,005	2,681
Adjusted R^2	0.786	0.712	0.752	0.746	0.591	0.680

Panel C: $1 billion size cut-off

	Dependent Variables: Bank Liquidity Creation			
	catfat_gta		*catnonfat_gta*	
	Small Banks	Large Banks	Small Banks	Large Banks
Independent Variables	(1)	(2)	(4)	(5)
Post TARP × TARP Recipient	**0.009*****	**-0.004**	**0.011*****	**-0.004**
	(0.00)	(0.01)	(0.00)	(0.01)
TARP Recipient	-0.009***	0.008	-0.010***	0.009
	(0.00)	(0.01)	(0.00)	(0.02)
Bank controls	Yes	Yes	Yes	Yes
Macro and local controls	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
Observations	251,309	17,686	251,309	17,686
Adjusted R^2	0.786	0.714	0.746	0.578

Panel D: $10 billion size cut-off

	Dependent Variables: Bank Liquidity Creation					
	catfat_gta			*catnonfat_gta*		
	Small Banks	Large Banks with TBTF	Large Banks without TBTF	Small Banks	Large Banks with TBTF	Large Banks without TBTF
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
Post TARP × TARP Recipient	**0.013*****	**0.004**	**0.003**	**0.015*****	**0.000**	**0.032**
	(0.00)	(0.02)	(0.03)	(0.00)	(0.02)	(0.03)
TARP Recipient	-0.009***	0.009	0.008	-0.011***	-0.009	-0.004
	(0.00)	(0.02)	(0.02)	(0.00)	(0.02)	(0.02)
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes
Macro and local controls	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	266,314	2,681	1,656	266,314	2,681	1,656
Adjusted R^2	0.787	0.752	0.785	0.740	0.680	0.693

Table 8 Robustness Checks: Subcomponents of Bank Liquidity Creation, Alternative Measure of TARP, Excluding TARP Involuntary Participants, Excluding Participants Subject to the "Stress Test", and Dynamics of the Effects of TARP on Bank Liquidity Creation

To better understand the driving forces behind the total liquidity creation and enhance our analysis, in Panel A, we decompose on-balance sheet liquidity creation into asset-side liquidity creation (*lc_a_gta*) and liability-side liquidity creation (*lc_l_gta*). We further report the results for off-balance sheet liquidity creation (*lc_obs_gta*) (all scaled by total assets). Results for small banks are reported in Columns (1)-(3), medium banks in Columns (4)-(6), and large banks in Columns (7)-(9). To test the robustness of our main results to the use of an alternative measure of TARP, in Panel B, we replace the *TARP Recipient* with an alternative measure of TARP infusion: *Ln(1+Bailout Amount)*, the natural logarithm of one plus the bailout amount. In Panel C, we follow a conservative approach and re-estimate the results from a sample that excludes the largest eight banks which are involuntary participants in the TARP program to mitigate the concern that the Treasury Department might have different motivations when approving TARP funds for these banks. We also exclude from our sample banks that were subject to the "stress test" (called the Supervisory Capital Assessment Program, or SCAP) because its institutional design was different from TARP. The results are reported in Panel D. Panel E examines the dynamic effects of TARP on bank liquidity creation. In this panel, the coefficients are the interactions of the *TARP Recipient* variable with year dummies for each year after the TARP program was implemented (2009, 2010, 2011, 2012, 2013, and 2014). *TARP Recipient* takes the value of one if a bank is TARP recipient and zero otherwise. *Post TARP* is a dummy equal to one in the 2009-2014 period after TARP program initiation and zero otherwise. *catfat_gta* is the sum of on-balance sheet and off-balance sheet liquidity creation; *catnonfat_gta* measures liquidity created on the balance sheet only. All control variables in the baseline model are included across all specifications in this table, not shown for brevity. The variable descriptions are in Appendix 1. Robust standard errors clustered by bank are in parentheses. *, **, and *** denote significance at 10%, 5% and 1% level, respectively.

Panel A: Subcomponents of bank liquidity creation

	Dependent Variables: Bank Liquidity Creation								
	Asset-side liquidity creation *lc_a_gta*	Liability-side liquidity creation *lc_l_gta*	Off-balance sheet liquidity creation *lc_obs_gta*	Asset-side liquidity creation *lc_a_gta*	Liability-side liquidity creation *lc_l_gta*	Off-balance sheet liquidity creation *lc_obs_gta*	Asset-side liquidity creation *lc_a_gta*	Liability-side liquidity creation *lc_l_gta*	Off-balance sheet liquidity creation *lc_obs_gta*
	Small Banks			Medium Banks			Large Banks		
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Post TARP × TARP Recipient	**0.007*** **	**0.004**	**-0.002*** **	**-0.003**	**-0.004**	**0.001**	**0.002**	**-0.005**	**-0.003**
	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.00)
TARP Recipient	0.000	-0.011***	0.003***	0.004	-0.008	0.000	0.024**	0.000	0.002
	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.00)
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Macro and local controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	251,309	251,309	251,309	11,416	11,416	11,416	6,270	6,270	6,270
Adjusted R^2	0.850	0.374	0.877	0.771	0.418	0.888	0.771	0.363	0.926

Panel B: Alternative measure of TARP

	Dependent Variables: Bank Liquidity Creation					
	Small banks	Medium banks	Large banks	Small banks	Medium banks	Large banks
		catfat_gta			*catnonfat_gta*	
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
Post TARP × Ln(1+Bailout Amount)	**0.001*** **	**-0.001**	**0.000**	**0.001*** **	**-0.000**	**-0.001**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Ln(1+Bailout Amount)	-0.001***	-0.000	0.001	-0.001***	-0.000	0.001
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes
Macro and local controls	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	251,309	11,416	6,270	251,309	11,416	6,270
Adjusted R^2	0.786	0.712	0.751	0.746	0.618	0.635

Panel C: Excluding TARP involuntary participants

	Dependent Variables: Bank Liquidity Creation					
	Small banks	Medium banks	Large banks	Small banks	Medium banks	Large banks
		catfat_gta			*catnonfat_gta*	
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
Post TARP × TARP Recipient	**0.009*** **	**-0.005**	**-0.001**	**0.011*** **	**-0.006**	**-0.015**
	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.02)
TARP Recipient	-0.009***	-0.004	0.033**	-0.010***	-0.004	0.051***
	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes
Macro and local controls	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	251,291	11,318	5,798	251,291	11,318	5,798
Adjusted R^2	0.786	0.708	0.738	0.746	0.621	0.619

Panel D: Excluding participants subject to the "stress test"

	Dependent Variables: Bank Liquidity Creation					
	Small banks	Medium banks	Large banks	Small banks	Medium banks	Large banks
		catfat_gta			*catnonfat_gta*	

Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
Post TARP × TARP Recipient	**0.009*****	**-0.005**	**-0.009**	**0.011*****	**-0.007**	**-0.019**
	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)
TARP Recipient	-0.009***	-0.005	0.034**	-0.010***	-0.004	0.050***
	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes
Macro and local controls	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	251,289	11,295	5,411	251,289	11,295	5,411
Adjusted R^2	0.786	0.706	0.734	0.746	0.621	0.631

Panel E: Dynamics of the effects of TARP on bank liquidity creation

	Dependent Variables: Bank Liquidity Creation					
	Small banks		Medium banks		Large banks	
	catfat_gta	*catnonfat_gta*	*catfat_gta*	*catnonfat_gta*	*catfat_gta*	*catnonfat_gta*
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
Post TARP_2009 × TARP Recipient	**0.002**	**0.004***	**-0.000**	**0.002**	**0.016**	**0.001**
	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
Post TARP_2010 × TARP Recipient	**0.007****	**0.010*****	**-0.008**	**-0.007**	**0.009**	**0.002**
	(0.00)	(0.00)	(0.01)	(0.01)	(0.02)	(0.02)
Post TARP_2011 × TARP Recipient	**0.010*****	**0.013*****	**-0.007**	**-0.008**	**0.001**	**-0.007**
	(0.00)	(0.00)	(0.01)	(0.01)	(0.02)	(0.02)
Post TARP_2012 × TARP Recipient	**0.012*****	**0.015*****	**-0.008**	**-0.011**	**0.004**	**-0.006**
	(0.00)	(0.00)	(0.01)	(0.01)	(0.02)	(0.02)
Post TARP_2013 × TARP Recipient	**0.012*****	**0.013*****	**-0.007**	**-0.007**	**-0.010**	**-0.019**
	(0.00)	(0.00)	(0.01)	(0.01)	(0.02)	(0.02)
Post TARP_2014 × TARP Recipient	**0.011****	**0.011*****	**-0.014**	**-0.012**	**-0.013**	**-0.025**
	(0.00)	(0.00)	(0.01)	(0.01)	(0.02)	(0.02)
TARP Recipient	-0.009***	-0.010***	-0.003	-0.003	0.023*	0.029**
	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes
Macro and local controls	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	251,309	251,309	11,416	11,416	6,270	6,270
Adjusted R^2	0.787	0.746	0.712	0.618	0.752	0.638