The Economic Consequences of the TARP: The effectiveness of bank recapitalization policies in the US

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Abstract:

This study empirically analyzes the impact of the United States' bank recapitalization program, the centerpiece of the United States' $700 billion Troubled Asset Relief Program (TARP), on bank portfolios. Our findings demonstrate that the program did not achieve the stated policy objective of stimulating bank lending. On the contrary, we find evidence that recipient banks grew assets significantly slower, particularly heavily risk-weighted assets. This affected aggregate loan growth as well as growth in lending to specific sectors: agriculture, real estate, and, most significantly, business loans. The slower loan growth rates were more significant under TARP 2, the second round of the program. These findings are robust to various empirical specifications, including two-stage least squares estimation using instrumental variables, which controls for possible endogeneity bias. The empirical results suggest that TARP recipients grew loans significantly slower than other banks and that the slowdown was more pronounced the more capital the banks received.

Keywords: bank; crisis; recapitalization; capital; TARP
JEL Codes: G21, G28, G01

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You can't force banks to lend."
Tim Geithner[1]

1. Introduction

The Troubled Asset Relief Program (TARP), dubbed "the $700 bailout" in the popular press, was the largest government bailout in United States history. The bulk of the $700 billion in funds were earmarked for a series of capital injections in America's troubled financial sector. Representatives of the United States Treasury and the Federal Reserve have credited TARP with preventing a second great depression. But the effectiveness of the program remains a subject of heated debate among policymakers. The United States Treasury, which proposed the plan and oversaw its implementation, asserts that "thanks to TARP…credit is more available to consumers and small businesses." (Office of Financial Stability, 2013, page ii). However, the Congressional Oversight Panel for Economic Stabilization charged in its report on Accountability for the Troubled Asset Relief Program that "The Panel still does not know what the banks are doing with taxpayer money" (Congressional Oversight Panel, 2009).

Academic research on this policy question is also divided. Theory suggests that shrinking assets is the preferred response for a bank manager facing a capital shortage (as an example of current research, see Hyun & Rhee, 2011), so, as Treasury Secretary Tim Geithner was trying to suggest in his comments to the Senate quoted above, although "you can't force banks to lend", boosting bank capital would be expected to stimulate lending by those banks. Policymakers in Japan implemented a similar program in the late 1990s and empirical research on that episode supports Geithner's thesis (Montgomery, 2005; Peek & Rosengren, 1995; Watanabe, 2007; Woo, 2003). Policymakers in the U.K. are following suit with their "Funding for Lending" scheme.

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[1] A comment by Treasury Secretary Timothy Geithner hearing of the Senate Committee on Small Business and Entrepreneurship. Secretary Geithner went on to add the important qualifier that "..for every bank that has capital in this program, they have more capacity to lend than they otherwise would have."

On the other hand, despite the huge $700 billion headline figure, when the program was announced commentators familiar with the experience of Japan worried that the TARP capital injections were not large enough to really be effective (Hoshi & Kashyap, 2008; Shimizutani & Montgomery, 2008). If the recapitalizations were not large enough and recipient banks themselves, or their regulators, were too draconian in their monitoring of capital adequacy ratios, incentives to shrink bank portfolios, especially those assets in the heaviest risk-weight category, would have been strong. This perspective is also supported by academic research. In their theory of bank capital, (Diamond & Rajan, 2000) point that recapitalizations that are too small may actually damage bank lending. Empirical research by Watanabe (2007) and Iwatsubo (2007) has shown that in the case of Japan - where capital injections were perhaps inadequate to offset a credit crunch and were accompanied by more stringent regulation – Japanese banks cut bank on lending in response to capital losses and the government capital injections led banks to reduce risky loans at the margin. Japan's experience with capital injections suggests that details of the program implementation are crucial: tailoring recapitalization programs to the recipient banks' individual situation is a necessary condition to achieving policy objectives (Allen, Chakraborty, & Watanabe, 2011; Montgomery & Shimizutani, 2009).

In this study, we contribute to the body of research on the effects of government intervention in the form of capital injections on bank behavior, investigating the impact of the TARP on bank lending and other assets. There are a small number of emerging related studies that, like this study, also take advantage of micro-level data to analyze the impact of TARP on bank behavior (Black & Hazelwood (2012) and Duchin & Sosyura (2010))[2]. However, this study makes several unique contributions to the literature. The current study explores the effect of TARP – both receipt of TARP funds and the amount of capital received under the program as a percent of total bank assets – on recipient bank loan growth. The impact of TARP not only on total lending by recipient banks, but also on lending to specific sectors is examined, as well as the effect of TARP on the growth of various asset risk-weight classes. Because of significant differences in the institutional design of the successive rounds of TARP, this study investigates the possibility of differences in the effectiveness of TARP 1 and TARP 2 on those outcomes. Finally, this study explicitly addresses the issue of possible endogeneity in the estimating equation by basing the empirical analysis in economic theory and confirming the robustness of the empirical results to various

[2] Both Duchin and Sosyura (2010) and Black and Hazelwood (2012), discussed further in the conclusions, examine a slightly different hypothesis than the current study: focusing on bank risk taking.

empirical methodologies, including generalized method of moments and instrumental variables analysis.

Our findings are surprising given the predictions standard economic theory would provide on the effect of increased capital on bank behavior. Our analysis presents no evidence that TARP stimulated bank lending of any kind. On the contrary, we find strong evidence that recipients of TARP 2, or the CAP, implemented following bank stress tests under Treasury Secretary Tim Geithner, actually *reduced* loan growth. The cut in lending is higher the greater the amount of capital received as a percentage of bank total assets. This finding is robust to various empirical specifications and is observed in aggregate lending as well as mortgage loans, agricultural lending and, most significantly, "C&I" lending to businesses, where the cutbacks were seen even earlier, under TARP 1. However, as elaborated in the conclusions, our results may be consistent with the picture that is currently emerging from related studies.

This rest of this article is organized as follows. The next section provides some institutional detail on the Troubled Asset Relief Program that is most relevant to the analysis to follow. Section 3 lays out a simplified model of bank behavior that can be used to analyze the effect of the TARP capital injections on the banks. Sections four through six then turn to an empirical evaluation of the effectiveness of the bank recapitalizations based on that model. Section four discusses our data, section five details the different empirical methodologies employed and section six discusses the empirical results. In the last section, we conclude with a discussion of our findings and how they may be interpreted and perhaps used to guide future policy interventions.

2. The Troubled Assets Relief Program (TARP)

The Troubled Assets Relief Program (TARP) was the centerpiece of the United States' Emergency Economic Stabilization Act [3] (EESA), signed into law by President Bush on October 3, 2008 in response to the economic meltdown that threatened the global economy in the autumn of 2008. As its name implies, the TARP was originally envisaged as a program to purchase troubled assets – in particular, mortgage backed assets – to stabilize the financial system. Treasury may have hoped not to have to

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[3] The new law also allowed the Federal Reserve to begin paying interest on deposits of financial institutions and increased deposit insurance provided by the Federal Deposit Insurance Corporation (FDIC) from 100,000 dollars to 250,000 dollars per deposit account.

actually use the allocated funds, the largest bailout in U.S. history. As then Secretary of the Treasury Hank Paulson famously quipped at a Senate Banking Committee hearing, "If you've got a bazooka and people know you've got it, you may not have to take it out." But immediately after passage of the TARP, attention shifted from troubled asset markets to the urgent need for bank capital. Eleven days later, on October 14, 2008, the Treasury announced that the bulk of the funds would be used toward recapitalization of the banking system.

Under the recapitalization programs – first, the Capital Purchase Program (CPP) under "TARP 1" and then its successor, the Capital Assistance Program (CAP) under "TARP 2" – Treasury would recapitalize the U.S. banking system through purchases of up to 250 billion dollars in senior preferred stock of U.S. controlled financial institutions. One significant difference between TARP1 and TARP2 was that the second round, TARP 2, was implemented after conducting "stress tests" of the major banks to ensure that capital only went to banks that were fundamentally sound – meaning able to withstand a "steeper-than-projected" negative shock. Readers are referred to Bayazitova & Shivdasani (2012) for more interesting details on the implementation of TARP, the CPP and the CAP.

The overarching goal of the TARP was "to stabilize the financial system by providing capital to viable financial institutions of all sizes throughout the nation" (U.S. Department of the Treasury, n.d.) This was to be achieved through the following objectives of the program, as we interpret them from statements by the Department of the Treasury: (1) boosting bank capital, both directly and indirectly by increasing "confidence in our banks…in a way that attracts private capital as well" (2) increasing lending by encouraging banks to "deploy, not hoard, their capital" and (3) in particular, increasing mortgage roll-overs in order to "avoid foreclosures" (U.S. Department of the Treasury, 2008a).

Although banks were encouraged to meet these objectives, there were no explicit targets or incentives for doing so and no guidance on how to balance the conflicting demands on their limited capital. Policymakers have bemoaned the lack of clear targets for recipients of TARP funds[4]. Some economists, however, have praised Treasury for this approach as having for avoiding the dangers of linking explicit lending targets with bank recapitalization programs that were seen in Japan in the late 1990s (Hoshi & Kashyap, 2010). Although Japan's bank recapitalization program

[4] Senator Charles Schumer of New York is an example of one of the more vocal members of congress on this point.

was found by some researchers to have been successful in achieving policy objectives such as stimulating loan growth (Allen et al., 2011; Ito & Harada, 2005; Montgomery & Shimizutani, 2009; Watanabe, 2007), bank restructuring (Onji, Vera, & Corbett, 2012) and firm investment (Kasahara, Sawada, & Suzuki, 2011), other researchers uncovered the fact that much of the increased lending went to unhealthy "zombie firms" (Peek & Rosengren, 2005; Watanabe, 2010).

At the time of this writing, the overarching goal of stabilizing financial markets appears to have been achieved. Bayazitova & Shivdasani (2012) report valuation gains for all banks when the TARP was first announced and Veronesi and Zingales (2010), in an analysis of the costs and benefits of the TARP, conclude that there was a net benefit from TARP thanks to the reduced probability of bankruptcy. But despite exhortations from Treasury officials to the financial industry to "meet their responsibility to lend" (U.S. Department of the Treasury, 2008b), a sharp drop in aggregate bank lending has been clearly documented (Cornett, McNutt, Strahan, & Tehranian, 2011; Ivashina & Scharfstein, 2010). This study builds on these findings, examining the impact of the TARP on individual bank lending using micro-level panel data, which allows us to explore the impact of TARP on different kinds of lending, and possible differences in the impact of the successive rounds of TARP 1 and TARP 2.

3. Model of Representative Bank Behavior

Our empirical analysis is based on a rational expectations model of bank behavior. Consider a simplified balance sheet in which we have loans on the assets side and deposits and capital (shareholder's equity) on the liability side:

Assets	Liabilities
L	D
	K

Where L is loans, D is deposits and K is capital. Under perfect competition, each bank is in principle a price taker, so the interest rate on loans, r^L, and deposits, r^D, are assumed to be exogenously given in each time period t.

In the short run, capital, K, is also assumed to be exogenous, so the revenue of an individual bank at time t is determined by the interest income on loans minus the interest expense on deposits[5]:

$$R_{i,t} = r_t^L L_{i,t} - r_t^D D_{i,t} \tag{1}$$

Substituting D with L – K the revenue of bank i can be expressed as:

$$R_{i,t} = (r_t^L - r_t^D) L_{i,t} + r_t^D K_{i,t} \tag{2}$$

Next consider costs. There is some benefit, B_t , that comes from high capitalization. This benefit might include banks self-interest in maintaining a capital cushion to reduce the likelihood of bankruptcy, and it certainly also includes regulatory incentives, which are explained in detail below.

$$B_{i,t} = K_{i,t} h\left(\frac{K_{i,t}}{L_{i,t}}\right) \tag{3}$$

Where h(.) is a non-specified concave function.

On the other hand, there is some adjustment cost, A_t, associated with changes in loan growth relative to a given loan demand as in Furfine (2001). This could include the costs of seeking out new customers to expand lending as well as adjustments such as cutting back on existing loans (see Diamond, 1984; Sharpe, 1990) or loss of economies of scale (Berger, Hancock, & Humphrey, 1993):

$$A_{i,t} = L_{i,t} f\left(\frac{L_{i,t+1} - L_{i,t}}{L_{i,t}}\right) \tag{4}$$

Where f(.) is a non-specified convex function.

Finally, consider profit. In this stylized model, banks select loans at time t to maximize π_t, their expected future profit stream discounted to present value:

$$\max_{i,t} \pi_{i,t} = E_t \sum b^j \left[(r_{t+j}^L - r_{t+j}^D) L_{i,t+j} + r_{t+j}^D K_{i,t+j} + K_{i,t+j} h\left(\frac{K_{i,t+j}}{L_{i,t+j}}\right) - L_{i,t+j} f\left(\frac{L_{i,t+j+1} - L_{i,t+j}}{L_{i,t+j}}\right)\right] \tag{5}$$

[5] This is a short run simplifying assumption that banks set loans and then are able to obtain the necessary deposits to fund those loans at the market given interest rate on loans and deposits.

Where $0 < b < 1$ is the discount rate. Solving this maximization problem with respect to L_t yields the Euler equation:

$$E_t\left[\left(r^L_{t+j} - r^D_{t+j}\right) + h'\left(\frac{K_{i,t+j}}{L_{i,t+j}}\right) - L_{i,t+j-1}f'\left(\frac{L_{i,t+j} - L_{i,t+j-1}}{L_{i,t+j-1}}\right)\right] = E_t\left[-bL_{i,t+j}f'\left(\frac{L_{i,t+j+1} - L_{i,t+j}}{L_{i,t+j}}\right) - bf\left(\frac{L_{i,t+j+1} - L_{i,t+j}}{L_{i,t+j}}\right)\right] \tag{6}$$

If we let

$$h'\left(\frac{K_{i,t+j}}{L_{i,t+j}}\right) = \phi\left(log\left(\frac{K_{i,t+j}}{L_{i,t+j}}\right)\right) \tag{7}$$

$$-L_{i,t+j-1}f'\left(\frac{L_{i,t+j} - L_{i,t+j-1}}{L_{i,t+j-1}}\right) = \psi\left(\Delta\, log\left(L_{i,t+j}\right)\right) \tag{8}$$

$$-bL_{i,t+j}f'\left(\frac{L_{i,t+j+1} - L_{i,t+j}}{L_{i,t+j}}\right) - bf\left(\frac{L_{i,t+j+1} - L_{i,t+j}}{L_{i,t+j}}\right) = \Upsilon\left(\Delta\, log\left(L_{i,t+j+1}\right)\right) \tag{9}$$

We can express the Euler equation in a log-linearized form:

$$E_t\left[\Delta\, log\left(L_{i,t+j+1}\right)\right] = E_t\left[\beta_1 \Delta\, log\left(L_{i,t+j}\right) + \beta_2\left(r^L_{t+j} - r^D_{t+j}\right) + \beta_3 log\left(\frac{K_{i,t+j}}{L_{i,t+j}}\right)\right] \tag{10}$$

Replacing conditional expectations in the equation (10) with actual values we have:

$$\Delta\, log\left(L_{i,t+j+1}\right) = \alpha_0 + \alpha_1 \Delta\, log\left(L_{i,t+j}\right) + \beta\, log\left(\frac{K_{i,t+j}}{L_{i,t+j}}\right) + \gamma\left(r^L_{t+j} - r^D_{t+j}\right) + \varepsilon_{i,t+j+1} \tag{11}$$

Where $\varepsilon_{i,t+j+1}$ is a rational expectations error term.

Our main empirical results use a panel of data on 9,337 commercial bank balance sheets and income statements for the years 2001-2010 to estimate a reduced form equation based on equation 11. The following sections explain our data and methodology in more detail.

4. Data

To construct our panel of data, we compiled annual balance sheets and income statements from the Report of Condition and Income (Call Report) data. These reports are submitted quarterly by all banks that are regulated by the Federal Reserve, Federal Deposit Insurance Corporation (FDIC) or the Office of the Comptroller of the Currency (OCC), and include financial information from the balance sheet, income statement and cash-flow statements. We also use information such as the location and legal structure of each bank maintained and made public by the Federal Reserve along with the Call Report data. The amount of capital injected into individual institutions is based upon the TARP "Transaction Reports", which are made publicly available by the U.S. Treasury Department Office of Financial Stability[6]. These sources provide a sample of 9,337 publicly traded commercial banks over the 10 year period of 2001-2010, or 69,753 total observations for analysis.

Table 1 reports the summary statistics of those 69,753 observations used in our analysis. The choice of dependent and independent variables reported in table 1 was guided by the model of bank behavior above and the choice of instrumental variables is explained in the following section.

Insert Table 1 SUMMARY STATISTICS FOR COMMERCIAL BANKS Here (#1)
Insert Figure 1 REGULATORY CAPITAL RATIO OF COMMERCIAL BANKS Here (#1)

Looking at table 1, readers may note that the mean regulatory capital ratio for U.S. commercial banks over the period 2001-2010 was well above the required minimum at 15.79%, although there is a wide range and overall, as illustrated in Figure 1, bank capital deteriorates after the crisis. Average loan growth over the period was about 8.05%. When we look at loans by sector we note that real estate loans grew above that rate on average, while C&I loan growth was slightly lower and growth in loans for agriculture or to individuals was even lower (although none of these differences would be statistically significant given the high standard deviations).

Since direct information on interest rates is not available[7], the interest rate spread between loans made by the bank and deposits taken in by the bank is approximated by the difference in the ratio of interest income to total loans and

[6] Data available at http://www.treasury.gov/initiatives/financial-stability/briefing-room/reports/tarp-transactions/Pages/default.aspx. Latest release: October 29, 2010.

[7] Actual interest rates on automobile loans and loans for consumer goods and personal expenditures are available in some Call Reports, but they are reported on a voluntary basis, so coverage is incomplete.

interest expenses to total deposits[8]. On average that spread is about 5% over the sample period. In addition to the interest rate spread, we control for the regulatory capital ratio, the log of which is 2.56% on average.

The main variable of interest is the amount of capital received by each bank in the years of the TARP capital injections, 2008 and 2009, which was made public by the U.S. Treasury Department Office of Financial Stability TARP Transactions Report. When the capital injection went directly to a commercial bank, we simply normalize the amount of capital received by dividing by the institution's risk-weighted assets. In most cases, however, the capital injection went to a parent bank holding company rather than directly to the commercial banks operating under the bank holding company. In those cases, we researched the parent bank holding company relationships to subsidiary commercial banks using the commercial bank's financial high holder information, which was provided along with Call Report data[9]. The amount of capital injection is normalized by the commercial bank's risk-weighted assets and then multiplied by the ratio of the commercial bank's total assets to the bank holding company's total assets to reflect the importance of the commercial bank to its parent bank holding company. After normalization, the amount of capital injection in log is estimated to be, on average, 0.01%. But the standard deviations are quite large since most banks did not receive a capital injection at all.

As indicated in Table 2, among those that did receive a capital injection, the normalized average amount in log is estimated to be just under 1.4% for the first and second round capital injection, with a range of 0.46% to 1.90%. The pre-normalized amount at the bank holding company level ranges from $1.5 million to $25 billion and $300 thousand to $10 billion for the first and the second round, respectively.

Insert Table SUMMARY OF THE TARP CAPITAL INJECTIONS Here (#2)

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[8] More precisely, it is the difference in the ratio of interest and fee income on loans to net loans and leases and the ratio of interest expenses on deposits to total deposits. Interest rates for bank holding companies are calculated similarly.

[9] The financial high holder is defined as "the highest level relationship that meets all of the following requirements: 1) The higher level entity has a direct ownership and control relationship with the lower entity, 2) Voting equity is the basis for ownership/control and 3) The higher level entity owns at least 51% of the lower entity (E-mail correspondence with the Federal Reserve Bank of Chicago, on September 8, 2011).

In addition to our basic question of the effect of the capital injections on the TARP objectives of stimulating loan growth, we look at the impact of the program on the banks' asset risk weight categories to examine the decisions of banks in managing their balance sheet upon receiving capital injection, as they are the basis for calculating regulatory capital ratios. Asset risk weight categories are not reported by commercial banks in their Call Report, so for that we need to turn to analysis of the bank holding companies with assets of more than $500 million, which are required to submit detailed financial data in a format similar to the commercial bank call report to their regulator, the Federal Reserve[10]. This cuts our sample to 1,081 bank holding companies over the 6 years between 2005-2010, reducing the total number of observations to 5,333. However, since most of the capital injections went to bank holding companies rather than directly to commercial banks, this still covers the majority of the funds distributed in 2008 and 2009.

Insert Table SUMMARY STATISTICS FOR BANK HOLDING COMPANIES Here (#3)

Table 3 reports the summary statistics for the bank holding companies. In the interest of brevity, only variables used in the asset risk weight analysis are included: total asset growth and growth in each of the asset risk-weight categories used in calculating regulatory capital ratios, 0%, 20%, 50% and 100%. The return on assets minus expenses on liabilities is also added to be used in place of interest rate spread, as it better represents the spread for risk weight assets.

5. Empirical Methodology

5.1. *Baseline Methodology*

Our baseline specification is a reduced form equation based on equation 11 of the model presented above.

$$Y_{i,t+1} = \mathrm{K} + \alpha Y_{i,t} + \beta X_{i,t} + \chi Z_{i,t} + \varepsilon_{i,t+1} \qquad (12)$$

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[10] From the first quarter of 2006 the threshold above which bank holding companies need to report detailed financial data rose from assets size of $150 million to $500 million. Thus, although the data for the earlier periods is available, one needs to use the data only from 2006 to have a consistent panel. However, we can use data from 2005 and still have consistent panel, since our equation includes lagged variables.

In equation 12, vector $Y_{i,t+1}$ represents the dependent variable. In our simplified model of bank behavior above, this would be the growth, proxied by the log-change, in lending at time *t+1* for bank *i*. Vector $X_{i,t}$ includes the variable of interest, the log of the capital injection as a percent of total risk-weighted assets. This variable takes the value of zero for those banks which did not receive a capital injection. Vector $Z_{i,t}$ denotes a vector of control variables for bank specific factors such as the banks' logged regulatory capital ratio and loan to deposit interest rate spread (the difference in the interest rate on loans and the interest rate on deposits). The error term $\varepsilon_{i,t+1}$ is a rational expectations error term, which is orthogonal to information available at time t, I_t : $\mathrm{E}\left[\varepsilon_{i,t+1}|I_t\right] = 0$. So our baseline specification is simple ordinary least squares (OLS), which yields robust parameter estimates.

We then proceed to refine our empirical analysis by estimating equation 12 with ordinary least squares including individual random and fixed effects, and a model that includes both individual fixed effects and a vector of time dummies, T_t. We then adopt clustered standard errors, which are robust to within-bank autocorrelation. Our preferred specification, the results of which are discussed below, includes individual fixed effects as suggested by a Hausman test to account for unobservable bank characteristics that may affect loan growth, time dummies to account for macroeconomic events that might affect loan growth at all banks within a given year, and standard errors that are robust to potential within-bank autocorrelation.

To investigate the effects of the program on various types of lending, the same basic specification is applied, but the dependent variable $Y_{i,t+1}$ is replaced with growth in sectoral lending – loans secured by real-estate, C&I business loans, agricultural loans and loan to individuals.

5.2. *Details by Asset Risk-Weight*

The methodology used in our baseline specification answers our main research question, but we then proceed to expand upon those findings with additional data on asset risk weight categories to examine the decisions of banks in managing their balance sheet upon receiving a capital injection, as they are the basis for calculating the banks' regulatory capital ratios. With the exception of a few large banks that have already switched over to Basel II, the original Basel Accord (now called "Basel I") had been used with some modifications in the U.S. throughout our sample period between 2001-2010 (Eubanks, 2006; Jickling & Murphy, 2010). The aim of Basel I was to categorize asset items according to their riskiness and require banks to have 8% or more capital against their risk weighted assets (RWA):

$$\text{Regulatory Capital Ratio} = \frac{\text{Tier I Capital} + \text{Tier II Capital}}{0\%\text{RWA} \times 0 + 20\%\text{RWA} \times 0.2 + 50\%\text{RWA} \times 0.5 + 100\%\text{RWA} \times 1} \geq 8\%$$

Risk weighted assets fall into four categories: 0% risk weight (0%RWA), 20% risk weight (20%RWA), 50% risk weight (50%RWA) and 100% risk weight (100%RWA). 0% risk weight assets include items such as cash and due from central banks, as well as OECD government bonds, 20% risk weight assets include items such as claims on depository institutions, 50% risk weight assets include items such as residential first mortgages and 100% risk weight assets include items such as business and consumer loans. Tier I capital consists of common equity, most retained earnings and certain perpetual noncumulative preferred stocks. Tier II capital consists of subordinated debt, non-perpetual preferred stocks and loan loss reserves up to 1.25% of the risk weight assets.

To explore how banks that received capital injections may have adjusted their portfolios in response to regulatory incentives, we keep the same basic specification in equation 12, but replace the dependent variable $Y_{i,t+1}$ with growth in total assets and the four risk-weight asset-classes, all again proxied by the log-change of those variables. Risk-weighted asset classes do not follow as closely to our model of bank behavior: we might not expect adjustment costs to be high for all asset classes, for example. Nonetheless, for consistency, the control variables here are the same as in the previous specification for loan growth, with the exception of the interest rate spread, which is replaced with the return on assets minus expenses on liabilities to more accurately represent the "spread" on various assets.

5.3. *Generalized Method of Moments*

In our model, equation 11, and reduced-form specification, equation 12, the error term $\varepsilon_{i,t+1}$ is a rational expectations error term, which is orthogonal to information available at time t, I_t , $\mathrm{E}[\varepsilon_{i,t+1}|I_t] = 0$, so ordinary least square estimation is appropriate. However, we recognize concerns that the lagged dependent variable in the right hand side of equations 11 and 12 introduces possible dynamic panel bias, endogeneity in the lagged dependent variable, especially given our large cross-section and comparatively short time-series.

To address these concerns, the commonly used statistical tools are Arellano & Bond's (1991) generalized method of moments (difference GMM) and Arellano & Bover

(1995) and Blundell & Bond's (1998) augmented GMM (system GMM). Difference GMM addresses the potential dynamic panel bias by instrumenting for the lagged dependent variable with further lags in level form, while system GMM instruments for the lagged dependent variable with its further lags, but in difference form. We estimate both system and difference GMM and find little difference between estimates of equation 12 using the two approaches. In our results reported below we focus on the difference GMM estimation, as that approach requires fewer assumptions. We use two-step GMM since it is asymptotically more efficient than one-step GMM. Since standard errors for two-step difference GMM can be downward biased with a finite sample (Arellano & Bond, 1991; Blundell & Bond, 1998), we make a finite sample correction to the variance estimate as proposed by Windmeijer (2005).

For the third moment conditions used in GMM estimation to be valid, there should *not* be any serial correlation in the first-differenced errors at an order higher than two (since all our variables are log-differenced). Tables 4 and 5 below report p-values for the following specification tests: the Arellano-Bond test for autocorrelation and Hansen's test for joint validity of the instruments. For the most part, the specification tests seem to indicate that GMM estimation is valid. The p-values for the Arellano-Bond test demonstrate that the null hypothesis of no autocorrelation in the first-differenced errors at order three[11] cannot be rejected at the 5% confidence level. The generally high p-values for Hansen's J statistic indicate that the null hypothesis that the instruments are uncorrelated with the error term cannot be rejected at the 5% level for most specifications. Thus, there is strong evidence that the third moment conditions are jointly valid instruments for most specifications.

5.4. *Instrumental Variables*

Our use of clustered standard errors and GMM estimators above addresses potential bias introduced by the use of dynamic panel data. But concerns about possible endogeneity may remain if injection of capital into the banks was non-random. To investigate this concern, we perform an exogeneity test – essentially a Hausman test that is robust to heteroskedasticity comparing OLS to 2SLS-IV estimation – on the capital injection variables in our data. An exogeneity test on the capital injections and growth in assets using the bank holding company data does not

[11] For total loan growth, reported in column 1, there was strong evidence (from Hansen's J test) that the third moment conditions were not good instruments, so we use the sixth moment. The Arellano-Bond autocorrelation test statistics reported in the table for aggregate loan growth are for sixth-order autocorrelation.

reject the null that the capital injection was exogenous to asset growth at the 5% level, so the robust OLS or GMM estimates are preferred over 2SLS-IV for the asset data. However, the same test results cannot rule out endogeneity of the capital injections and commercial bank loan growth at the 95% confidence interval, suggesting that instrumental variable estimation is preferred for our lending data.

Existing research gives us guidance on the choice of appropriate instruments. Bayazitova and Shivdasani (2012), for example, find evidence that TARP funds were more likely to go to banks that posed systemic risk or faced high financial distress costs. Duchin & Sosyura (2012) find that politically connected firms were more likely to be funded under the TARP program. Thus, we construct three instrumental variables that reflect the potential systemic risk, financial distress and political connectedness of each bank. We use these variables as instruments for the amount of capital injection in 2008 and 2009[12] and estimate equation 12 using two-stage least squares techniques.

As a proxy for the first criteria, systemic risk, we measure the concentration of bank deposits in each bank. The failure of a bank with a high concentration of total US deposits could potentially trigger a bank run, creating systemic risk. Thus, deposit concentration may indicate potential systemic risk and therefore provide a good instrument for the amount of capital received under TARP. We measure the concentration of deposits in each bank by constructing a Harfindahl-Hirschman Index for bank deposits (deposit HHI). The deposit HHI is calculated as the squared sum of each bank's total deposits as a percent of the banking sector's total aggregate deposits:

$$\mathrm{HHI_t} = \sum \left((\text{total deposits}_{i,t} / \text{banking sector total deposits}_t) \times 100 \right)^2$$

where subscript i stands for bank i and t for time t. The higher the index, the more concentrated the market, with 10,000 being monopoly and 10,000/N being perfect competition (where N is the number of banks).

As a proxy for the second criteria, financial distress, we construct a measure of each banks' exposure to sub-prime loans by calculating the ratio of mortgage loans to total loans for each bank in our sample. There is some precedence for this in the case of Japan, where a similar bank recapitalization program was carried out in 1997 and 1998. Ueda (2000) and Hoshi (2001) perhaps first noted that for Japanese banks real

[12] So that they better correspond to the capital injection terms, the instruments reflecting systemic risk and financial distress are set to 0 if they fall under a certain threshold: 5 for the deposit HHI and 20% for the ratio of real estate loans to total loans.

estate sector lending in the 1980s best explained non-performing loan ratios in the late 1990s. Watanabe (2007) applied this in later work, using the share of real estate lending in the late 1980s as an instrumental variable for bank capital. Although the originate and distribute model used in the U.S. means that the ratio of mortgage loans to total loans on bank books may not accurately represent the bank's origination of mortgage loans, it does still accurately reflect the bank's exposure to the sub-prime market. To ensure exogeneity with the dependent variable error term, we take a 3-year lag.

As a proxy for political connectedness we construct an instrumental variable proposed by Duchin & Sosyura (2012) that indicates whether a bank is likely to have political connections to either of two key subcommittees of the House Financial Services Committee that played a key role in the TARP program: the Subcommittee on Financial Institutions or the Subcommittee on Capital Markets. We compare the location of the headquarter of each bank in our sample with the district represented by members of the these two powerful subcommittees in 2008 and 2009 and create a political connectedness variable that takes the value between 0 and 1 in each year, depending on whether or not that location is represented on both, one or neither of the two powerful subcommittees[13].

We also check the statistical properties of our chosen instruments. The ideal instrumental variables meet two conditions, (i) they are correlated with the endogenous variables of interest: in this case, the capital injection, and (ii) they are uncorrelated with the error term ϵ_{t+1}. A Lagrange-Multiplier test and F-statistics suggest that the first condition is met. The low p-values for the Lagrange-Multiplier test statistic reject the null hypothesis that the instrumental variables are jointly uncorrelated with the endogenous variables at the 5% level for all specifications. Corroborating this, F-statistics are large, well over ten. First stage coefficient estimates on the instruments were generally highly statistically significant, with p-values less than 0.05. Generally high p-values for Hansen's test statistic suggest that the second condition is also met. There is no significant evidence that the instrumental variables are correlated with the error term for most specifications: the

[13] For both years of the TARP capital injections, 2008 and 2009, these political connectedness dummy variables take a value of 0, 0.5 or 1. For example, if a bank in headquartered in an area represented by a member of the House Financial Services Committee who is serving on one of these key subcommittees in 2008, the dummy variable is assigned a value of 0.5 in 2008 for that bank. If a bank headquartered in an area represented by a member of the House Financial Services Committee who is serving on two of these key subcommittees in 2008, the dummy variable would take a value of 1 in 2008 for that bank.

null hypothesis that the instrumental variables are uncorrelated with the error term cannot be rejected at the 5% level in any specifications. F-statistics and Hansen's test of joint validity of the instrumental variables are reported below with the other empirical results, at the bottom of table 6.

6. Results

The results of the baseline empirical estimation of equation 12 using lending by commercial banks to various sectors of the economy are presented in Table 4. In Table 4, the main variable of interest, the capital injection into each bank, is represented as a percent of bank total assets. Another specification using a simple 0-1 dummy variable for receipt of a capital injection are reported in appendix table A1. We report both OLS including individual and time fixed effects and two-step difference GMM results.

Insert Table THE EFFCT OF TARP ON COMMERCIAL BANK LENDING *Here (#4)*

Columns 1 and 2, with total loan growth as the dependent variable, report the specification most consistent with the model of bank behavior presented above. The coefficient estimates on the interest rate spread and regulatory capital ratio are both positive, as our model would predict, and highly statistically significant. This indicates that institutions that earn a higher spread on the rate charged for loans relative to that paid for deposits, and institutions with a relatively high capital ratio in the previous period tend to have higher loan growth. Lagged loan growth is also highly statistically significant, as the model of adjustment costs would predict. The coefficient estimate of can be interpreted as a speed of adjustment. The coefficient estimate on the main variable of interest, the TARP capital injection, is negative in both 2008 and 2009, but statistically significant only in 2009 for the two-step GMM specification, our preferred sepcification. The parameter estimate is also quantitatively significant suggesting that a 1% increase in the amount of capital injected (as a ratio to the institutions' assets) resulted in more than a 3% *decrease* in loan growth in the following year. This finding suggests that institutions that received a capital injection were under pressure to boost regulatory capital ratios and to meet that objective were forced to readjust their asset portfolios away from higher-risk assets such as loans.

Columns 3-10 illustrate that the cut in loan growth was not distributed equally across all sectors of the economy. For example, "C&I" business lending (columns 5-6), declines sharply under both rounds of TARP, while loans to individuals were not statistically significantly impacted.

Insert Table THE EFFECT OF TARP ON BANK HOLDING COMPANY ASSETS BY RISK WEIGHT Here (#5)

Table 5 reports the results of a similar specification – OLS including individual and time fixed effects and two-step difference GMM – using the bank holding company data, which allows us to explore the impact of the capital injections on holding company assets in different risk-weight categories.

In our preferred GMM specification, the spread on assets is generally insignificantly different from zero, suggesting that – unlike in the case of loan growth – there is not a strong relationship between the spread earned on assets over liabilities and the holding of assets in various risk-categories. Lagged regulatory capital ratios are again positive and highly statistically significant, but only for the riskiest asset class (columns 9-10). This suggests that banks with higher regulatory ratios tend to grow 100% risk-weighted assets faster. Consistent with regulatory incentives, coefficient estimates on lagged regulatory capital for the 0% risk-weight assets in columns 3-4 show the *opposite* relationship: risk-free assets tend to grow faster at banks with *lower* regulatory capital ratios.

Turning to the variable of interest, the capital injection as a percent of total assets in 2008 and 2009, we find strong evidence that TARP recipients responded to regulatory incentives: banks receiving TARP capital injections cut back sharply on heavily risk-weighted assets (appendix table A2, columns 9-10) and that reduction was sharper the more capital they received as a percent of total bank assets (table 5, columns 9-10). This brought down total asset growth (columns 1-2), despite that fact that TARP recipients saw no statistically significant change, or perhaps even increased, their "riskless", 0% risk-weighted assets (columns 3-4).

Insert Table INSTRUMENTAL VARIABLE REGRESSION Here (#6)

As discussed above, an exogeneity test cannot rule out endogeneity of the capital injections with commercial bank loan growth at the 95% confidence interval so in table 6 we report the results of two-stage least squares estimation with instrumental variables for the commercial bank lending.

Instrumenting for receipt of the TARP capital injections, we still see a statistically and economically significant decline in aggregate loan growth for those banks that received a capital injection with the second-round capital injections in 2009 (column 1 of appendix table 3). Column 1 of table 6 shows that loan growth was slower the more capital was injected into the recipient banks as a percent of total bank assets. Columns 2-5 suggest the cut-backs in loans were not distributed equally across the various sectors of the economy. For example, a statistically significant reduction in C&I business lending and agricultural lending by recipient banks is evident under both rounds of TARP, although the decline is much larger under TARP 2 in 2009.

6. Conclusions

What were the economic consequences of the TARP? Using an empirical specification based on a rational expectations model of representative bank behavior, we estimate the impact of capital injections carried out under the TARP on bank portfolios. Our findings demonstrate that, contrary to the stated objectives of the program, TARP did not stimulate bank lending. In fact, we find evidence of the opposite result: recipient banks shrunk their assets, in particular heavily risk-weighted assets such as loans. Banks receiving TARP funds show lower aggregate loan growth and reductions in lending to particular sectors: agriculture, real estate and, most sharply, commercial and industrial businesses. Financial institutions that received TARP funds show statistically and economically significantly lower loan growth than other banks and the reduction in loan growth is larger the larger the capital injection as a percent of bank assets. These findings are robust to a variety of empirical specifications, including two-step difference GMM and instrumental variables.

Although cuts in lending are evident on aggregate, not all loans were affected equally. Business C&I lending was the most affected, and agricultural lending and real estate lending saw sharp cuts as well. The impact of TARP also varied across TARP 1, the Capital Purchase Program (CPP) implemented under then-Secretary of the Treasury Hank Paulson in 2008, and TARP 2, the Capital Assistance Program (CAP) implemented by incoming Secretary of the Treasury Tim Geithner in 2009. Although there is no evidence that either program stimulated lending, we find the strongest evidence of slowed loan growth by recipient banks after TARP 2.

Note that these findings do not mean that TARP was a failure. First, this study looks at just one of TARP's objectives: to boost lending and prevent a potential credit crunch. Pundits have pointed out that in comparison to banking crises in other countries, the U.S. authorities reacted with remarkable speed (Shimizutani & Montgomery, 2008; Takenaka, 2008). This enabled U.S. banks to get bad loans off their books and achieved what was arguably the most critical objective, preventing bank runs. Secondly, as we noted at the outset, although policy makers often declare loan growth as a policy objective for bank recapitalization programs, whether loan growth actually *should* be a policy objective is open for debate. Certainly, it makes sense to try to limit the economic damage from a capital crunch, where even good borrowers cannot access loan financing. But research on Japan, the only other developed country with a large presence in the global banking industry to have experienced a banking crisis in the post-Bretton Woods era, has shown that capital injections carried out there may have stimulated lending to unhealthy "zombie" firms, (Peek & Rosengren, 2005; Watanabe, 2010), in which case the documented increase in bank lending in response to the capital injections in Japan (Montgomery & Shimizutani, 2009; Watanabe, 2007) may not be cause to celebrate. Thinking about how those findings may relate to the case of the U.S., if the cut in bank lending by recipient banks after the TARP 2 capital injection indicates restructuring of bank balance sheets towards higher-quality borrowers, then perhaps the "failure" of the banks to realize policy makers stated objectives are not as disappointing as they appear at first pass.

Thus, this study contributes on piece to the puzzle. We can see that U.S. banks are not falling into the trap seen in Japan where banks that received capital injections continued to evergreen loans to low-growth industries and kept "zombie firms" alive. But we still cannot rule out regulatory arbitrage. We can see that riskiest asset class, and in particular lending, is shrinking, but not what kind of borrowers are being cut off. Unfortunately, the evidence emerging at this time from current research by Black and Hazelwood (2012) and Duchin and Sosyura (2010) suggests that bank portfolios are shifting toward riskier borrowers. Combined with the evidence presented here, the picture that is emerging is of a banking industry that shrunk in order to shore up capital ratios and respond to stricter regulation, but maintained profit margins by extending the loans they did make to riskier borrowers.

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Tables & Figures

Table 1: Summary Statistics for Commercial Banks (2001-2010, Annual Data)

	Observations	Mean	Standard Deviation	Min	Max
Dependent Variables					
Total loans, Δlog, %	69,753	8.05	16.08	-93	100
Real estate loans, Δlog, %	69,600	10.10	20.40	-641	447
C&I loans, Δlog, %	69,338	5.55	34.21	-466	592
Agricultural loans, Δlog, %	50,426	0.83	55.67	-625	770
Loans to individuals, Δlog, %	69,364	-1.47	33.99	-585	875
Independent Variables					
Interest rate spread, %	69,753	4.90	1.16	-5	12
Regulatory capital ratio, log	69,753	2.71	0.32	-5	4
Regulatory capital ratio, %	69,753	15.79	5.62	0.01	40
TARP 2008 / risk-weighted assets, log, weighted	69,753	0.01	0.09	0	2
TARP 2009 / risk-weighted assets, log, weighted	69,753	0.01	0.12	0	2
Instrumental Variables					
Deposits HHI, log (see notes below for more detail)	69,753	0.00	0.05	0	5
Real estate loans / total loans, log (see notes below for more detail)	69,753	0.75	1.61	0	5
Interaction the above two instruments	69,753	0.00	0.19	0	20

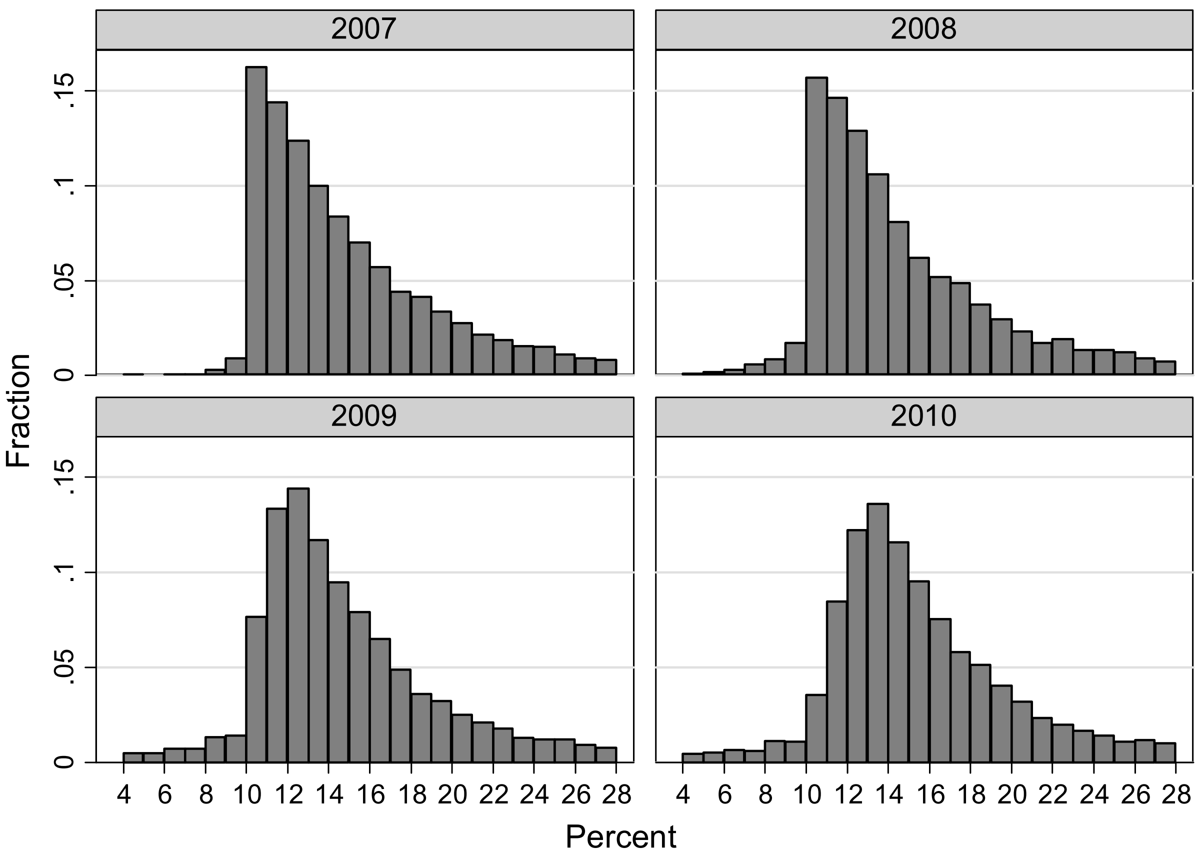
69,753 bank-year observations with 9,337 banks.
Weight is applied to the capital injection terms to reflect the importance of the bank to its parent holding company: commercial bank assets / parent holding company assets. Weight is not applied when the capital injection is received directly by commercial bank.
We apply weight to the TARP terms to reflect the importance of the bank to its parent holding company. The weight is defined as commercial bank assets / parent holding company assets. We do not apply weight when the capital directly went to commercial bank.
Deposits HHI (in log) is set to 0 for years other than 2008 and 2009 and when it falls below 5 threshold so that they better correspond to the TARP terms.
Real estate loans / total loans (in log) is set to 0 for years other than 2008 and 2009 and when it falls below 20% threshold (before taking log) so that they better correspond to the TARP terms.

Table 2: Summary of the TARP Capital Injections
Amount of capital received as a percent of risk-weighted assets in log (see note)

The first round in 2008 (TARP 1)				The second round in 2009 (TARP 2)			
Number of Recipients	Mean	Min	Max	Number of Recipients	Mean	Min	Max
292	1.34%	0.66% ($1.5 million)	1.82% ($25 billion)	517	1.34%	0.46% ($0.3 million)	1.90% ($10 billion)

Note: In cases in which the capital injection went to a bank holding company rather than directly to a commercial bank, figures are weighted to reflect the importance of the bank to its parent holding company (commercial bank assets / parent holding company assets).
Dollar amount received in parentheses.

Figure 1: Regulatory Capital Ratios of Commercial Banks, 2007-2010



Note: 5% tails have been trimmed.

Table 3: Summary Statistics for Bank Holding Companies (2005-2010, Annual Data)

	Observations	Mean	Standard Deviation	Min	Max
Dependent Variables					
Total assets, Δlog, %	5,333	7.23	12.45	-84	96
Assets with 0% risk weight, Δlog, %	5,325	26.83	76.05	-493	692
Assets with 20% risk weight, Δlog, %	5,327	2.45	36.05	-360	242
Assets with 50% risk weight, Δlog, %	5,312	5.53	29.63	-445	431
Assets with 100% risk weight, Δlog, %	5,331	7.48	14.72	-66	238
Independent Variables					
Return on assets minus expenses on liabilities, %	5,333	0.83	1.13	-17	12
Regulatory capital ratio, log	5,333	2.56	0.30	-3	4
TARP 2008 / risk-weighted assets, log	5,333	0.03	0.21	0	1
TARP 2009 / risk-weighted assets, log	5,333	0.04	0.22	0	2

5,333 bank-year observations with 1,081 banks.

Table 4: The Effect of TARP on Commercial Bank Lending

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Specification	OLS with Individual Fixed Effects	Two-Step Difference GMM	OLS with Individual Fixed Effects	Two-Step Difference GMM	OLS with Individual Fixed Effects	Two-Step Difference GMM	OLS with Individual Fixed Effects	Two-Step Difference GMM	OLS with Individual Fixed Effects	Two-Step Difference GMM
Dependent Variable	Total, Δlog t+1	Total, Δlog t+1	Real estate, Δlog t+1	Real estate, Δlog t+1	C&I, Δlog t+1	C&I, Δlog t+1	Agricultural, Δlog t+1	Agricultural, Δlog t+1	Individual, Δlog t+1	Individual, Δlog t+1
TARP 2008 / risk weighted assets, log t, weighted	**-5.12*** [0.746]**	**-2.21 [1.352]**	**-4.52*** [0.912]**	**-0.62 [1.322]**	**-7.13*** [1.303]**	**-4.50*** [1.234]**	**-3.03 [4.560]**	**3.23 [6.382]**	**2.05 [2.863]**	**7.50* [4.001]**
TARP 2009 / risk weighted assets, log t, weighted	**-5.01*** [0.470]**	**-3.05*** [0.867]**	**-6.10*** [0.559]**	**-3.20*** [0.828]**	**-6.69*** [1.051]**	**-5.39*** [1.259]**	**-7.36** [2.915]**	**-10.30** [5.023]**	**-3.95** [1.788]**	**0.23 [2.443]**
Loan deposit interest rate spread, t	1.05*** [0.162]	13.44*** [0.667]	-0.46** [0.231]	10.95*** [0.834]	-1.96*** [0.322]	-1.36 [2.128]	-3.05*** [0.544]	3.24*** [1.134]	-2.50*** [0.330]	2.77** [1.224]
Regulatory capital ratio, log t	20.44*** [0.655]	41.09*** [1.832]	20.07*** [0.813]	37.20*** [1.884]	24.90*** [1.433]	30.74*** [2.701]	12.29*** [2.484]	29.60*** [5.464]	18.02*** [1.519]	21.73*** [3.261]
Dependent variable, Δlog t	0.23*** [0.008]	0.93*** [0.045]	0.09*** [0.012]	0.69*** [0.058]	-0.13*** [0.008]	-0.49*** [0.172]	-0.23*** [0.011]	0.15 [0.110]	-0.11*** [0.012]	0.28 [0.173]
Constant	-60.88*** [1.763]		-51.75*** [2.210]		-61.11*** [3.860]		-19.83*** [6.459]		-42.58*** [3.923]	
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	60,125	51,535	60,016	51,451	59,874	51,321	43,479	37,191	59,802	51,265
Number of banks	8,423	7,965	8,402	7,949	8,386	7,935	6,080	5,727	8,368	7,913
Number of years	9	8	9	8	9	8	9	8	9	8
R-squared	0.18		0.10		0.05		0.06		0.03	
Arellano-Bond test for no 3rd order autocorrelation in differenced error terms (p-value)		0.09		0.19		0.93		0.83		0.18
Hansen test for exogeneity of instruments (p-value)		0		0		0.55		0.67		0.10

Notes: Standard errors for OLS are clustered at individual bank level so that they are robust to within-group autocorrelation of error terms. Standard errors for GMM are Windmeijer bias-corrected so that they are robust to the bias of two-step GMM. They are reported in brackets below each coefficient estimate. *, **, ***, indicate statistical significance at the 10, 5 and 1 percent level respectively.

We apply weight to the TARP terms to reflect the importance of the bank to its parent holding company. The weight is defined as commercial bank assets / parent holding company assets. We do not apply weight when the capital directly went to commercial bank.

In all specifications of GMM in this table, minimum lag of dependent variables used as instruments is 3 as our dependent variables are in log change form. Number of instruments is 40.

One period is lost for OLS results because they include lagged variables.

Two periods are lost for difference GMM results because they include lagged variables and are first-differenced. Constants are also differenced out for GMM results.

Table 5: The Effect of TARP on Bank Holding Company Assets

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Specification	OLS with Individual Fixed Effects	Two-Step Difference GMM	OLS with Individual Fixed Effects	Two-Step Difference GMM	OLS with Individual Fixed Effects	Two-Step Difference GMM	OLS with Individual Fixed Effects	Two-Step Difference GMM	OLS with Individual Fixed Effects	Two-Step Difference GMM
Dependent Variable	Total, Δlog t+1	Total, Δlog t+1	0% risk weight, Δlog t+1	0% risk weight, Δlog t+1	20% risk weight, Δlog t+1	20% risk weight, Δlog t+1	50% risk weight, Δlog t+1	50% risk weight, Δlog t+1	100% risk weight, Δlog t+1	100% risk weight, Δlog t+1
TARP 2008 / risk	**-2.92*****	**-5.26*****	**5.93**	**-3.89**	**2.26**	**0.02**	**-3.20**	**-0.98**	**-4.46*****	**-6.92*****
weighted assets, log t	**[1.021]**	**[1.708]**	**[6.690]**	**[13.436]**	**[3.949]**	**[3.619]**	**[2.564]**	**[3.744]**	**[0.798]**	**[1.471]**
TARP 2009 / risk	**-4.27*****	**-7.51*****	**10.46***	**-1.28**	**-4.69**	**-11.08*****	**-1.75**	**-3.06**	**-5.38*****	**-6.74*****
weighted assets, log t	**[0.940]**	**[1.511]**	**[5.897]**	**[11.565]**	**[3.140]**	**[3.862]**	**[1.899]**	**[3.011]**	**[0.845]**	**[1.149]**
Return on assets	1.70***	-1.53***	-2.46	0.09	3.76*	0.11	2.15***	1.14	1.66***	-0.35
minus expenses on liabilities, t	[0.454]	[0.534]	[1.667]	[3.273]	[1.973]	[1.803]	[0.617]	[0.838]	[0.441]	[0.440]
Regulatory capital	13.36***	31.18***	-27.53**	-46.04**	21.75***	9.06	11.20**	8.73	20.02***	47.91***
ratio, log t	[1.746]	[5.459]	[12.825]	[18.978]	[6.991]	[8.376]	[4.566]	[6.419]	[2.171]	[6.541]
Dependent variable,	-0.03	0.73***	-0.35***	-0.04	-0.29***	-0.38**	-0.22***	-0.42	0.04	0.63***
Δlog t	[0.024]	[0.152]	[0.020]	[0.402]	[0.035]	[0.187]	[0.034]	[0.338]	[0.026]	[0.111]
Constant	-25.56***		70.76**		-51.26***		-20.18*		-40.87***	
	[4.433]		[32.838]		[17.597]		[11.801]		[5.591]	
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,150	3,141	4,142	3,133	4,144	3,135	4,130	3,122	4,148	3,139
Number of BHCs	1,004	894	1,004	893	1,004	893	1,003	891	1,004	894
Number of years	5	4	5	4	5	4	5	4	5	4
R-squared	0.17		0.28		0.09		0.09		0.36	
Exogeneity test for TARP (p-value)	0.70		0.72		0.78		0.38		0.88	
Arellano-Bond test for no 3rd order autocorrelation in differenced error terms (p-value)		0.33		0.61		0.23		0.27		0.91
Hansen test for exogeneity of instruments (p-value)		0.04		0.83		0.09		0.16		0.19

Notes: Standard errors for OLS are clustered at individual bank level so that they are robust to within-group autocorrelation of error terms. Standard errors for GMM are Windmeijer bias-corrected so that they are robust to the bias of two-step GMM. They are reported in brackets below each coefficient estimate. *, **, ***, indicate statistical significance at the 10, 5 and 1 percent level respectively.

In all specifications of GMM in this table, minimum lag of dependent variables used as instruments is 3 as our dependent variables are in log change form. Number of instruments is 14.

One period is lost for OLS results because they include lagged variables.

Two periods are lost for difference GMM results because they include lagged variables and are first-differenced. Constants are also differenced out for GMM results.

Table 6: The Effect of TARP on Commercial Bank Lending – 2SLS-IV with Individual Fixed Effects

	(1)	(2)	(3)	(4)	(5)
Dependent Variable	Total, Δlog t+1	Real estate, Δlog t+1	C&I, Δlog t+1	Agricultural, Δlog t+1	Individual, Δlog t+1
TARP 2008 / risk weighted assets, log t, weighted	**-1.22**	**-2.36**	**-2.50****	**-2.50*****	**-0.37**
	[1.265]	**[1.923]**	**[1.211]**	**[0.961]**	**[1.696]**
TARP 2009 / risk weighted assets, log t, weighted	**-8.47*****	**-11.71*****	**-7.05*****	**-11.44*****	**-7.58*****
	[1.307]	**[1.922]**	**[1.996]**	**[4.190]**	**[2.629]**
Loan deposit interest rate spread, t	0.58***	-0.98***	-2.14***	-3.31***	-2.65***
	[0.197]	[0.263]	[0.329]	[0.555]	[0.340]
Regulatory capital ratio, log t	23.56***	24.76***	27.83***	16.25***	21.08***
	[0.937]	[1.247]	[1.672]	[2.903]	[1.914]
Dependent variable, Δlog t	0.19***	0.06***	-0.13***	-0.23***	-0.12***
	[0.010]	[0.013]	[0.008]	[0.011]	[0.012]
Year dummies	Yes	Yes	Yes	Yes	Yes
Observations	59,670	59,566	59,426	43,138	59,351
Number of banks	7,968	7,952	7,938	5,739	7,917
Number of years	9	9	9	9	9
F-statistic for excluded instruments	25.25	26.02	37.44	13.38	34.19
Hansen test for exogeneity of instruments (p-value)	0.79	0.92	0.50	0.79	0.03
Exogeneity test for instrumented variables (p-value)	0	0	0.00	0.00	0.00

Instrumented variables in IV-2SLS: TARP 2008 / risk weighted assets, log t, weighted & TARP 2009 / risk weighted assets, log t, weighted

Excluded instruments in IV-2SLS: systemic risk, financial distress, their interaction term & a political connectedness variable (see notes below and text for more detail)

Notes: Standard errors are clustered at individual bank level so that they are robust to within-group autocorrelation of error terms. They are reported in brackets below each coefficient estimate. *, **, ***, indicate statistical significance at the 10, 5 and 1 percent level respectively.

We apply weight to the TARP terms to reflect the importance of the bank to its parent holding company. The weight is defined as commercial bank assets / parent holding company assets. We do not apply weight when the capital directly went to commercial bank.

TARP terms are rescaled by multiplying 10 so that their coefficient estimates are close in scale to other specifications.

Systemic Risk instrument is a Deposits HHI (in log) above a 5% threshold for 2008 and 2009

Financial Distress instrument is the ratio of Real estate loans / total loans (in log, t-3) above a 20% threshold in 2008 and 2009

Political Connectedness instrument takes a value between 0 and 1 in 2008 and 2009 to indicate potential political connections on two powerful House subcommittees. (see text)

One period is lost because the specifications include lagged variables.

Appendix Tables

Appendix Table A1: The Effect of TARP (0-1 Dummy) on Commercial Bank Lending

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Specification	OLS with Individual Fixed Effects	Two-Step Difference GMM	OLS with Individual Fixed Effects	Two-Step Difference GMM	OLS with Individual Fixed Effects	Two-Step Difference GMM	OLS with Individual Fixed Effects	Two-Step Difference GMM	OLS with Individual Fixed Effects	Two-Step Difference GMM
Dependent Variable	Total, Δlog t+1	Total, Δlog t+1	Real estate, Δlog t+1	Real estate, Δlog t+1	C&I, Δlog t+1	C&I, Δlog t+1	Agricultural, Δlog t+1	Agricultural, Δlog t+1	Individual, Δlog t+1	Individual, Δlog t+1
TARP 2008 Dummy	**-7.01*****	**-3.68****	**-5.92*****	**-1.13**	**-9.61*****	**-5.95*****	**-3.98**	**4.12**	**2.60**	**9.93***
(=1 if received) (t)	**[1.023]**	**[1.867]**	**[1.365]**	**[1.916]**	**[1.750]**	**[1.664]**	**[6.038]**	**[8.284]**	**[3.876]**	**[5.382]**
TARP 2008 Dummy	**-6.98*****	**-4.84*****	**-8.50*****	**-5.17*****	**-8.99*****	**-7.53*****	**-8.71****	**-13.35****	**-5.47****	**0.21**
(=1 if received) (t)	**[0.631]**	**[1.167]**	**[0.764]**	**[1.177]**	**[1.401]**	**[1.683]**	**[3.984]**	**[6.744]**	**[2.318]**	**[3.251]**
Loan deposit interest	1.05***	13.39***	-0.47**	10.91***	-1.96***	-1.39	-3.05***	3.24***	-2.51***	2.78**
rate spread, t	[0.162]	[0.666]	[0.231]	[0.833]	[0.322]	[2.132]	[0.544]	[1.134]	[0.330]	[1.225]
Regulatory capital	20.46***	41.12***	20.09***	37.22***	24.91***	30.72***	12.27***	29.60***	18.03***	21.75***
ratio, log t	[0.655]	[1.831]	[0.813]	[1.882]	[1.433]	[2.705]	[2.485]	[5.470]	[1.519]	[3.261]
Dependent variable,	0.23***	0.93***	0.09***	0.69***	-0.13***	-0.49***	-0.23***	0.15	-0.11***	0.28
Δlog t	[0.008]	[0.045]	[0.012]	[0.058]	[0.008]	[0.172]	[0.011]	[0.110]	[0.012]	[0.173]
Constant	-60.89***		-51.74***		-61.11***		-19.76***		-42.60***	
	[1.762]		[2.210]		[3.860]		[6.460]		[3.924]	
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	60,125	51,535	60,016	51,451	59,874	51,321	43,479	37,191	59,802	51,265
Number of banks	8,423	7,965	8,402	7,949	8,386	7,935	6,080	5,727	8,368	7,913
Number of years	9	8	9	8	9	8	9	8	9	8
R-squared	0.18		0.10		0.05		0.06		0.03	
Arellano-Bond test for no 3rd order autocorrelation in differenced error terms (p-value)		0.09		0.19		0.93		0.83		0.18
Hansen test for exogeneity of instruments (p-value)		0		0		0.55		0.67		0.10

Notes: Standard errors for OLS are clustered at individual bank level so that they are robust to within-group autocorrelation of error terms. Standard errors for GMM are Windmeijer bias-corrected so that they are robust to the bias of two-step GMM. They are reported in brackets below each coefficient estimate. *, **, ***, indicate statistical significance at the 10, 5 and 1 percent level respectively.
We apply weight to the TARP terms to reflect the importance of the bank to its parent holding company. The weight is defined as commercial bank assets / parent holding company assets. We do not apply weight when the capital directly went to commercial bank.
In all specifications of GMM in this table, minimum lag of dependent variables used as instruments is 3 as our dependent variables are in log change form. Number of instruments is 40.
One period is lost for OLS results because they include lagged variables.
Two periods are lost for difference GMM results because they include lagged variables and are first-differenced. Constants are also differenced out for GMM results.

Appendix Table A2: The Effect of TARP (0-1 Dummy) on Bank Holding Company Assets

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Specification	OLS with Individual Fixed Effects	Two-Step Difference GMM	OLS with Individual Fixed Effects	Two-Step Difference GMM	OLS with Individual Fixed Effects	Two-Step Difference GMM	OLS with Individual Fixed Effects	Two-Step Difference GMM	OLS with Individual Fixed Effects	Two-Step Difference GMM
Dependent Variable	Total, Δlog t+1	Total, Δlog t+1	0% risk weight, Δlog t+1	0% risk weight, Δlog t+1	20% risk weight, Δlog t+1	20% risk weight, Δlog t+1	50% risk weight, Δlog t+1	50% risk weight, Δlog t+1	100% risk weight, Δlog t+1	100% risk weight, Δlog t+1
TARP 2008 Dummy	**-3.75*****	**-7.25*****	**7.31**	**-5.72**	**3.39**	**0.19**	**-4.73**	**-1.62**	**-5.71*****	**-9.35*****
(=1 if received) (t)	**[1.348]**	**[2.311]**	**[8.794]**	**[17.550]**	**[5.085]**	**[4.674]**	**[3.443]**	**[4.745]**	**[1.091]**	**[2.016]**
TARP 2008 Dummy	**-5.10*****	**-9.76*****	**14.70***	**0.95**	**-4.95**	**-14.03*****	**-1.96**	**-4.16**	**-6.42*****	**-8.94*****
(=1 if received) (t)	**[1.127]**	**[2.058]**	**[7.824]**	**[15.595]**	**[3.953]**	**[4.993]**	**[2.354]**	**[3.608]**	**[1.117]**	**[1.543]**
Return on assets	1.72***	-1.52***	-2.50	0.12	3.80*	0.15	2.16***	1.15	1.70***	-0.33
minus expenses on liabilities, t	[0.457]	[0.535]	[1.661]	[3.276]	[1.973]	[1.808]	[0.617]	[0.845]	[0.444]	[0.439]
Regulatory capital	13.20***	31.19***	-27.53**	-46.49**	21.38***	8.80	11.25**	8.87	19.81***	48.01***
ratio, log t	[1.740]	[5.459]	[12.797]	[18.951]	[6.962]	[8.324]	[4.540]	[6.516]	[2.165]	[6.564]
Dependent variable,	-0.03	0.73***	-0.35***	-0.04	-0.29***	-0.38**	-0.22***	-0.43	0.04	0.63***
Δlog t	[0.024]	[0.152]	[0.020]	[0.401]	[0.035]	[0.188]	[0.034]	[0.338]	[0.026]	[0.111]
Constant	-25.18***		70.80**		-50.35***		-20.31*		-40.40***	
	[4.418]		[32.773]		[17.533]		[11.726]		[5.576]	
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,150	3,141	4,142	3,133	4,144	3,135	4,130	3,122	4,148	3,139
Number of BHCs	1,004	894	1,004	893	1,004	893	1,003	891	1,004	894
Number of years	5	4	5	4	5	4	5	4	5	4
R-squared	0.17		0.28		0.09		0.09		0.36	
Exogeneity test for TARP (p-value)	0.70		0.72		0.78		0.38		0.88	
Arellano-Bond test for no 3^{rd} order autocorrelation in differenced error terms (p-value)		0.34		0.62		0.23		0.27		0.90
Hansen test for exogeneity of instruments (p-value)		0.03		0.84		0.09		0.16		0.17

Notes: Standard errors for OLS are clustered at individual bank level so that they are robust to within-group autocorrelation of error terms. Standard errors for GMM are Windmeijer bias-corrected so that they are robust to the bias of two-step GMM. They are reported in brackets below each coefficient estimate. *, **, ***, indicate statistical significance at the 10, 5 and 1 percent level respectively.

In all specifications of GMM in this table, minimum lag of dependent variables used as instruments is 3 as our dependent variables are in log change form. Number of instruments is 14.

One period is lost for OLS results because they include lagged variables.

Two periods are lost for difference GMM results because they include lagged variables and are first-differenced. Constants are also differenced out for GMM results.

Appendix Table A3: The Effect of TARP (0-1 Dummy) on Commercial Bank Lending – 2SLS-IV with Individual Fixed Effects

	(1)	(2)	(3)	(4)	(5)
Dependent Variable	Total, Δlog t+1	Real estate, Δlog t+1	C&I, Δlog t+1	Agricultural, Δlog t+1	Individual, Δlog t+1
TARP 2008 Dummy (=1 if received) (t)	**0.14**	**-0.48**	**-1.51**	**-0.72**	**0.47**
	[2.476]	**[3.709]**	**[2.266]**	**[2.887]**	**[2.844]**
TARP 2008 Dummy (=1 if received) (t)	**-12.13*** **	**-16.92*** **	**-10.40*** **	**-15.58*** **	**-11.18*** **
	[1.878]	**[2.763]**	**[2.874]**	**[5.601]**	**[3.800]**
Loan deposit interest rate spread, t	0.57***	-1.01***	-2.17***	-3.33***	-2.69***
	[0.203]	[0.271]	[0.332]	[0.556]	[0.344]
Regulatory capital ratio, log t	23.50***	24.68***	27.78***	15.94***	21.24***
	[1.016]	[1.352]	[1.706]	[2.906]	[1.952]
Dependent variable, Δlog t	0.19***	0.06***	-0.13***	-0.23***	-0.12***
	[0.011]	[0.013]	[0.008]	[0.011]	[0.012]
Year dummies	Yes	Yes	Yes	Yes	Yes
Observations	59,670	59,566	59,426	43,138	59,351
Number of banks	7,968	7,952	7,938	5,739	7,917
Number of years	9	9	9	9	9
F-statistic for excluded instruments	16.58	16.80	20.52	14.51	18.61
Hansen test for exogeneity of instruments (p-value)	0.62	0.67	0.45	0.54	0.04
Exogeneity test for instrumented variables (p-value)	0	0	0.00	0.02	0.00

Instrumented variables in IV-2SLS: TARP 2008 / risk weighted assets, log t, weighted & TARP 2009 / risk weighted assets, log t, weighted
Excluded instruments in IV-2SLS: systemic risk, financial distress, their interaction term and political connectedness. (see notes below & description in text for more detail)

Notes: Standard errors are clustered at individual bank level so that they are robust to within-group autocorrelation of error terms. They are reported in brackets below each coefficient estimate. *, **, ***, indicate statistical significance at the 10, 5 and 1 percent level respectively.
We apply weight to the TARP terms to reflect the importance of the bank to its parent holding company. The weight is defined as commercial bank assets / parent holding company assets. We do not apply weight when the capital directly went to commercial bank.
TARP terms are rescaled by multiplying 10 so that their coefficient estimates are close in scale to other specifications.
Systemic Risk instrument is a Deposits HHI (in log) above a 5% threshold for 2008 and 2009
Financial Distress instrument is the ratio of Real estate loans / total loans (in log, t-3) above a 20% threshold in 2008 and 2009
Political Connectedness instrument takes a value between 0 and 1 in 2008 and 2009 to indicate potential political connections on two powerful House subcommittees. (see text)
One period is lost because the specifications include lagged variables.