The Economic Consequences of the TARP

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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 and, particularly, preventing foreclosures. On the contrary, we find evidence that recipient banks shrunk their assets, particularly heavily risk-weighted assets such as loans. This affected loan growth in aggregate as well as to specific sectors: agriculture, real estate, and, most significantly, business loans. The cuts in lending were more significant under TARP 2, the second round of the program. This finding is robust to various empirical specifications, including two-stage least squares estimation using instrumental variables. The empirical results suggest that TARP recipients cut back on lending more than other banks and that the cuts in lending were larger the more capital the banks received.

Keywords: bank, crisis, recapitalization, capital injection, TARP

JEL Codes: G21, G28, G01

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1. Introduction

The centerpiece of the United States' Emergency Economic Stabilization Act (EESA), signed into law by President Bush on October 3, 2008 in response to the economic meltdown that threatened the global economy in the Fall of 2008, was the "700 billion dollar bailout" also known as the Troubled Assets Relief Program (TARP) [1]. 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 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[2]. The overarching goal of the program 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

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[1] 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.

[2] Treasury also received "warrants to purchase common stock with an aggregate market price equal to 15 percent of the senior preferred investment" (U.S. Department of the Treasury, 2008a). Bayazitova & Shivdasani (2012) provide details on implementation of TARP, the CPP and the CAP.

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, 2008b).

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. This has been praised by some economists 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), where there is evidence that bank recapitalization was successful in achieving policy objectives such as stimulating loan growth (Allen, Chakraborty, & Watanabe, 2011; Ito & Harada, 2005; Montgomery & Shimizutani, 2009; Watanabe, 2007), bank restructuring (Onji, Vera, & Corbett, 2011) and firm investment (Kasahara, Sawada, & Suzuki, 2011), but also that much of the increased lending went to unhealthy "zombie firms" (Peek & Rosengren, 2005; Watanabe, 2010). Policymakers, however, have bemoaned the lack of clear targets for recipients of TARP funds. The Congressional Oversight Panel for Economic Stabilization, for example, 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).

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, 2008c), a sharp drop in aggregate bank lending has been clearly documented (Cornett, McNutt, Strahan, & Tehranian, 2011; Ivashina & Scharfstein, 2010).

In this study, we contribute to the body of research on the effects of TARP on bank behavior, investigating the impact of the program on bank lending and other assets. We explore 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 – in aggregate and to specific sectors – and on growth of various asset risk-weight classes. The results are surprising but consistent with the picture that is emerging from related studies (Black & Hazelwood, 2012; Duchin & Sosyura, 2010)[3]. We find 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.

This article is organized as follows. The next section 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 three and four then turn to an empirical evaluation of the effectiveness of the bank recapitalizations: section three discusses our data, while section four details the empirical methodology and results. In section five, we conclude with a discussion of our findings and how they fit in with the existing and emerging literature.

2. 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.

[3] Both Duchin and Sosyura (2010) and Black and Hazelwood (2012), discussed further in the conclusions, have a slightly different focus on bank risk taking. Consistent with our findings, however, they report no increase in lending among TARP recipient institutions.

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[4]:

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

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:

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

[4] 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:

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

If we let

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

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

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

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

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

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

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

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.

3. 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[5].

After eliminating some extreme data outliers that appear to be data entry errors and banks filing Call Reports that are not in the U.S., we have a sample of 9,337 publicly traded commercial banks over the 10 year period of 2001-2010, or 69,753 observations for analysis.

Table 2 reports the summary statistics of those 69,753 observations used in our analysis. 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.

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

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[6], the interest rate spread between loans made by the bank and deposits taken in by the bank is

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

[6] 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.

approximated by the difference in the ratio of interest income to total loans and interest expenses to total deposits[7]. 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[8]. 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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[7] 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.

[8] 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[9]. 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.

4. Empirical Methodology and Results

4.1. *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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[9] 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 : $\mathrm{E}[\varepsilon_{i,t+1}|I_t] = 0$. 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.

As stated above, in addition to encouraging bank lending on aggregate, one of the stated objectives of the TARP was to "avoid foreclosures". To investigate the effects of the program on mortgages and lending to other specific sectors of the economy that are reported in the call reports, we apply our preferred specification, OLS with individual fixed effects, time dummies and clustered standard errors, to growth in sectoral lending, including mortgages. 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.

The results of this baseline empirical estimation of equation 12 using lending to various sectors of the economy, are presented in Tables 4A and 4B. In table 4A, the main variable of interest, the capital injection into each bank, is represented simply by a 0-1 dummy variable, while in table 4B the actual amount of capital injected as a percent of bank total assets is included. Each column reports our preferred specification, which 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.

Insert Table THE EFFCT OF TARP ON COMMERCIAL BANK LENDING *Here (4A, 4B)*

Column 1, with total loan growth as the dependent variable, is 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 0.23 can be interpreted as a speed of adjustment. The coefficient estimate on the main variable of interest, the TARP capital injection, is negative and highly statistically significant in both 2008 and 2009. The parameter estimate is also quantitatively significant. In table 4A we see that banks that received TARP funds tended to grow loans about 7% slower than other banks. In table 4B, the coefficient estimate on the lagged capital injection amount as a percent of the banks' assets suggests that a 1% increase in the amount of capital injected (as a ratio to the institutions' assets) resulted in more than a 5% *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 2-5 illustrate that the cut in loan growth was not distributed equally across all sectors of the economy. The cuts in loan growth appear to have been the sharpest in mortgages (column 2) and business lending (column 3). Agricultural loans and loans to individuals, while they did not grow, were not cut back under TARP 1 and the contraction under TARP 2 is not as statistically or economically significant as it is for real estate lending or C&I loans.

4.2. *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):

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

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.

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

Tables 5A and 5B report the results. Looking at column 1, which has growth in total assets as the left-hand side dependent variable, we see again that this spread on assets is positive and highly statistically significant, as expected, for total asset growth (column 1) and the heavier-weighted asset classes (50% risk-weighted assets, column 4, and 100% risk-weighted assets, column 5). This suggests that, with the exception of the 0% risk-weight category, in column 2, which is not significantly influenced by the spread at all, institutions that earned a higher spread on assets over liabilities tend to have higher asset growth in the following period. Lagged regulatory capital ratios are also generally positive and highly statistically significant, suggesting that banks with higher regulatory ratios tend to grow assets faster. The exception again, though, is the 0% risk-weight assets in column 2, which 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 some interesting differences across different asset classes. As was the case with total loans, total asset growth was statistically significantly *lower* for those banks that received a capital injection (column 1 of table 5A), and the fall in asset growth was sharper the larger the capital injection as a percent of bank total assets (column 1 of table 5B). There is also clear evidence of a response to regulatory incentives: the drop in asset growth is even larger if we restrict our analysis to assets that are 100% risk-weighted (column 5), while 0% risk-weight assets seem unaffected or possibly grew slightly faster in 2009 for those banks that received a capital injection (column 2).

4.3. *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. Below we report the results of 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 6 and 7 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[10] 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.

Insert Table TWO-STEP DIFFERENCE GMM Here (#6A, 6B and #7A, 7B)

Two-step difference GMM estimation results are reported for lending in tables 6A and 6B, and for risk-weighted asset classes in tables 7A and 7B.Looking first at tables 6A and 6B, which report the results of using two-step difference GMM estimation for the loan growth equations, we still observe a drop in loan growth for those banks that received a capital injection (table 6A), and the decline in lending is again larger the more capital the banks received as a percentage of bank assets (table 6B). The reduction in lending is slightly less than under the previous OLS specification, but still economically significant. Banks that received TARP funds grew loans about 4-5% slower than other banks (table 6A, column 1) and for each percent of capital injected as a percent of bank total assets, total loan growth was lower by 2-5% (table 6B, column 1). Reductions in C&I business lending show the most dramatic reduction for TARP recipient banks in both 2008 and 2009. Cuts in aggregate lending and real estate lending are also statistically and economically significant, but the decline doesn't come until the second-round capital injections in 2009.

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[10] 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.

The results reported in tables 7A and 7B using two-step difference GMM estimation for the asset growth equations are qualitatively the same as those of the baseline specification discussed above. There is strong evidence that TARP recipients responded to regulatory incentives: banks receiving TARP capital injections cut back sharply on heavily risk-weighted assets (column 5 of table 7A) and that reduction was sharper the more capital they received as a percent of total bank assets (column 5 of table 7B). This brought down total asset growth (column 1 of tables 7A and 7B), despite that fact that TARP recipients saw no statistically significant change, or perhaps even grew their "riskless", 0% risk-weighted assets (column 2 of table 7A).

4.4. *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 bank recipients of the capital injections were selected non-randomly by policy makers. 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. 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 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.

Thinking about policy makers concerns in selecting the recipient banks, we construct variables that reflect each bank's systemic importance and likely balance-sheet exposure to sub-prime loans. As a proxy for the first criteria, systemic importance, we construct a Harfindahl-Hirschman Index for the concentration of bank deposits (deposits HHI). As a proxy for the second criteria, exposure to sub-prime loans, we calculate the ratio of mortgage loans to total loans for each bank in our sample[11]. We use these variables as instruments for the amount of capital injection in

[11] 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 estate sector lending in the 1980s best explained non-performing loan ratios in the late 1990s.

2008 and 2009[12] and estimate equation 12 using two-stage least squares techniques. So that they better correspond to the capital injection terms, these instruments 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.

At the bottom of tables 8A and 8B, the following specification tests are reported: the p-value for a Lagrange-Multiplier test of joint significance of the instrumental variables, an F-statistic and Hansen's test of joint validity of the instrumental variables. 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}.

The 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. 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: the null hypothesis that the instrumental variables are uncorrelated with the error term cannot be rejected at the 5% level in any specifications.

Insert Table INSTRUMENTAL VARIABLE REGRESSION Here (#8)

Estimation results using two-stage least squares estimation with instrumental variables, reported in tables 8A and 8B, are similar to the results discussed above using GMM. In column 1 of table 8A, we still see a decline in aggregate loan growth for those banks that received a capital injection with the second-round capital injections in 2009, while the response of aggregate loan growth to the 2008 capital

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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.

[12] To ensure exogeneity, we use the 3-year lag of the mortgage loan ratio. The deposit HHI is used without taking lag because in the short-run it is difficult for banks to adjust their amount of deposits, so we consider it reasonable to assume exogenous in the short-run.

injection is statistically insignificant. Column 1 of table 8B 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. A statistically significant reduction in C&I business lending by recipient banks is evident under TARP 1 in 2008. In 2009, under TARP 2, the drag on lending expands to include mortgages and agricultural loans.

5. 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. On the contrary, we find evidence that 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.

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 slower loan growth by recipient banks after TARP 2.

These findings may seem counter-intuitive at first. But of course theoretical and empirical research has demonstrated that shrinking assets is the preferred response for a bank manager facing a capital shortage (Hyun & Rhee, 2011; Montgomery, 2005; Peek & Rosengren, 1995; Watanabe, 2007; Woo, 2003). Despite the huge $700 billion headline figure, when the program was announced commentators familiar with the experience of other countries worried that the TARP capital injections were not large enough to really be effective (Hoshi & Kashyap, 2008; Shimizutani & Montgomery, 2008). Research has shown that infusions of capital may not be able to offset a credit crunch, especially if capital comes with more stringent regulation (Watanabe, 2007). This may explain why we find that the cuts in lending were most significant under TARP 2, the CAP, implemented by incoming Treasury Secretary Timothy Geithner 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. The experience of other countries suggests that tailoring capital injection programs to the recipient banks' individual situation is a necessary condition to achieving policy objectives (Allen et al., 2011; Montgomery & Shimizutani, 2009), so designing TARP 2 based on the results of the stress tests might have been expected to facilitate the goals of the program. But if 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.

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					
ΔLog(Total Loans) (%)	69,753	8.05	16.08	-93	100
ΔLog(Real Estate Loans) (%)	69,600	10.10	20.40	-641	447
ΔLog(C&I Loans) (%)	69,338	5.55	34.21	-466	592
ΔLog(Agricultural Loans) (%)	50,426	0.83	55.67	-625	770
ΔLog(Loans to Individuals) (%)	69,364	-1.47	33.99	-585	875
Independent Variables					
Interest Rate Spread (%)	69,753	4.90	1.16	-5	12
Log(Regulatory Capital Ratio)	69,753	2.71	0.32	-5	4
Regulatory Capital Ratio (%)	69,753	15.79	5.62	0.01	40
Log(Capital Injection 2008 / Risk-Weighted Assets) (Weighted)	69,753	0.01	0.09	0	2
Log(Capital Injection 2009 / Risk-Weighted Assets) (Weighted)	69,753	0.01	0.12	0	2
Capital Injection 2008 Dummy (=1 if received)	69,753	0.004	0.06	0	1
Capital Injection 2009 Dummy (=1 if received)	69,753	0.01	0.09	0	1
Instrumental Variables					
Log(Deposits HHI) (=0 for years other than 2008 or 2009 or under a threshold of 5)	69,753	0.00	0.05	0	5
Log(Real Estate Loans / Total Loans) (=0 for years other than 2005 or 2006 or under a threshold of 20%)	69,753	0.75	1.61	0	5
Interaction term of the above two IVs	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.

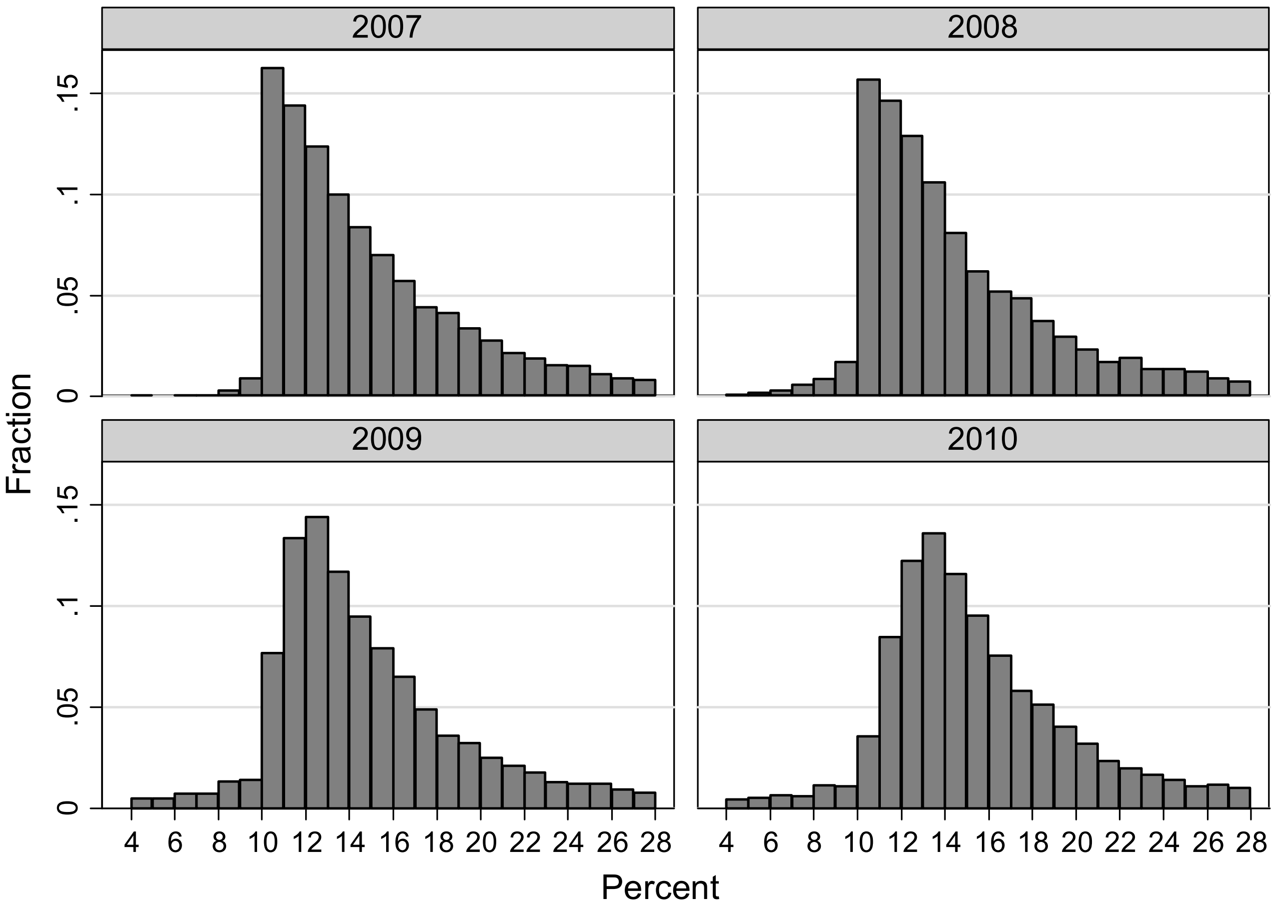
Table 2: Summary of the TARP Capital Injections

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					
ΔLog(Total Assets) (%)	5,333	7.23	12.45	-84	96
ΔLog(Assets with 0% Risk Weight) (%)	5,325	26.83	76.05	-493	692
ΔLog(Assets with 20% Risk Weight) (%)	5,327	2.45	36.05	-360	242
ΔLog(Assets with 50% Risk Weight) (%)	5,312	5.53	29.63	-445	431
ΔLog(Assets with 100% Risk Weight) (%)	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
Log(Regulatory Capital Ratio)	5,333	2.56	0.30	-3	4
Log(Capital Injection 2008 / Risk-Weighted Assets)	5,333	0.03	0.21	0	1
Log(Capital Injection 2009 / Risk-Weighted Assets)	5,333	0.04	0.22	0	2

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

Table 4A: The Effect of TARP (0-1 Dummy) on Commercial Bank Lending

	(1)	(2)	(3)	(4)	(5)
Sample	Commercial Banks	Commercial Banks	Commercial Banks	Commercial Banks	Commercial Banks
Specification	OLS with Individual Fixed Effects & Clustered Standard Errors	OLS with Individual Fixed Effects & Clustered Standard Errors	OLS with Individual Fixed Effects & Clustered Standard Errors	OLS with Individual Fixed Effects & Clustered Standard Errors	OLS with Individual Fixed Effects & Clustered Standard Errors
Dependent Variable	ΔLog (Total Loans) (t+1)	ΔLog (Loans Secured by Real Estate) (t+1)	ΔLog (Commercial and Industrial Loans) (t+1)	ΔLog (Agricultural Loans) (t+1)	ΔLog (Loans to Individuals) (t+1)
Capital Injection 2008 Dummy (=1 if received) (t)	**-7.01*** [1.023]**	**-5.92*** [1.365]**	**-9.61*** [1.750]**	**-3.98 [6.038]**	**2.60 [3.876]**
Capital Injection 2009 Dummy (=1 if received) (t)	**-6.98*** [0.631]**	**-8.50*** [0.764]**	**-8.99*** [1.401]**	**-8.71** [3.984]**	**-5.47** [2.318]**
Loan Deposit Interest Rate Spread (t)	1.05*** [0.162]	-0.47** [0.231]	-1.96*** [0.322]	-3.05*** [0.544]	-2.51*** [0.330]
Log(Regulatory Capital Ratio) (t)	20.46*** [0.655]	20.09*** [0.813]	24.91*** [1.433]	12.27*** [2.485]	18.03*** [1.519]
ΔLog(Total Loans) (t)	0.23*** [0.008]				
ΔLog(Loans Secured by Real Estate) (t)		0.09*** [0.012]			
ΔLog(Commercial and Industrial Loans) (t)			-0.13*** [0.008]		
ΔLog(Agricultural Loans) (t)				-0.23*** [0.011]	
ΔLog(Loans to Individuals) (t)					-0.11*** [0.012]
Constant	-60.89*** [1.762]	-51.74*** [2.210]	-61.11*** [3.860]	-19.76*** [6.460]	-42.60*** [3.924]
Year dummies	Yes	Yes	Yes	Yes	Yes
Observations	60,125	60,016	59,874	43,479	59,802
R-squared	0.18	0.10	0.05	0.06	0.03
Number of banks	8,423	8,402	8,386	6,080	8,368
Number of years	9	9	9	9	9
Hausman test for use of random effects model (p-value)	0	0	0	0	0

Notes: Standard errors clustered at individual bank level in brackets below each coefficient estimate. These standard errors are robust to within-group correlation. *, **, ***, indicate statistical significance at the 10, 5 and 1 percent level respectively.
Hausman test is based on estimates without clustered standard errors.
One period is lost because the equation includes lagged variables.

Table 4B: The Effect of TARP on Commercial Bank Lending

	(1)	(2)	(3)	(4)	(5)
Sample	Commercial Banks	Commercial Banks	Commercial Banks	Commercial Banks	Commercial Banks
Specification	OLS with Individual Fixed Effects & Clustered Standard Errors	OLS with Individual Fixed Effects & Clustered Standard Errors	OLS with Individual Fixed Effects & Clustered Standard Errors	OLS with Individual Fixed Effects & Clustered Standard Errors	OLS with Individual Fixed Effects & Clustered Standard Errors
Dependent Variable	ΔLog (Total Loans) (t+1)	ΔLog (Loans Secured by Real Estate) (t+1)	ΔLog (Commercial and Industrial Loans) (t+1)	ΔLog (Agricultural Loans) (t+1)	ΔLog (Loans to Individuals) (t+1)
Log(Capital Injection 2008 / Risk-Weighted Assets) (Weighted) (t)	**-5.12*** [0.746]**	**-4.52*** [0.912]**	**-7.13*** [1.303]**	**-3.03 [4.560]**	**2.05 [2.863]**
Log(Capital Injection 2009 / Risk-Weighted Assets) (Weighted) (t)	**-5.01*** [0.470]**	**-6.10*** [0.559]**	**-6.69*** [1.051]**	**-7.36** [2.915]**	**-3.95** [1.788]**
Loan Deposit Interest Rate Spread (t)	1.05*** [0.162]	-0.46** [0.231]	-1.96*** [0.322]	-3.05*** [0.544]	-2.50*** [0.330]
Log(Regulatory Capital Ratio) (t)	20.44*** [0.655]	20.07*** [0.813]	24.90*** [1.433]	12.29*** [2.484]	18.02*** [1.519]
ΔLog(Total Loans) (t)	0.23*** [0.008]				
ΔLog(Loans Secured by Real Estate) (t)		0.09*** [0.012]			
ΔLog(Commercial and Industrial Loans) (t)			-0.13*** [0.008]		
ΔLog(Agricultural Loans) (t)				-0.23*** [0.011]	
ΔLog(Loans to Individuals) (t)					-0.11*** [0.012]
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
Observations	60,125	60,016	59,874	43,479	59,802
R-squared	0.18	0.10	0.05	0.06	0.03
Number of banks	8,423	8,402	8,386	6,080	8,368
Number of years	9	9	9	9	9
Hausman test for use of random effects model (p-value)	0	0	0	0	0

Notes: Standard errors clustered at individual bank level in brackets below each coefficient estimate. These standard errors are robust to within-group correlation. *, **, ***, indicate statistical significance at the 10, 5 and 1 percent level respectively.
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.
Hausman test is based on estimates without clustered standard errors.
One period is lost because the equation includes lagged variables.

Estimation Specification used for Table 4A:

$$log\left(\frac{L_{t+1}}{L_t}\cdot 100\right)_{t+1} = \alpha + \beta_1 KJ\ Dummy_t + \beta_2((r^L - r^D)\cdot 100)_t + \beta_3 log\left(\frac{K}{RWA}\cdot 100\right)_t + \beta_4 log\left(\frac{L_t}{L_{t-1}}\cdot 100\right)_t + T_t + I_i + \epsilon_{t+1}$$

Estimation Specification used for Table 4B:

$$log\left(\frac{L_{t+1}}{L_t}\cdot 100\right)_{t+1} = \alpha + \beta_1\ log\left(\frac{KJ}{RWA}\cdot\frac{CBAssets}{BHCAssets}\cdot 100 + 1\right)_t + \beta_2((r^L - r^D)\cdot 100)_t + \beta_3 log\left(\frac{K}{RWA}\cdot 100\right)_t + \beta_4 log\left(\frac{L_t}{L_{t-1}}\cdot 100\right)_t + T_t + I_i + \epsilon_{t+1}$$

Table 5A: The Effect of TARP (0-1 Dummy) on Bank Holding Company Assets by Risk Weight

	(1)	(2)	(3)	(4)	(5)
Sample	Bank Holding Companies	Bank Holding Companies	Bank Holding Companies	Bank Holding Companies	Bank Holding Companies
Specification	OLS with Individual Fixed Effects & Clustered Standard Errors	OLS with Individual Fixed Effects & Clustered Standard Errors	OLS with Individual Fixed Effects & Clustered Standard Errors	OLS with Individual Fixed Effects & Clustered Standard Errors	OLS with Individual Fixed Effects & Clustered Standard Errors
Dependent Variable	ΔLog(Total Assets) (t+1)	ΔLog(Assets with 0% Risk Weight) (t+1)	ΔLog(Assets with 20% Risk Weight) (t+1)	ΔLog(Assets with 50% Risk Weight) (t+1)	ΔLog(Assets with 100% Risk Weight) (t+1)
Capital Injection 2008 Dummy (=1 if received) (t)	**-3.75*** [1.348]**	**7.31 [8.794]**	**3.39 [5.085]**	**-4.73 [3.443]**	**-5.71*** [1.091]**
Capital Injection 2009 Dummy (=1 if received) (t)	**-5.10*** [1.127]**	**14.70* [7.824]**	**-4.95 [3.953]**	**-1.96 [2.354]**	**-6.42*** [1.117]**
Return on Assets minus Expenses on Liabilities (t)	1.72*** [0.457]	-2.50 [1.661]	3.80* [1.973]	2.16*** [0.617]	1.70*** [0.444]
Log(Regulatory Capital Ratio) (t)	13.20*** [1.740]	-27.53** [12.797]	21.38*** [6.962]	11.25** [4.540]	19.81*** [2.165]
ΔLog(Total Assets) (t)	-0.03 [0.024]				
ΔLog(Assets with 0% Risk Weight) (t)		-0.35*** [0.020]			
ΔLog(Assets with 20% Risk Weight) (t)			-0.29*** [0.035]		
ΔLog(Assets with 50% Risk Weight) (t)				-0.22*** [0.034]	
ΔLog(Assets with 100% Risk Weight) (t)					0.04 [0.026]
Constant	-25.18*** [4.418]	70.80** [32.773]	-50.35*** [17.533]	-20.31* [11.726]	-40.40*** [5.576]
Year dummies	Yes	Yes	Yes	Yes	Yes
Observations	4,150	4,142	4,144	4,130	4,148
R-squared	0.17	0.28	0.09	0.09	0.36
Number of BHCs	1,004	1,004	1,004	1,003	1,004
Number of years	5	5	5	5	5
Hausman test for use of random effects model (p-value)	0	0	0	0	0
Endogeneity test for capital injection variables (p-value)	0.18	0.45	0.32	0.31	0.44

Notes: Standard errors clustered at individual bank level in brackets below each coefficient estimate. These standard errors are robust to within-group correlation. *, **, ***, indicate statistical significance at the 10, 5 and 1 percent level respectively.
Hausman test is based on estimates without clustered standard errors.
One period is lost because the equation includes lagged variables.

Table 5B: The Effect of TARP on Bank Holding Company Assets by Risk Weight

	(1)	(2)	(3)	(4)	(5)
Sample	Bank Holding Companies	Bank Holding Companies	Bank Holding Companies	Bank Holding Companies	Bank Holding Companies
Specification	OLS with Individual Fixed Effects & Clustered Standard Errors	OLS with Individual Fixed Effects & Clustered Standard Errors	OLS with Individual Fixed Effects & Clustered Standard Errors	OLS with Individual Fixed Effects & Clustered Standard Errors	OLS with Individual Fixed Effects & Clustered Standard Errors
Dependent Variable	ΔLog(Total Assets) (t+1)	ΔLog(Assets with 0% Risk Weight) (t+1)	ΔLog(Assets with 20% Risk Weight) (t+1)	ΔLog(Assets with 50% Risk Weight) (t+1)	ΔLog(Assets with 100% Risk Weight) (t+1)
Log(Capital Injection 2008 / Risk-Weighted Assets) (t)	**-2.92*** [1.021]**	**5.93 [6.690]**	**2.26 [3.949]**	**-3.20 [2.564]**	**-4.46*** [0.798]**
Log(Capital Injection 2009 / Risk-Weighted Assets) (t)	**-4.27*** [0.940]**	**10.46* [5.897]**	**-4.69 [3.140]**	**-1.75 [1.899]**	**-5.38*** [0.845]**
Return on Assets minus Expenses on Liabilities (t)	1.70*** [0.454]	-2.46 [1.667]	3.76* [1.973]	2.15*** [0.617]	1.66*** [0.441]
Log(Regulatory Capital Ratio) (t)	13.36*** [1.746]	-27.53** [12.825]	21.75*** [6.991]	11.20** [4.566]	20.02*** [2.171]
ΔLog(Total Assets) (t)	-0.03 [0.024]				
ΔLog(Assets with 0% Risk Weight) (t)		-0.35*** [0.020]			
ΔLog(Assets with 20% Risk Weight) (t)			-0.29*** [0.035]		
ΔLog(Assets with 50% Risk Weight) (t)				-0.22*** [0.034]	
ΔLog(Assets with 100% Risk Weight) (t)					0.04 [0.026]
Constant	-25.56*** [4.433]	70.76** [32.838]	-51.26*** [17.597]	-20.18* [11.801]	-40.87*** [5.591]
Year dummies	Yes	Yes	Yes	Yes	Yes
Observations	4,150	4,142	4,144	4,130	4,148
R-squared	0.18	0.28	0.09	0.09	0.36
Number of BHCs	1,004	1,004	1,004	1,003	1,004
Number of years	5	5	5	5	5
Hausman test for use of random effects model (p-value)	0	0	0	0	0
Endogeneity test for capital injection variables (p-value)	0.70	0.72	0.78	0.38	0.88

Notes: Standard errors clustered at individual bank level in brackets below each coefficient estimate. These standard errors are robust to within-group correlation. *, **, ***, indicate statistical significance at the 10, 5 and 1 percent level respectively.
Hausman test is based on estimates without clustered standard errors.
One period is lost because the equation includes lagged variables.

Table 6A: The Effect of TARP (0-1 Dummy) on Lending by Commercial Banks
Two-Step Difference GMM

	(1)	(2)	(3)	(4)	(5)
Sample	Commercial Banks	Commercial Banks	Commercial Banks	Commercial Banks	Commercial Banks
Specification	Two-Step Difference GMM	Two-Step Difference GMM	Two-Step Difference GMM	Two-Step Difference GMM	Two-Step Difference GMM
Dependent Variable	ΔLog (Total Loans) (t+1)	ΔLog (Loans Secured by Real Estate) (t+1)	ΔLog (Commercial and Industrial Loans) (t+1)	ΔLog (Agricultural Loans) (t+1)	ΔLog (Loans to Individuals) (t+1)
Capital Injection 2008 Dummy (=1 if received) (t)	**-3.68****	**-1.13**	**-5.95*****	**4.12**	**9.93***
	[1.867]	**[1.916]**	**[1.664]**	**[8.284]**	**[5.382]**
Capital Injection 2009 Dummy (=1 if received) (t)	**-4.84*****	**-5.17*****	**-7.53*****	**-13.35****	**0.21**
	[1.167]	**[1.177]**	**[1.683]**	**[6.744]**	**[3.251]**
Loan Deposit Interest Rate Spread (t)	13.39***	10.91***	-1.39	3.24***	2.78**
	[0.666]	[0.833]	[2.132]	[1.134]	[1.225]
Log(Regulatory Capital Ratio) (t)	41.12***	37.22***	30.72***	29.60***	21.75***
	[1.831]	[1.882]	[2.705]	[5.470]	[3.261]
ΔLog(Total Loans) (t)	0.93***				
	[0.045]				
ΔLog(Loans Secured by Real Estate) (t)		0.69***			
		[0.058]			
ΔLog(Commercial and Industrial Loans) (t)			-0.49***		
			[0.172]		
ΔLog(Agricultural Loans) (t)				0.15	
				[0.110]	
ΔLog(Loans to Individuals) (t)					0.28
					[0.173]
Year dummies	Yes	Yes	Yes	Yes	Yes
Observations	51,535	51,451	51,321	37,191	51,265
Number of banks	7,965	7,949	7,935	5,727	7,913
Number of years	8	8	8	8	8
Wald test	3677	4102	1357	207.7	589.7
Wald test (p-value)	0	0	0	0	0
Number of instruments	40	40	40	40	40
Minimum lag of LHS variable in the instruments	3	3	3	3	3
Arellano-Bond test for no 3rd order autocorrelation in differenced errors (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: Windmeijer bias-corrected standard errors in brackets below each coefficient estimate. These standard errors are robust to the bias of two-step GMM. *, **, ***, indicate statistical significance at the 10, 5 and 1 percent level respectively.
Two periods are lost because the equation includes lagged variables and is first-differenced.
Constant terms are differenced out.

Table 6B: The Effect of TARP on Lending by Commercial Banks
Two-Step Difference GMM

	(1)	(2)	(3)	(4)	(5)
Sample	Commercial Banks	Commercial Banks	Commercial Banks	Commercial Banks	Commercial Banks
Specification	Two-Step Difference GMM	Two-Step Difference GMM	Two-Step Difference GMM	Two-Step Difference GMM	Two-Step Difference GMM
Dependent Variable	ΔLog (Total Loans) (t+1)	ΔLog (Loans Secured by Real Estate) (t+1)	ΔLog (Commercial and Industrial Loans) (t+1)	ΔLog (Agricultural Loans) (t+1)	ΔLog (Loans to Individuals) (t+1)
Log(Capital Injection 2008 / Risk-Weighted Assets) (Weighted) (t)	**-2.21** **[1.352]**	**-0.62** **[1.322]**	**-4.50***** **[1.234]**	**3.23** **[6.382]**	**7.50*** **[4.001]**
Log(Capital Injection 2009 / Risk-Weighted Assets) (Weighted) (t)	**-3.05***** **[0.867]**	**-3.20***** **[0.828]**	**-5.39***** **[1.259]**	**-10.30**** **[5.023]**	**0.23** **[2.443]**
Loan Deposit Interest Rate Spread (t)	13.44*** [0.667]	10.95*** [0.834]	-1.36 [2.128]	3.24*** [1.134]	2.77** [1.224]
Log(Regulatory Capital Ratio) (t)	41.09*** [1.832]	37.20*** [1.884]	30.74*** [2.701]	29.60*** [5.464]	21.73*** [3.261]
ΔLog(Total Loans) (t)	0.93*** [0.045]				
ΔLog(Loans Secured by Real Estate) (t)		0.69*** [0.058]			
ΔLog(Commercial and Industrial Loans) (t)			-0.49*** [0.172]		
ΔLog(Agricultural Loans) (t)				0.15 [0.110]	
ΔLog(Loans to Individuals) (t)					0.28 [0.173]
Year dummies	Yes	Yes	Yes	Yes	Yes
Observations	51,535	51,451	51,321	37,191	51,265
Number of banks	7,965	7,949	7,935	5,727	7,913
Number of years	8	8	8	8	8
Wald test	3663	4095	1357	208.7	590.3
Wald test (p-value)	0	0	0	0	0
Number of instruments	40	40	40	40	40
Minimum lag of LHS variable in the instruments	3	3	3	3	3
Arellano-Bond test for no 3rd order autocorrelation in differenced errors (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: Windmeijer bias-corrected standard errors in brackets below each coefficient estimate. These standard errors are robust to the bias of two-step GMM. *, **, ***, indicate statistical significance at the 10, 5 and 1 percent level respectively.
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.
Two periods are lost because the equation includes lagged variables and is first-differenced.
Constant terms are differenced out.

Table 7A: The Effect of TARP (0-1 Dummy) on Bank Holding Company Assets
Two-Step Difference GMM

	(1)	(2)	(3)	(4)	(5)
Sample	Bank Holding Companies	Bank Holding Companies	Bank Holding Companies	Bank Holding Companies	Bank Holding Companies
Specification	Two-Step Difference GMM	Two-Step Difference GMM	Two-Step Difference GMM	Two-Step Difference GMM	Two-Step Difference GMM
Dependent Variable	ΔLog(Total Assets) (t+1)	ΔLog(Assets with 0% Risk Weight) (t+1)	ΔLog(Assets with 20% Risk Weight) (t+1)	ΔLog(Assets with 50% Risk Weight) (t+1)	ΔLog(Assets with 100% Risk Weight) (t+1)
Capital Injection 2008 Dummy (=1 if received) (t)	**-7.25*** [2.311]**	**-5.72 [17.550]**	**0.19 [4.674]**	**-1.62 [4.745]**	**-9.35*** [2.016]**
Capital Injection 2009 Dummy (=1 if received) (t)	**-9.76*** [2.058]**	**0.95 [15.595]**	**-14.03*** [4.993]**	**-4.16 [3.608]**	**-8.94*** [1.543]**
Return on Assets minus Expenses on Liabilities (t)	-1.52*** [0.535]	0.12 [3.276]	0.15 [1.808]	1.15 [0.845]	-0.33 [0.439]
Log(Regulatory Capital Ratio) (t)	31.19*** [5.459]	-46.49** [18.951]	8.80 [8.324]	8.87 [6.516]	48.01*** [6.564]
ΔLog(Total Assets) (t)	0.73*** [0.152]				
ΔLog(Assets with 0% Risk Weight) (t)		-0.04 [0.401]			
ΔLog(Assets with 20% Risk Weight) (t)			-0.38** [0.188]		
ΔLog(Assets with 50% Risk Weight) (t)				-0.43 [0.338]	
ΔLog(Assets with 100% Risk Weight) (t)					0.63*** [0.111]
Year dummies	Yes	Yes	Yes	Yes	Yes
Observations	3,141	3,133	3,135	3,122	3,139
Number of BHCs	894	893	893	891	894
Number of years	4	4	4	4	4
Wald test	535.0	744.0	60.22	128.7	1434
Wald test (p-value)	0	0	0.00	0	0
Number of instruments	14	14	14	14	14
Minimum lag of LHS variable in the instruments	3	3	3	3	3
Arellano-Bond test for no 3rd order autocorrelation in differenced errors (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: Windmeijer bias-corrected standard errors in brackets below each coefficient estimate. These standard errors are robust to the bias of two-step GMM. *, **, ***, indicate statistical significance at the 10, 5 and 1 percent level respectively.
Two periods are lost because the equation includes lagged variables and is first-differenced.
Constant terms are differenced out.

Table 7B: The Effect of TARP on Bank Holding Company Assets
Two-Step Difference GMM

	(1)	(2)	(3)	(4)	(5)
Sample	Bank Holding Companies	Bank Holding Companies	Bank Holding Companies	Bank Holding Companies	Bank Holding Companies
Specification	Two-Step Difference GMM	Two-Step Difference GMM	Two-Step Difference GMM	Two-Step Difference GMM	Two-Step Difference GMM
Dependent Variable	ΔLog(Total Assets) (t+1)	ΔLog(Assets with 0% Risk Weight) (t+1)	ΔLog(Assets with 20% Risk Weight) (t+1)	ΔLog(Assets with 50% Risk Weight) (t+1)	ΔLog(Assets with 100% Risk Weight) (t+1)
Log(Capital Injection 2008 / Risk-Weighted Assets) (t)	**-5.26*** [1.708]**	**-3.89 [13.436]**	**0.02 [3.619]**	**-0.98 [3.744]**	**-6.92*** [1.471]**
Log(Capital Injection 2009 / Risk-Weighted Assets) (t)	**-7.51*** [1.511]**	**-1.28 [11.565]**	**-11.08*** [3.862]**	**-3.06 [3.011]**	**-6.74*** [1.149]**
Return on Assets minus Expenses on Liabilities (t)	-1.53*** [0.534]	0.09 [3.273]	0.11 [1.803]	1.14 [0.838]	-0.35 [0.440]
Log(Regulatory Capital Ratio) (t)	31.18*** [5.459]	-46.04** [18.978]	9.06 [8.376]	8.73 [6.419]	47.91*** [6.541]
ΔLog(Total Assets) (t)	0.73*** [0.152]				
ΔLog(Assets with 0% Risk Weight) (t)		-0.04 [0.402]			
ΔLog(Assets with 20% Risk Weight) (t)			-0.38** [0.187]		
ΔLog(Assets with 50% Risk Weight) (t)				-0.42 [0.338]	
ΔLog(Assets with 100% Risk Weight) (t)					0.63*** [0.111]
Year dummies	Yes	Yes	Yes	Yes	Yes
Observations	3,141	3,133	3,135	3,122	3,139
Number of BHCs	894	893	893	891	894
Number of years	4	4	4	4	4
Wald test	535.9	744.2	59.65	130.1	1441
Wald test (p-value)	0	0	0.00	0	0
Number of instruments	14	14	14	14	14
Minimum lag of LHS variable in the instruments	3	3	3	3	3
Arellano-Bond test for no 3rd order autocorrelation in differenced errors (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: Windmeijer bias-corrected standard errors in brackets below each coefficient estimate. These standard errors are robust to the bias of two-step GMM. *, **, ***, indicate statistical significance at the 10, 5 and 1 percent level respectively.
Two periods are lost because the equation includes lagged variables and is first-differenced.
Constant terms are differenced out.

Table 8A: The Effect of TARP (0-1 Dummy) on Commercial Bank Lending
Instrumental Variable Regression

	(1)	(2)	(3)	(4)	(5)
Sample	Commercial Banks	Commercial Banks	Commercial Banks	Commercial Banks	Commercial Banks
Specification	2SLS-IV with Individual Fixed Effects & Clustered Standard Errors	2SLS-IV with Individual Fixed Effects & Clustered Standard Errors	2SLS-IV with Individual Fixed Effects & Clustered Standard Errors	2SLS-IV with Individual Fixed Effects & Clustered Standard Errors	2SLS-IV with Individual Fixed Effects & Clustered Standard Errors
Dependent Variable	ΔLog (Total Loans) (t+1)	ΔLog (Loans Secured by Real Estate) (t+1)	ΔLog (Commercial and Industrial Loans) (t+1)	ΔLog (Agricultural Loans) (t+1)	ΔLog (Loans to Individuals) (t+1)
Capital Injection 2008 Dummy (=1 if received) (t)	**0.21**	**-3.76**	**-20.49**	**-4.35**	**-11.42**
	[23.730]	**[38.515]**	**[19.546]**	**[30.359]**	**[18.622]**
Capital Injection 2009 Dummy (=1 if received) (t)	**-113.58*** **	**-173.92*** **	**-85.27*** **	**-163.77*** **	**-58.34**
	[19.941]	**[31.762]**	**[30.730]**	**[56.643]**	**[41.820]**
Loan Deposit Interest Rate Spread (t)	0.60***	-1.00***	-2.12***	-3.31***	-2.62***
	[0.201]	[0.275]	[0.329]	[0.557]	[0.338]
Log(Regulatory Capital Ratio) (t)	23.19***	24.58***	27.24***	16.02***	19.81***
	[0.996]	[1.385]	[1.696]	[2.916]	[1.920]
ΔLog(Total Loans) (t)	0.20***				
	[0.011]				
ΔLog(Loans Secured by Real Estate) (t)		0.06***			
		[0.014]			
ΔLog(Commercial and Industrial Loans) (t)			-0.13***		
			[0.008]		
ΔLog(Agricultural Loans) (t)				-0.23***	
				[0.011]	
ΔLog(Loans to Individuals) (t)					-0.11***
					[0.012]
Constant					
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
Wald test	299.4	193.1	119.8	50.69	54.86
Wald test (p-value)	0	0	0	0	0
Lagrange Multiplier test for joint significance of excluded instruments (p-value)	0.00	0.00	0.00	0.00	0.00
F-statistic for excluded instruments	19.49	19.40	24.21	19.35	21.50
Hansen test for exogeneity of excluded instruments (p-value)	0.35	0.37	0.43	0.35	0.64
Exogeneity test for instrumented variables (p-value)	0	0	0.01	0.02	0.22
Instrumented variables:	- Capital Injection 2008 Dummy (=1 if received) (t), - Capital Injection 2009 Dummy (=1 if received) (t)				

Excluded instruments:	- Log(Deposits HHI) (t) (=0 for years other than 2008 or 2009 or under a threshold of 5), - Log(Real Estate Loans / Total Loans) (t-3) (=0 for years other than 2005 or 2006 or under a threshold of 20%), - Interaction term of the above two IVs

Notes: Standard errors clustered at individual bank level in brackets below each coefficient estimate. These standard errors are robust to within-group correlation. *, **, ***, indicate statistical significance at the 10, 5 and 1 percent level respectively.
One period is lost because the equation includes lagged variables.

Table 8B: The Effect of TARP on Commercial Bank Lending
Instrumental Variable Regression

	(1)	(2)	(3)	(4)	(5)
Sample	Commercial Banks	Commercial Banks	Commercial Banks	Commercial Banks	Commercial Banks
Specification	2SLS-IV with Individual Fixed Effects & Clustered Standard Errors	2SLS-IV with Individual Fixed Effects & Clustered Standard Errors	2SLS-IV with Individual Fixed Effects & Clustered Standard Errors	2SLS-IV with Individual Fixed Effects & Clustered Standard Errors	2SLS-IV with Individual Fixed Effects & Clustered Standard Errors
Dependent Variable	ΔLog (Total Loans) (t+1)	ΔLog (Loans Secured by Real Estate) (t+1)	ΔLog (Commercial and Industrial Loans) (t+1)	ΔLog (Agricultural Loans) (t+1)	ΔLog (Loans to Individuals) (t+1)
Log(Capital Injection 2008 / Risk-Weighted Assets) (Weighted) (t)	**-13.31**	**-24.08**	**-30.28*** **	**-23.07** **	**-18.08***
	[12.261]	**[19.406]**	**[10.223]**	**[9.858]**	**[10.126]**
Log(Capital Injection 2009 / Risk-Weighted Assets) (Weighted) (t)	**-77.84*** **	**-117.54*** **	**-56.07*** **	**-119.38*** **	**-38.36**
	[13.718]	**[21.619]**	**[21.193]**	**[42.225]**	**[28.697]**
Loan Deposit Interest Rate Spread (t)	0.61***	-0.96***	-2.09***	-3.29***	-2.60***
	[0.194]	[0.266]	[0.326]	[0.555]	[0.335]
Log(Regulatory Capital Ratio) (t)	23.23***	24.59***	27.33***	16.30***	19.85***
	[0.921]	[1.271]	[1.667]	[2.905]	[1.892]
ΔLog(Total Loans) (t)	0.19***				
	[0.010]				
ΔLog(Loans Secured by Real Estate) (t)		0.06***			
		[0.013]			
ΔLog(Commercial and Industrial Loans) (t)			-0.13***		
			[0.008]		
ΔLog(Agricultural Loans) (t)				-0.23***	
				[0.011]	
ΔLog(Loans to Individuals) (t)					-0.11***
					[0.012]
Constant					
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
Wald test	303.6	192.3	121.2	51.37	55.64
Wald test (p-value)	0	0	0	0	0
Lagrange Multiplier test for joint significance of excluded instruments (p-value)	0.00	0.00	0.00	0.00	0.00
F-statistic for excluded instruments	24.71	25.46	33.44	17.89	30.28
Hansen test for exogeneity of excluded instruments (p-value)	0.67	0.72	0.85	0.65	0.94
Exogeneity test for instrumented variables (p-value)	0	0	0.01	0.00	0.16

Instrumented variables:	- Log(Capital Injection 2008 / Risk-Weighted Assets) (Weighted) (t), - Log(Capital Injection 2009 / Risk-Weighted Assets) (Weighted) (t)
Excluded instruments:	- Log(Deposits HHI) (t) (=0 for years other than 2008 or 2009 or under a threshold of 5), - Log(Real Estate Loans / Total Loans) (t-3) (=0 for years other than 2005 or 2006 or under a threshold of 20%), - Interaction term of the above two IVs

Notes: Standard errors clustered at individual bank level in brackets below each coefficient estimate. These standard errors are robust to within-group correlation. *, **, ***, indicate statistical significance at the 10, 5 and 1 percent level respectively.
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.
One period is lost because the equation includes lagged variables.

IVs

$$Deposits\ HHI_t = \left(\frac{Deposits_t}{Banking\ Sector\ Deposits_t}\right)^2 \cdot 10{,}000\ (= 0\ if < 5\ or\ in\ years\ not\ 2008\ or\ 2009)$$

$$IV1_t = log(Deposits\ HHI_t + 1)$$

$$FractionRELoans_t = \left(\frac{RELoans_t}{Total\ Loans_t}\right) \cdot 100\ (= 0\ if < 20\%\ or\ in\ years\ not\ 2005\ or\ 2006)$$

$$IV2_t = log(FractionRELoans_{t-3} + 1)$$

$$IV3 = IV1 \times IV2$$