

Monetary Stimulus and Bank Lending

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Abstract

The U.S. Federal Reserve purchased both agency mortgage-backed securities (MBS) and Treasury securities to conduct quantitative easing (QE). Using micro-level data, we find that banks benefiting from MBS purchases increase mortgage origination, compared to other banks. At the same time, these banks reduce commercial lending and firms that borrow from these banks decrease investment. The effect of Treasury purchases is different: either positive or insignificant in most cases. Our results suggest that MBS purchases caused unintended real effects and that Treasury purchases did not cause a large positive stimulus to the economy through the bank lending channel.

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The recent crisis and recession has led central banks to conduct unconventional monetary policy in continuous attempts to revive their economies. Quantitative easing (QE) was a prominent tool used in the U.S., Japan, Europe, and elsewhere in this spirit. With this tool, the central bank purchases financial assets such as Treasuries or mortgage-backed securities (MBS) hoping to reduce yields, boost lending, and stimulate economic activities. Banks and their lending decisions are thought to play a key role in the transmission mechanism. A key question in academic and policy circles following these events is whether QE was successful in its stated goals. Some think that QE helped revive the economy and the recession would have been much worse without it. Others think that QE might have had no effect. Yet, some others even consider the possibility that it had negative effects by inflating bubbles and distorting the allocation of resources.

Over the years, a large literature attempted to identify the impact of traditional monetary policy via the bank lending channel. While the effects of quantitative easing may be similar in some respects, there are also meaningful distinctions given the unprecedented magnitude of intervention and the nature of the tools. Like traditional monetary policy, identifying the effect of QE is difficult because changes that follow the intervention could be attributed to other changes in the economy around the same time. In this paper, we follow the logic of Kashyap and Stein (2000) and others by exploiting the heterogeneity across banks to assist with identification. The usual idea is that some banks are expected to be more affected by the policy than others, and so their different actions following monetary policy shocks can speak to the causal effect of monetary policy.

This idea is sharpened in the context of QE. In the U.S., the Federal Reserve had bought particular types of assets (specifically Treasury and MBS) in varying quantities in the different rounds. Within the bank lending channel, the typical mechanism through which such policy is thought to have an effect is through capital gains. Specifically, the large-scale asset purchases (LSAPs) lower yields and increase prices of banks' current asset holdings, thereby improving the condition of their balance sheets and leading to more lending in multiple sectors. Indeed, Fed officials often framed the impact of QE through these price effects (Yellen, 2012; Bernanke, 2012). Thus, one would expect that banks which held more of the purchased assets (Treasury and MBS)

and related securities will benefit more from such asset purchases.

A related mechanism within the bank lending channel which is less often mentioned is the origination channel in the specific context of MBS purchases: banks that securitize mortgages into agency MBS are strongly affected by the asset purchases because these banks directly sell such products to the Federal Reserve as a part of QE. The Federal Reserve chose to implement the MBS purchases through the to-be-announced (TBA) market. In this market, the main parameters of the contract (coupon, maturity, issuer, settlement date, face value, and price) are agreed upon in advance. However, the exact pool of mortgages satisfying these terms is determined at settlement, which is typically one to three months in the future. As the TBA market primarily focuses on new mortgages, banks have a strong incentive to originate and securitize mortgages to fulfill these contracts. Existing legacy MBS or mortgage holdings on the banks' balance sheet will not be a candidate for selling to the Federal Reserve via these asset purchases.

We use two measures to capture exposure of banks to these MBS purchases and the underlying mechanisms: the amount of MBS holdings on the banks' balance sheets and those high-MBS banks which actively securitize other assets. Ideally, we would disentangle banks that are only exposed to MBS-related capital gains from those which are also affected by the origination incentive. In practice, we cannot completely do so; while the banks which actively securitize assets and have high MBS holdings undoubtedly are strongly incentivized by the origination channel, many high-MBS banks may still be active originators without participating in securitization. Balance sheet data does not provide a way to separate these banks further. However, we can compare these banks to banks which are more exposed to the Treasury purchases, as there is only a capital gains mechanism in that case. As a measure of exposure to Treasury purchases, we use the amount of Treasury and other non-MBS securities on the banks' balance sheet.

Analyzing the behavior of banks after rounds of asset purchases in comparison to that of banks that were expected to be less affected by these two components within the bank lending channel allows us to shed light on the effects of QE. Moreover, our rich data enables us to track the effect from asset purchases, through the affected banks, to the firms that are connected to these banks,

and so get directly to the real effects of QE. Given that firms are sometimes connected to different banks, this also enables us to get clean identification. In particular, we inspect the borrowing of a given firm from different banks which are differentially affected by QE. This approach removes any concerns that the effects might be driven by firms' demand for borrowing instead of banks' lending decisions.

Asset purchases in the U.S. had three different rounds. In QE1 and QE3, the Federal Reserve bought MBS and Treasuries. In QE2, it bought primarily Treasuries. Although these three rounds were the impetus for much of the asset purchases, the Federal Reserve also made purchases between rounds of QE in response to maturing securities and to maintain the size of its balance sheet. A related program, the Maturity Extension Program (MEP), consisted of buying long-maturity Treasuries and selling short-maturity Treasuries. This program occurred between QE2 and QE3.

We start by investigating the patterns in bank mortgage lending following MBS purchases by the Federal Reserve. In this case, both capital gains and origination components of the bank lending channel have effects in the same direction. As expected, we show that banks that were more exposed to the MBS market increased their mortgage lending following MBS purchases more than the less exposed banks. For a total purchase of approximately 1.7 trillion USD worth of MBS, the banks that benefited most originated mortgages worth approximately 130 billion USD more. This is a reassuring confirmation of the fact that QE had indeed a direct positive effect. As intended, the Federal Reserve improved the attractiveness of mortgage lending, inducing banks exposed to this market to increase their activity in it.

More surprisingly, however, we show that the more exposed banks slowed their Commercial & Industrial (C&I) lending following these MBS purchases. Hence, there seems to be a negative indirect effect, which amounts to the crowding out of other types of loans not directly targeted by the MBS purchases in QE. As QE1 and QE3 focused on the housing market by purchasing large amounts of MBS assets, they indeed encouraged exposed banks to lend more in this market. However, this came at the expense of other types of lending, such as C&I lending for those affected banks. The magnitude of this crowding out is quite large: Due to the total MBS purchases under

QE, we estimate a reduction of \$28.2 billion in C&I lending. The mechanism is likely a result of a substitution effect: While banks benefit from capital gains, the origination component dominates and good opportunities for banks in one line of business (mortgages) shift resources away from other lines of business (C&I loans). While it is likely that such crowding out took place in other markets as well (e.g. consumer credit), this paper focuses on C&I lending. Consistent with this argument, we find a larger effect for the more financially constrained banks within this group. Over time, the reduction is strongest in the period through QE1, where the banking sector as a whole was most constrained. It could also be that other constraints, such as organizational or human-resource constraints, were behind such crowding out. The logic behind the crowding out behavior resembles that featured in the internal-capital-markets literature (e.g., Stein (1997) and Scharfstein and Stein (2000)), where constrained firms are expected to shift resources across divisions to respond to the most attractive investment opportunities.

Investigating further the implications of the crowding out behavior following MBS purchases, we use Dealscan and Compustat data to trace the behavior of firms connected to affected banks. We demonstrate the real effect of crowding out of C&I loans by banks affected by MBS purchases. In particular, firms that have relationships with these banks had to cut their investment following these rounds of QE. As expected, this behavior is observed mostly for firms which are more financially constrained. In interpreting these results, one might be concerned that the decrease in C&I loan growth and investment reflects a decrease in demand from firms rather than a decrease in supply from banks. We address this issue in several ways in the paper. Most notably, we conduct analysis for firms that borrow from multiple banks, some of which are strongly affected by MBS purchases and some of which are not. We show that, after controlling for firm-time fixed effects, a given firm saw a decrease in loan size from affected banks relative to the loan size from non-affected banks.

While MBS purchases increased mortgage origination and decreased C&I lending for affected banks, Treasury purchases did not have a negative effect on C&I lending or firm investment. This is important because in the case of Treasuries, only the capital gains mechanism is at work. The relatively insignificant real effects of Treasury purchases suggests that the capital gains mechanism

is relatively weak compared to the origination mechanism.

Overall, our paper demonstrates that the type of asset being purchased is very important in designing QE. Through its choice of assets purchased, beyond providing overall stimulus, the Federal Reserve directly affected credit allocation within the economy. The unintended negative consequences of MBS purchase for C&I lending and ultimately firm investment is due to the less discussed origination mechanism. This general message has broader implications, given that other countries have experimented with purchases of other assets: the European Central Bank has been purchasing corporate debt, while the Japanese Central Bank has purchased equities. It would be interesting to investigate their differential effects as well.

Our results contribute to the debate of what channels were most pertinent for the transmission of QE. Krishnamurthy and Vissing-Jørgensen (2013), for example, discuss several channels through which QE could have had a role. Our paper shows that the incentive of banks to originate mortgages (origination channel) is particularly important. Indeed, it appears to dominate any positive spillovers from the capital gains channel in markets, such as commercial lending, where the effects are opposite in direction. In general, the capital gains channel, whether for MBS or Treasury securities, appears to be relatively weak.

There is a recent small literature on QE and bank lending. The closest paper to us is Rodnyanski and Darmouni (2016). They also exploit heterogeneity at the bank level due to differences in holdings of MBS to ask what is the effect of QE on bank lending. Their main focus is on mortgage lending. While C&I lending is not central in their paper, their analysis does touch on it and does not uncover the crowding out effect that MBS purchases had on the C&I lending of exposed banks, which we show here. This is because of key differences in the research design. Rodnyanski and Darmouni (2016) utilize the timing of QE rounds as the only source of exogenous variation by using three time-dummies for the QEs. In other words, they compare lending patterns before and after the three QE rounds which effectively assumes that the only aggregate variation during and after the financial crisis was the introduction of the three QE episodes. This leads to the commingling of the effect of a QE round with that of *any* policy or aggregate variation that

coincides with that timing. For example, the Housing and Economic Recovery Act of 2008 which sought to insure \$300 billion in new mortgages was introduced in the same time period as QE1 and disproportionately affected the treatment group (i.e. banks with high MBS holdings). Similarly, the timing of QE2 and QE3 coincide with the introduction of many other non-QE measures. In contrast to time-dummies for the QEs, we use quarter-by-quarter observations of monetary stimulus so that we can control for unobserved aggregate economic conditions and changing regulatory policy during the period by including year-quarter fixed-effects. In addition, we explicitly use the amount of MBS purchases and the amount of Treasury purchases by the Federal Reserve in every quarter as the direct measure of monetary stimulus and its intensity. These two differences in our research design allows us to tease out the effects of monetary shocks from other confounding policy changes and economic conditions. Finally, a fundamental difference between our papers is that we explore the truly real effects of QE by looking at firms' investments and bank-firm specific lending relationships, whereas Rodnyanski and Darmouni (2016) only look at banks' general lending patterns.

In addition to Rodnyanski and Darmouni (2016), two other contemporary papers investigate separate aspects of QE and bank lending and complement our findings. Di Maggio, Kermani, and Palmer (2016) examine how unconventional monetary policy affected the volume of new mortgages issued. They find that financial institutions originated more mortgages of the type that were eligible for purchase by the Federal Reserve (GSE-eligible mortgages). During QE1, this led to \$600 billion of refinancing which led to equity extraction and consumption of an additional \$76 billion. Kandrach and Schulsche (2016) assess the effect of QE-induced reserve accumulation on bank-level lending and risk-taking activity. The authors find that bank reserves created by the Federal Reserve led to higher total loan growth and more risk taking within banks' loan portfolios.

Outside the recent QE literature, our paper relates to the broader literature that explores the impact of traditional monetary policy on the economy through the bank lending channel. The literature shows that shocks to financial institutions affect their ability to lend and end up impacting the firms that borrow from them (Bernanke, 1983; Stein, 1998; Kashyap and Stein, 2000). The im-

pact of monetary policy on firms assumes that banks and firms are financially constrained to some extent (literature also includes Kashyap and Stein, 1995; Peek and Rosengren, 1995; Holmstrom and Tirole, 1997; Bolton and Freixas, 2006, among others), which is a basic premise of our paper as well. The phenomenon of the crowding out of bank lending from one sector of the economy by another sector is related to the theory in Farhi and Tirole (2012) and the empirical evidence in Chakraborty, Goldstein, and MacKinlay (2016). Chakraborty, Goldstein, and MacKinlay (2016) find that during the U.S. housing boom, banks in stronger housing markets reduced commercial lending in favor of more mortgage activity, and firms that borrowed from these banks had to reduce investment as a result. Our paper shows that after the boom ended, a different phenomenon crowds out capital away from firms: MBS purchases in quantitative easing led to benefiting banks increasing real estate lending and reducing C&I lending.

Finally, our paper ties into a far more general literature of the effects of monetary stimulus on the economy. A recent literature investigates the connection between lower interest rates and bank activity (e.g., Maddaloni and Peydró, 2011; Jiménez, Ongena, Peydró, and Saurina, 2014; Dell’Ariccia, Laeven, and Marquez, 2014), negative interest rates and bank risk (Heider, Saidi, and Schepens, 2016), and pass-through to consumer credit (Agarwal, Chomsisengphet, Mahoney, and Stroebel, 2015). Another related strand looks at the effects of QE on asset prices (e.g., Krishnamurthy and Vissing-Jørgensen, 2011, 2013; Bekaert, Hoerova, and Duca, 2013; Hanson and Stein, 2015).

The remaining sections are organized as follows. Section I describes the data used for the analysis. Section II reports the empirical results. Section III provides additional discussion and robustness tests. Section IV concludes.

I Data

Our analysis uses four different panels of data. The first and second panels are used to investigate the effect of asset purchases on the bank’s mortgage origination and commercial loan activity,

respectively. As we do not require any firm data for this panel, we look at a larger sample of banks. One major difference between these two panels is the frequency of observations: the mortgage origination data is only available on an annual basis as opposed to quarterly availability for the commercial lending panel. Our third panel, which we use to investigate the effect of the lending channel on firm investment, is constructed at the firm-bank-year-quarter level. In this panel, firm-bank observations are included for each year-quarter of the lending relationship. Our fourth panel again uses the relationships between firms and banks, but focuses only on the quarters in which loans are originated.

Given our focus on asset purchases made by the Federal Reserve, our main analysis focuses on the period from 2005q4 through 2013q4.¹ Section [I.A](#) covers the Federal Reserve’s asset purchase programs in more detail. In Section [I.B](#), we discuss some features of the agency MBS market and how we measure bank involvement in the mortgage market. Section [I.C](#) discusses how we determine firm-bank lending relationships, along with the relevant firm, bank, and loan data.

I.A Federal Reserve Asset Purchases

Critical to our analysis are the amounts of MBS and Treasury securities purchased by the NY Federal Reserve under their permanent Open Market Operations programs. The Treasury Permanent Open Market Operations program in general has the power to purchase or sell Treasury securities to “offset other changes in the Federal Reserve’s balance sheet in conjunction with efforts to maintain conditions in the market for reserves consistent with the federal funds target rate set by the Federal Open Market Committee (FOMC).” Historical data for these Treasury purchases begin in August 2005.

In November 2008, the Federal Reserve announced a plan to purchase up to \$100 billion in direct GSE/GOE obligations and up to \$500 billion in MBS purchases, which started in early 2009. In March 2009, the program expanded with an additional \$750 billion in agency MBS purchases,

¹The third quarter of 2005 is the first quarter with any asset purchase data, and the fourth quarter of 2013 is the most recent quarter for which all our required data sources are updated through. For the annual mortgage origination data we are able to conduct analysis through the end of 2014.

\$300 billion in Treasury purchases, and continued until June 2010. Total purchases over this period totaled over 1.8 trillion in agency MBS, 300 billion in Treasuries, and became known as QE1. In November 2010, the Fed announced a second round of purchases (QE2), totaling up to \$600 billion in Treasury purchases and concluding in June 2011. The third round of quantitative easing (QE3), ran from September 2012 through October 2014, initially at purchase rates of \$40 billion per month for agency MBS and \$45 billion per month for Treasury securities. While the net and gross purchases yield similar empirical results, we use gross purchases as a measure of amount of assets purchased throughout our analysis. The reason is that gross purchases allow us to capture the Maturity Extension Program (MEP) as part of the treatment, when the Federal Reserve purchased long-term Treasuries and sold short-term Treasuries to reduce long-term bond yields.

Since completing the last major round of quantitative easing in October 2014, the FOMC has directed the Open Market Operations at the NY Fed to reinvest principal payments of agency MBS in new agency MBS to maintain current levels. Similarly, maturing Treasury holdings are being rolled over at auction to maintain current levels.

Figure 1 presents the total purchases by the Open Market Operations desk on a quarterly basis. Over this window, there are periods where there are predominantly MBS purchases (e.g., 2008q4 through 2009q3), Treasury purchases (e.g., 2010q3 through 2011q3), and a mix of both security types (e.g., 2012q1 through 2012q4). To complete the above purchases, the NY Federal Reserve uses a primary dealer system. These designated institutions serve as the counterparty to the NY Federal Reserve in all the MBS and Treasury purchases.²

²In our analysis, we use $\log(1+x)$, where x is the dollar amount of MBS or Treasuries purchased in a year-quarter in millions. Year-quarters without purchases take on a zero value. Although differences between quarters with and without purchases are important, there is significant variation within the changing dollar amounts across quarters with purchases. Using dollar amounts, rather than just binary variables for whether there were purchases of MBS or Treasury securities in that quarter, also allows us to focus on the relative variation between MBS and Treasury purchases quarter-by-quarter. This helps identify the separate impacts of the two types of securities.

I.B Mortgage Origination and Securitization Data

To capture changes in mortgage activity among banks, we incorporate data collected under the Home Mortgage Disclosure Act (HMDA). Available on an annual basis, we use the origination data from 2005–2014. Aggregated to the BHC level, we calculate the share of new mortgage originations for each bank in each state where it reports activity. We include all mortgage originators in HMDA, including thrifts and non-banks, to calculate the market share. We also calculate each bank’s market share for each individual CBSA market in which it reports activity.

We prefer using this data as opposed to the bank’s balance sheet data for a few reasons. First, this data captures both the mortgages that remain on the bank’s balance sheet and those that are sold to other financial institutions or the government sponsored or owned agencies (GSE/GOEs). Given the manner in which QE was undertaken, banks which are most affected by the MBS purchases should be actively selling mortgages or packaging mortgages into MBS and subsequently selling them. Disentangling the new origination activity from the subsequent MBS conversions and sales is difficult if only considering the amount of unsecured real estate loans on the bank’s balance sheet. Second, market share better captures the amount of mortgage activity by a bank in a given market relative to its peers. This allows us to control for changing local economic and mortgage demand conditions and identify the extent that QE affects a bank’s mortgage lending. Summary statistics are included in Panel A of Table [I](#).

I.B.1 MBS Market Exposure

The agency MBS market is composed of two parallel markets: a specified pool (SP) market, where specific MBS are traded, and a to-be-announced (TBA) market. In the TBA market, the buyer and seller agree on six parameters of the contract: coupon, maturity, issuer, settlement date, face value, and price. The exact pool of mortgages that fits these parameters is determined at settlement, which is typically one to three months in the future (Gao, Schultz, and Song, 2017). The majority of agency MBS purchases undertaken by the Federal Reserve occurred in the TBA market and the Fed mainly bought 15-year and 30-year MBS at coupons close to current mortgage rates.

Banks have two avenues to sell mortgages to GSE/GOEs: 1) sell loans individually for cash, which the GSE/GOE may include in an agency MBS pool, or 2) organize their mortgages into a MBS pool and have the GSE/GOE certify it as an agency MBS pool. The second method, referred to as a swap transaction, requires the bank to have an additional pool purchase contract with the agency. These swapped MBS remain on the bank's own balance sheet as MBS assets until they are sold or mature.

An important point of differentiation among banks is their level of involvement in the secondary mortgage market. We try to capture this in two ways: the first is a measure of how much of the bank's total assets are MBS. Because MBS holdings in part arise from these swap transactions, those banks which hold more MBS are more likely to be active in the secondary market. For the majority of our analysis, we treat the top tercile of banks by MBS holdings as most exposed to the secondary mortgage market and the bottom tercile of banks by MBS holdings as least exposed. The second variable we use to capture secondary market involvement is for the highest tercile MBS banks an indicator for whether the bank reports non-zero net securitization income. Those banks that not only engage in swap transactions with GSE/GOEs, but securitize other non-agency loans, are more likely to be involved in the secondary mortgage market. Whereas more than 80% of our bank observations report some MBS holdings on their balance sheets, only 3% of banks in our sample report non-zero securitization income at some point. A third measure, *GSE/GOE Seller*, based on the HMDA data, generates similar results to other two categorization variables. We use it in our robustness analysis in Appendix [B.1](#).

I.B.2 Other Mortgage Market Variables

In addition to including the mortgage market share, we include a few additional variables. At the state-level, we calculate the average APR of originated mortgages for each bank. This variable is reported as a spread above the equivalent maturity Treasury rate and is only provided for a certain subset of the mortgage market.³ At the CBSA-level, we also consider the role of housing prices

³Specifically, banks are only required to report in HMDA those mortgage rates that exceed the current Treasury rate by 3 percentage points or more. Because of this restriction, we also include a variable that captures the bank's

on bank-level mortgage activity. Specifically, we include the CBSA housing price index scaled by an equivalent index for the CBSA's per capita income level. Incorporating housing prices in our analysis introduces concerns that housing prices are picking up other unobserved economic shocks. We therefore use a measure of land area that is unavailable for residential or commercial real estate development as an instrument. Similar approaches are used by Mian and Sufi (2011), Chaney, Sraer, and Thesmar (2012), Adelino, Schoar, and Severino (2015), and Chakraborty, Goldstein, and MacKinlay (2016). This measure of supply elasticity, developed by Saiz (2010), is the area that is unavailable for residential or commercial real estate development in CBSAs. In addition, we use the 30-year national mortgage rate interacted with this land availability measure as a second instrument. The reasoning being that the aggregate changes in housing demand, coming from changes in the national mortgage rate, will impact housing prices differently depending on the local housing elasticity.

I.C Banks and Commercial Lending Relationships

We use Call Report data to construct our measure of commercial and industrial (C&I) loan growth and our other bank-level control variables. The summary statistics for these variables are presented in Panel A of Table I and specific variable definitions can be found Table A.1 in the Appendix.

We determine firm-bank relationships using loan-level data from Dealscan with firm-level data from Compustat. The Dealscan database provides loan origination information on more than 75% of the value of commercial loans originated in the U.S. (Chava and Roberts, 2008). The length of the relationship is defined as follows: it begins in the first year-quarter that we observe a loan being originated between the firm and bank and ends when the last loan observed between the firm and bank matures, according to the original loan terms. Panel B of Table I provides statistics on length and number of relationships and summary statistics for the loan terms. Additional details on how relationships are determined and on the loan package terms are provided in Appendix A.1. Details on the firm-level data are provided in Appendix A.2. As we are focusing on how financial

share of the total reported rate market.

intermediaries affect borrowing firms’ investment decisions, we exclude any borrowing firms that are financial companies. Panel B of Table I includes the summary statistics for our firm variables.

To obtain detailed financial information for the lending banks, we create a hand-matched link table which matches Dealscan lenders to their bank holding companies in the Call Report data.⁴ In our sample period, we match 243 largest Dealscan lenders to 54 bank holding companies in the Call Report data that are the most active commercial lenders in the U.S. These matches are determined by hand using the FDIC’s Summary of Deposits data and other available data of historical bank holding company structures. Throughout our analysis, all bank-activity is investigated at the holding company level, so we refer to BHCs as “banks” for simplicity.

II Empirical Results

Sections II.A and II.B investigate the impact of asset purchases on bank lending in the mortgage market and commercial and industrial loan market, respectively. Section II.C looks at the impact of asset purchases on the real economy. To rule out any firm-demand factors that could be affecting our results, Section II.D utilizes within-firm loan-level evidence from different banks to analyze the impact of QE on bank lending.

II.A Mortgage Lending and Asset Purchases

This section investigates the response of banks in terms of mortgage lending due to MBS purchases during QE. We use the annual mortgage origination market share of a bank in each state as the measure of interest. There are three reasons for the choice of this measure. First, since the Federal Reserve attempted to stimulate new mortgage origination through MBS purchases, focusing on new mortgage originations (rather than mortgage holdings) is reasonable. Second, looking at the bank’s balance sheet instead for mortgage activity would miss a key aspect for QE: the mechanism

⁴As the Dealscan lending data is for individual bank or financial companies, there can be multiple Dealscan lenders to each bank holding company. We choose to match to the bank holding company as it provides the most complete picture of the bank’s finances. This choice assumes that the bank holding company influences its subsidiary banks’ policies for lending, which we believe to be reasonable.

is for banks to originate mortgages, package them as MBS, and sell them to the Federal Reserve in the TBA market. Hence, they should not remain on the bank's balance sheet. Third, mortgage lending depends on local demand. State-level mortgage origination shares allow us to control for local demand and other characteristics using state-time fixed effects.⁵

Before conducting a detailed analysis, Figure 2 shows the average market share at the state-level for securitizer banks in years not following MBS purchases and years immediately following MBS purchases. For the securitizer banks, which are likely to be the most active in secondary mortgage markets, we see significant increases in their average state-level market share following government MBS purchases. This effect is consistent across the majority of states. Figure B.1 in the Appendix repeats the analysis for the non-securitizer banks. In this case, there is no significant difference in average state-level market share in response to MBS purchases.

Next, we investigate the change in mortgage origination market share of banks in a specific year and state in response to asset purchases, depending on the banks' exposure to the MBS market. We employ two approaches to measure a bank's exposure: whether its MBS holdings as a fraction of assets for the bank is relatively high or whether it is a securitizer. Specifically, we compare those banks in the top tercile by lagged MBS holdings to those banks in the bottom tercile.⁶ For sake of comparison, we maintain the same sample to compare securitizers (high-MBS banks with recent securitization income) to non-securitizers. To address changes in mortgage origination rates due to changes in demand for mortgages and other economic concerns at the location of the bank, the most exhaustive specifications include state by year fixed effects for each state where the bank has some market share. We also include bank fixed effects to ensure that bank-specific time-invariant characteristics are not driving the changes in market share. The specification for bank j active in

⁵Using national-level mortgage origination market share yields similar results and are discussed in Appendix B.1.

⁶We exclude the middle tercile for this and similar subsequent analyses.

state s in year t is as follows:

$$\begin{aligned} \text{Mort Orig Mkt Share}_{jst} = & \alpha_j + \beta_1 \text{Asset Purch Vars}_{t-1} + \beta_2 \text{Bank Vars}_{jt-1} \\ & + \beta_3 \text{Bank Asset Hldgs}_{jt-1} \times \text{Asset Purch Vars}_{t-1} + \gamma_{st} + \epsilon_{jst}. \end{aligned} \quad (1)$$

In this specification, as we are looking at annual market share, all lagged variables ($t - 1$) are from the fourth quarter of the prior year. We specifically focus on β_3 , the interaction of the *amount* of asset purchases with the exposure for the bank to the MBS market. Throughout our analysis, we use the log transform of the dollar amounts of the purchases. Because we include year-quarter or state by year-quarter fixed effects, the coefficients for the asset purchase variables (β_1) are absorbed. Table II reports the results. Column 1 shows that one standard deviation higher MBS purchases (142.8 billion USD) in the final quarter of the prior year at the mean (95.3 billion USD) leads to a gain of 0.24 bps in terms of MBS origination market share for a bank with high MBS holdings.⁷ The average origination market share of a bank in a state is 26.2 bps, hence the additional lending leads to approximately 0.92% higher market share for a bank in a year. In dollar terms, as the average mortgage origination during our sample period is 498.45 billion USD per quarter, and assuming an equal distribution of market share for banks with high MBS holdings and those without, we calculate a 1.53 billion USD additional market share for the banks with high MBS holdings.⁸ Column 2 introduces state by year fixed effects and finds that the coefficient of interest retains similar magnitude and statistical significance.

One concern is that banks with high MBS holdings may have other characteristics that drive the response of the banks in terms of mortgage origination. In other words, it is not MBS holdings but, for example, banks with high net income that respond more to the incentives provided by the Federal Reserve through MBS purchases. To address this concern, we next refine our approach of grouping banks based on MBS holdings. We estimate the amount of MBS holdings that can be explained by other bank characteristics (specifically size, equity ratio, net income, and cost of

⁷The calculation is $0.605 * (\log(142.8 + 95.3) - \log(95.3)) * 0.0001 = 0.24$ bps.

⁸The calculation is $498.45/3 \times 0.92\% = 1.53$ B.

deposits), and then calculate the residual MBS holdings for each bank. This term is thus the MBS holdings by the bank orthogonalized to other bank characteristics. We then refine the terciles of banks by MBS holdings using the orthogonalized MBS holdings and conduct a similar analysis. Column 3 reports the results. The coefficient point estimate drops but the result remains statistically and economically significant: banks with higher MBS holdings lend more in response to asset purchases.

Since our mechanism is that MBS asset purchases by the Federal Reserve in the TBA market encourage mortgage lending, we next use another refined measure of the exposure of banks to QE to test the mechanism more directly. Among the banks in the top tercile of MBS holdings, we focus on the banks that are securitizers since such banks can readily securitize the mortgages they originate and sell them to the Federal Reserve. Column 4 focuses on the gain in annual market share of MBS securitizer banks following MBS asset purchases. Comparing with column 1, we find that the effects are approximately seven times stronger in this case. One standard deviation higher MBS purchases in a quarter at the mean leads to a gain of 1.7 bps in terms of MBS origination market share for a bank with high MBS holdings. The results remain similar with the inclusion of state by year fixed effects to control for demand side effects in the state where the market share is calculated. The most exhaustive specification in column 5 shows that MBS securitizer banks provided additional mortgages worth \$130 billion due to the total MBS purchases, and obtained \$817 million in terms of accompanying fees (given average fees of 0.63%). Thus, in response to MBS asset purchases, benefiting banks did engage in more mortgage lending. This evidence shows that the mortgage origination channel is significant for the transmission of QE.

II.B Unintended Effects of Asset Purchases on Commercial Lending

This section discusses the effect of asset purchases by the Federal Reserve on commercial and industrial (C&I) lending. The argument why MBS lending may crowd out C&I lending is as follows: to implement quantitative easing, the Federal Reserve announced the intention to purchase MBS securities. As discussed in Section [I.B.1](#), the majority of agency MBS purchases by the

Federal Reserve were in the forward (TBA) market. Therefore banks, knowing that the Federal Reserve is purchasing TBA MBS, may shift resources away from C&I lending into mortgage origination and MBS creation in response to QE. To test whether such crowding out indeed took place, as in Section II.A we focus on new loan originations in the C&I lending market. We utilize C&I loan growth as our measure of interest. There is no clear state-level market in the case of firms since the selection of firms in our sample are generally large and can borrow from large geographic distances. Therefore the analysis is at the bank level rather than at the bank-state level. We address persistent heterogeneity among banks by including bank-level fixed effects. We also include year-quarter fixed effects based on the state where the bank has the largest footprint in terms of deposits to control for time-variant local economic conditions faced by the bank, which includes demand-side effects.

Table III reports the loan growth in commercial and industrial lending as a response to MBS and Treasury purchases. Columns 1–4 identify the effects on credit supply depending on whether the bank is in the top or bottom tercile of MBS holdings as a fraction of assets. Columns 5 and 6 focus on securitizer banks to identify the effect of MBS purchases on credit supply. All columns use whether the bank is in the top or bottom tercile of non-MBS securities holdings to identify the effect of Treasury purchases on lending at the bank level. The reason for this split is that as Treasury purchases lowers yields for Treasuries and other securities, banks with more securities holdings will benefit more.⁹ In addition to the two sets of fixed effects mentioned above, the specification includes bank-level characteristics and changes in the unemployment rate in the bank’s states as an additional regional economic control.

The variables of interest are the bank-level interaction terms with the amounts of MBS and Treasury purchases. Column 1 shows that banks which are in the top tercile of MBS holdings, and

⁹In our main analysis, we use all non-MBS securities, which includes: Treasury securities, other U.S. government agency or sponsored-agency securities, securities issued by states and other U.S. political subdivisions, other asset-backed securities (ABS), other debt securities, and investments in mutual funds and other equity securities. While the average bank in our sample holds 14.5% of assets in these non-MBS securities, 8.5% of assets on average are held in just Treasury and other U.S. government securities (see Table I). A possible argument is that Treasury purchases have a larger effect on government securities compared to other asset classes. Hence, as an alternative measure of securities holdings, in Table B.2 of Appendix B.1, we restrict securities holdings to Treasury and other U.S. government securities and find similar results to Table III.

hence benefit more from MBS purchases, have slower loan growth in response to MBS purchases by the Federal Reserve. One standard deviation additional MBS purchases at the mean reduces loan growth by 7.5 bps (annualized). Column 2 shows that banks with high holdings of securities reacted positively to Treasury purchases in terms of C&I lending. One standard deviation additional Treasury purchases at the mean leads to 13.1 bps additional C&I loan growth, again annualized. Column 3 includes both MBS and Treasury purchases and finds that the effects from columns 1 and 2 remain similar in magnitude and statistically similar.

As in Section II.A, a possible concern is that banks with high MBS holdings may have other characteristics that is driving their response in terms of C&I lending. Hence, we calculate the additional MBS holdings of a bank beyond what is predicted by observable bank characteristics. This, in effect, orthogonalizes banks' MBS holdings from other bank characteristics. We perform an analogous procedure for the securities holdings as well. Column 4 reports that as before, the results remain statistically and economically significant: banks with higher MBS holdings, even after controlling for other bank characteristics, provide less new C&I loans compared to banks with lower MBS holdings.

Columns 5 and 6 focus on banks that securitize MBS to confirm that the observed effects are stronger for banks that benefit more from MBS purchases. Indeed, we again find effects six times stronger in column 5 compared to column 4; one standard deviation additional MBS purchases at the mean leads to 54.7 bps less C&I loan growth for securitizing banks.¹⁰ In our sample period, the average annual C&I loan growth rate is 6.32 percentage points per year. In dollar terms, loan growth is approximately \$69.44 billion per year.¹¹

Since more than 40% of the total loan volume is originated by the securitizers, loan growth is depressed by approximately 152 million dollars per year due to a one standard deviation increase in MBS purchases. For each hundred dollars of additional MBS purchases at the mean, aggregate loan growth is depressed by 40 cents per year. Given that QE has led to approximately 1.76 trillion

¹⁰The calculation is $-0.344 \times 4 \times 0.01 \times (\log(142.8 + 95.3) - \log(95.3)) = 54.72$ bps.

¹¹See <https://fred.stlouisfed.org/series/CILACBQ158SBOG> for loan growth rate data and <https://fred.stlouisfed.org/series/BUSLOANS> for dollar amount change data.

dollars of MBS holdings,¹² this translates into a reduction of 7.05 billion dollars in terms of loan growth. For the eight year sample period, this translates to a gross reduction of approximately 28.2 billion dollars of C&I loans. Column 6 shows that controlling for Treasury purchases and whether banks have high securities holdings do not change the results obtained in column 5.

While the impact of asset purchases on C&I lending is not the main focus of Rodnyanski and Darmouni (2016), they find some evidence that the C&I lending grew during QE1 and QE3. Our results differ because, as discussed before, the authors use the timing of QEs as the source of exogenous variation. Therefore, *any* policy or aggregate variation that coincides with the timing of QEs is utilized as part of the source of variation in their analysis.¹³ Because Rodnyanski and Darmouni (2016) use three QE time period indicators as their treatment, they cannot differentiate between the impacts of Treasury and MBS purchases during QE1 and QE3.¹⁴

II.C Unintended Real Effects on Firm Investment

The third question that we address is if there are unintended real effects of QE on firm investment. Our approach evaluates the impact of monetary policy on the real economy by tracing the impact of asset purchases by the U.S. Federal Reserve through banks' balance sheets onto firms that have financing relationships with those banks. Thus, the aggregate impact of asset purchases is identified using micro-data at the firm-level.

An identification challenge in this case is that there is an inherent endogeneity in the choice of lending relationships between firms and banks. It is possible that firms with different capital demands pair with banks which have different exposures to these asset purchases. We address this possibility in three ways: in all specifications we include firm-bank pair fixed effects, which

¹²See <https://fred.stlouisfed.org/series/MBST> for MBS holdings of the Federal Reserve and <https://fred.stlouisfed.org/series/TREAST> for Treasury holdings data.

¹³Examples include Housing and Economic Recovery Act of 2008 which sought to insure \$300 billion in new mortgages was introduced in the same time period as QE1. Duchin and Sosyura (2012) and Berger and Roman (2015) have investigated the \$205 billion TARP investments in banks which happened mostly between November 2008 and December 2009 at the same time as QE1. Many of the banks that received TARP support were in distress due to real estate market exposure.

¹⁴A more detailed comparison of our approaches is available on request.

remove any time-invariant differences across lending relationships (α_{ij}). Second, it is possible that firm-demand for capital and investment changes over time in a manner that is correlated with the lending bank’s holdings. For example, local economic conditions can be driving firm investment decisions and bank MBS holding decisions. Hence, in addition to standard firm-level controls, in all specifications we include firm’s state by year-quarter fixed effects (γ_{sit}). These fixed effects remove any common economic shocks to all firms headquartered in a given state, regardless of their lending bank’s location. In addition, to address time-variant matching between banks and firms that can be correlated with MBS or securities holdings of the bank, we include interaction terms between firm characteristics and the MBS holdings tercile, securities holdings tercile, or securitization status of the bank.

Our regression specifications estimate the impact of the Federal Reserve’s asset purchases on firm investment through the bank lending channel. Specifically, we focus on the investment of firm i in quarter t which borrows from bank j :

$$\text{Investment}_{ijt} = \beta_1 \text{Firm Variables}_{it-1} + \beta_2 \text{Asset Purchase Variables}_{t-1} + \beta_3 \text{Bank Variables}_{jt-1} \\ + \beta_4 \text{Bank Asset Holdings}_{jt-1} \times \text{Asset Purch. Variables}_{t-1} + \alpha_{ij} + \gamma_{sit} + \varepsilon_{ijt}. \quad (2)$$

The coefficients of interest are the interaction variables that capture the heterogeneous impact of Treasury and MBS purchases depending on the holdings of the lending bank. The firm’s state by year-quarter fixed effects absorb the coefficients for *MBS Purchases* and *Treasury Purchases*. Similar to Section II.B, banks are divided into terciles based on MBS and non-MBS securities holdings. We also consider the group of high-MBS banks that report securitization income. These banks, based on our mechanism, should be the most affected by QE.¹⁵

All specifications include the following firm-level characteristics: firm cash flow, Tobin’s Q as measured by lagged market to book value, the financial health of the firm as measured by the Altman Z-Score, and firm size. The same bank-level controls as in Section II.B are included as

¹⁵We present similar specifications that instead use continuous versions of the MBS and securities holdings variables over the full sample in Appendix B.2.

well. Table IV reports results for investment regressions for firms that have an active lending relationship with at least one bank in a given year-quarter. The unit of observation in this panel is, therefore, a firm-bank-year-quarter observation.

Noting the coefficient of the interaction term in column 1, we find that firms that borrowed from banks with higher MBS holdings *decreased* investment following higher MBS purchases from the Federal Reserve. The mean quarterly purchase of Treasury and MBS during our sample period is 70.3 billion USD and 95.3 billion USD, respectively. One percent additional MBS purchases at the mean, which is 953 million USD per quarter, led to a decrease of 0.99% of a standard deviation in terms of firm-level investment.¹⁶ Micro effects of aggregate policy, especially monetary policy, are generally small. Given that, these effects on firm-level investment are significant, and when aggregated to the macro-level, show large impacts on the economy.

To demonstrate this, we conduct a back of the envelope calculation. First, the average quarterly gross domestic private investment is approximately 2.394 trillion dollars in the sample period and the mean investment in the sample period is 5.74% of PP&E per quarter. Let us assume that firm-bank relationships are equally distributed across banks.¹⁷ Under this assumption, we obtain an estimate of 36.9 million USD decrease in private investment due to one percent (953 million) higher MBS purchases.¹⁸ Thus, for each dollar invested in MBS purchases, firms that borrowed from banks with high MBS holdings decrease investment by 3.87 cents. This is a statistically and economically significant unintended negative effect on firm investment for firms that borrowed from banks with high MBS holdings.

In contrast, the impact of Treasury purchases on firm investment is negligible, as the coefficient of the interaction term *High Securities Holdings* \times *TSY Purchases* in column 2 is statistically insignificant. This evidence shows that the impact of asset purchases on firm investment through

¹⁶The calculation is $-0.053 \times 0.01 \times 0.01 \times 1/5.34\% = 0.99\%$, where 5.34% is the standard deviation of investment.

¹⁷This is a conservative estimate since larger banks have more relationships. Given that our estimation approach gives firms equal weights and in the data firm size distribution is positively skewed (Axtell, 2001), we conservatively handicap our mean estimate by half to adjust for the overestimation of the effect due to the skew. The argument is that the smaller firms are the more constrained ones, and hence the effect may be overestimated in the OLS regression.

¹⁸See <https://fred.stlouisfed.org/series/GPDIC1> for real gross private domestic investment. The calculation is $-0.053 \times 0.01 \times 1/5.74 \times 2394.81/3 \times 0.5 = -36.9\text{M}$.

a bank lending channel is asymmetric for Treasury and MBS purchases. Column 3 combines the two types of asset purchases and finds similar results. Similar to Table III, column 4 calculates the residual MBS holdings and residual non-MBS securities holdings after controlling for bank characteristics. The coefficient of interaction of banks in the highest orthogonalized MBS holding tercile and MBS purchases is statistically and economically similar to the coefficients in columns 1 and 3.¹⁹

Columns 5 and 6 test our mechanism further by focusing on banks that are securitizers and are in the highest tercile of MBS holdings. In both columns we find that firms which borrow from MBS securitizer banks invest less in response to MBS asset purchases.²⁰

These results show the unintended real effects of MBS purchases during QE: there is a negative effect of MBS purchases on firm investment through the bank lending channel. We do not find statistically significant evidence that Treasury purchases affect firm investment through its lending bank, suggesting that Treasury purchases and MBS purchases are dissimilar instruments for transmitting economic stimulus.

II.D Additional Evidence of the Effect of Asset Purchases on C&I Lending

To address the concern that firm-level characteristics, rather than credit supply was the reason for decline in C&I lending in response to MBS purchases, this section conducts two additional tests.

¹⁹The coefficient for *High MBS Holdings* in column 4 is absorbed by the firm-bank fixed effects, as none of the orthogonalized MBS tercile banks switch between the top and bottom tercile in this sample.

²⁰An alternative approach to conduct the analysis in this section is to aggregate the characteristics of all banks lending to a firm in a given quarter into those of one “average” bank. Our results are generally robust in this case as well. We prefer our framework because we can explicitly control for differences in specific lending relationships with firm-bank fixed effects. For example, the nature of a bank’s relationship with an established multinational firm may be very different from its relationship with a young smaller firm (see Petersen and Rajan, 1994; Karolyi, 2017, for example, regarding the importance of lending relationships). Our identification is then obtained within a firm-bank relationship: specifically, how the treatment of monetary stimulus affects a firm through a specific bank over the course of their relationship.

II.D.1 Loan Amount Evidence

We first investigate the loan amounts obtained by firms in response to asset purchases. As in Section II.C, we want to rule out any firm-demand factors that could be affecting our results. Here, we do so by focusing on the subset of firms which originate loans with different lenders at the same point in time. We use firm by year-quarter fixed effects (θ_{it}) to remove any variation specific to a given firm in a given quarter. Any remaining differences in loan sizes, therefore, will not be driven by differences in firm demand for capital.

The most exhaustive regression specification that estimates the impact of the asset purchases on loan amount through the bank lending channel in year-quarter t for firm i which borrows from bank j is:

$$\begin{aligned} \text{Loan Amount}_{ijt} = & \beta_1 \text{Loan Controls}_{ij} + \beta_2 \text{Asset Purchase Variables}_{t-1} + \beta_3 \text{Bank Variables}_{jt-1} \\ & + \beta_4 \text{Bank Asset Hldgs}_{jt-1} \times \text{Asset Purch Vars}_{t-1} + \alpha_j + \theta_{it} + \varepsilon_{ijt}. \end{aligned} \quad (3)$$

The coefficients of interest are, as before, the vector of β_4 . Table V reports the results. Columns 1–4 use the amount of MBS and other securities held by banks to trace the effect of asset purchases on commercial lending. Specifically, we focus on those banks which are in either the highest or lowest tercile of MBS holdings or securities holdings in our sample.²¹ Columns 5 and 6 focus specifically on the securitizer banks. These banks, as we argue in Section I.B.1, benefit more from MBS purchases as compared to banks that do not securitize. In addition to controls that have been discussed in Section II.C, the specifications also include loan level controls that include indicators for whether the facility is for takeover purposes, is a revolving credit line, or is a term loan.

Column 1 provides the estimates of the impact of MBS purchases by the Federal Reserve on the credit supply of banks with higher MBS holdings. One standard deviation (142.8B) higher purchase of MBS at the mean of 95.3 billion USD in the prior quarter leads to 3.97 bps lower loan amounts from banks to firms when the bank is in the top tercile of MBS holdings among U.S.

²¹Because none of the banks in this subsample change between the highest and lowest terciles for MBS or securities holdings, those specific controls are absorbed by the bank fixed effects α_j .

banks. Column 2 does not find statistically significant effects for Treasury purchases.

Column 3, which includes both types of asset purchases, shows that for a one standard deviation increase in MBS purchases, loan amounts from banks with higher MBS holdings decrease by 8.15 bps. In contrast, for one standard deviation higher Treasury purchases, loan amounts increase by 6.0 bps on average; although this result is significant only at the 10% level. As before, in column 4 we calculate the MBS and securities holdings for each bank orthogonalized to the bank's characteristics. This refinement in the method of calculating banks with high MBS or securities holdings does not change the results qualitatively.

Since our economic mechanism focuses on securitizing banks, an important test is whether the aforementioned effects are stronger in the subsample of securitizing banks. Given the institutional details surrounding these purchases, especially for the MBS purchases, we suspect that securitizer banks will be most sensitive to the purchases. Columns 5 and 6 investigate this question. Indeed, we find that MBS purchases led to a negative effect almost two times stronger than in column 1 when we focus only on banks that are securitizers. One standard deviation higher MBS purchases leads to 7.1 bps lower loan amounts from MBS securitizer banks. Column 6 suggests that Treasury purchases have a positive effect in the case of banks with high securities holdings, although the results are significant only at the 10% level. These results corroborate the observation that MBS and Treasury purchases have different effects.

Overall, we find that when controlling for firm demand factors by only comparing loans given to the same firm, banks which have higher exposure to MBS purchases (whether measured by high MBS holdings or active securitization) respond by reducing the amount of capital to borrowing firms.

II.D.2 Loan Growth Evidence

The prior section compared loan amounts from different banks to the same firm in the same quarter to most exhaustively control for firm-specific demand effects. A complementary approach is to track changes in the individual loan shares of specific banks to a given firm before and after

quarters with asset purchases. In addition to documenting the reduction in total loan amount when a relationship bank is exposed to asset purchases (as in Section II.D.1), we can see if other exposed members of the syndicate reduce their commercial lending as well.

Following Khwaja and Mian (2008) and Lin and Paravisini (2012), among others, this section investigates the firm-bank pair loan growth after controlling for firm characteristics and aggregate economic conditions. Using loan-level data from Dealscan, we first create a year-quarter level total supply of credit by each bank to each firm in Compustat. This is in effect the credit supply by banks active in the C&I market to the firms in our sample. We then calculate firm-bank pair level growth of C&I lending per quarter by averaging over a rolling window of four-quarters. The regression specification that estimates the impact of the asset purchases on C&I lending in year-quarter t for firm i which borrows from bank j is:

$$\begin{aligned} \text{Log Loan Growth}_{ijt} = & \beta_1 \text{Asset Purchase Variables}_{t-1} + \beta_2 \text{Bank Variables}_{jt-1} \\ & + \beta_3 \text{Bank Asset Hldgs}_{jt-1} \times \text{Asset Purch Vars}_{t-1} + \alpha_i + \gamma_j + \theta_t + \varepsilon_{ijt}. \end{aligned} \quad (4)$$

The coefficients of interest is the vector of β_3 . Table VI reports the results.

Column 1 shows that banks that are in the top tercile of MBS holdings, have 1.6 percentage points slower loan growth to individual firms in response to one standard deviation additional MBS purchases. This number is larger than that in Section II.B because of how the sample is created in this case. We are now focusing on the sample of banks that actually lent to Compustat firms in Dealscan rather than the sample of all banks in the Call Report data lending to all firms. Column 2 suggests that Treasury purchases have a positive effect on C&I loan growth. These results remain similar when we integrate the specifications of the first two columns in column 3. As before, we refine the MBS and securities holdings measures by orthogonalizing these holdings to other bank characteristics and ranking them based on the refined measures. Column 4 reports that the results remain robust to this refinement.

Columns 5 and 6 focus on banks that securitize MBS. Column 5 shows that one standard devi-

ation additional MBS purchases at the mean leads to 1.48 percentage points less C&I loan growth for securitizing banks to individual firms.²² Column 6 shows that including Treasury purchases and whether banks have high securities holdings do not affect the results.

III Additional Discussion and Robustness

Section III.A considers the role of bank constraints for our negative commercial lending results. Section III.B looks at how commercial lending is affected by asset purchases in the early and later parts of the QE period. Section III.C investigates the impact of asset purchases based on whether firms are capital constrained. Section III.D investigates how banks that benefited from MBS purchases increased mortgage lending, both in terms of the risk of the loans and which geographic markets they concentrated on.

III.A Commercial Lending and Bank Constraints

In this paper, we argue that the negative C&I growth result is driven by the mortgage origination channel related to QE. Our argument requires us to show that the mortgage originating banks are responding to MBS purchases by increasing mortgage lending activity. The results from Section II.A provide evidence of this.

In addition, it is also necessary that these securitizing banks which drive the origination channel were sufficiently constrained that they needed to substitute away from other types of lending, and C&I lending in particular. To test this, in Table VII, we split the securitizer banks into constrained and unconstrained subsamples. Specifically, we consider banks that are in the lowest tercile for both demand deposits to total assets and tier 1 capital as constrained, and banks that are in the highest tercile for both demand deposits to total assets and tier 1 capital as unconstrained. Cornett, McNutt, Strahan, and Tehranian (2011) show that during the financial crisis and the period following, banks that were constrained by these particular measures had to take steps to manage liquidity

²²The calculation is $-0.931 \times 4 \times 0.01 \times (\log(142.8 + 95.3) - \log(95.3)) = 1.48\%$.

and as a result cut credit supply.

Comparing the securitizers in the two subsamples, we find that the reduction in C&I lending is strongest for the constrained subsample. The effect for the constrained securitizer banks is significant at the one percent level and is also significantly different than the effect for the unconstrained securitizers banks. The unconstrained securitizers do not adjust their C&I lending in a significant manner in response to the MBS purchases.

Part of the reason for this reduction is that engaging in additional mortgage lending does tie up what capital these constrained banks have available. Even for banks which are originating mortgages with the sole purpose to quickly distribute as MBS, Demyanyk and Loutskina (2016) estimate that for more active banks, the temporary mortgage holdings would lead to 1% higher capital requirements. For banks that are already near the lower boundary of capital requirements, it is understandable that banks would cut back on other types of lending that already carry larger capital requirements. In our sample, 23% of banks are within 5 percentage points of the 6% requirement for being considered well-capitalized according to their tier 1 capital ratio. As C&I loans generally carry a 100% risk weight, reducing new C&I lending is an effective way to help offset the increase from new mortgage activity.

Considering the evidence above, along with the evidence of Sections [II.A](#) and [II.B](#), the origination channel drives up mortgage lending at the expense of C&I lending. Further, the net effect of a possible capital gains channel from MBS purchases and the origination channel does not create a positive stimulus to commercial lending. The unintended negative consequence is most significant for the most constrained banks that are active in the mortgage market. For Treasury purchases, which does not have an equivalent origination channel, we do see a positive effect consistent with capital gains for those banks with large non-MBS securities holdings.

III.B Commercial Lending in Different QE Periods

In Section [II.B](#), we show that banks particularly exposed to the Federal Reserve's MBS purchases reduce their commercial loan growth. We further find that the effects that are strongest for those

banks which are the most constrained. A related question is whether the effect varied over the QE period. Specifically, the banking sector as a whole was most constrained during the financial crisis and the period leading up through QE1. Although there continued to be macroeconomic issues during QE2 and QE3, the banking sector was recovering.

In Table VIII, we split our main interaction variables into two parts: the effect of MBS and Treasury purchases through QE1 and the effect of MBS and Treasury purchases post QE1. Column 1 presents the MBS and securities holdings terciles and column 2 presents the orthogonalized versions. We find that for banks with high MBS holdings, the effect of MBS purchases is concentrated in the period through QE1. This is consistent with banks being more constrained on average in that period and would be more likely to cut commercial lending when increasing mortgage lending to alleviate capital charges. At the same time, the strongest effects for Treasury purchases on commercial lending appear after QE1. Although banks are benefiting from the capital gains channel across both periods, the banks did not actively convert those gains into more commercial lending through QE1. From a capital requirements standpoint, Treasuries and other government agency debts carry a 0% risk weight and GSE obligations and general obligations of state and local governments carry a 20% risk weight. If banks were already constrained, selling these types of securities and increasing their commercial lending (which carries a 100% risk weight) would be particularly costly.

Column 3 of Table VIII looks at the effect of MBS purchases on securitizing banks depending on the time period. In this case, both the period through QE1 and after QE1 show strong negative effects. The origination channel of QE is sufficiently strong for these particular banks that throughout the QE period they see mortgage origination and MBS production as the focus of additional lending activity at the continued expense of new commercial lending.

III.C Constrained Firms and Asset Purchases

The analysis so far has focused mainly on the heterogeneity among banks. However, for the reduction in firm investment to be driven by banks reducing C&I lending, the firms must face

some capital constraints. Otherwise, these firms would simply move to another source of capital, such as another bank or public debt markets.

Table IX divides firms by likelihood of facing financing constraints in two different manners.²³ In columns 1 and 2, we split the firms based on firm size and interact the amount of MBS and Treasury purchases with the lending bank's exposure to the respective asset classes. We find that the negative investment effect for firms that borrow from banks with higher MBS holdings during MBS purchases is concentrated in the smaller firms in our sample. The effect on larger firms is also negative and significant but smaller, and the difference between the two samples is statistically significant at the 5% level.

Columns 3 and 4 split the sample of firms based on their access to the bond markets. The assumption is that if a firm does not have an investment grade bond rating, then it will have significantly less access to bond markets (Faulkender and Petersen, 2006). We find that firms without an investment grade rating are the ones that experience a lower investment in the presence of MBS purchases. The difference in investment between constrained and unconstrained firms in response to MBS purchases is statistically significant. The impact of Treasury purchases is negligible in both categories when we split the sample by firm-level constraints. This again is an important result if the prior is that Treasury purchases positively affect firm investment decisions.

III.D New Mortgage Lending: Risk and Affordability

This section investigates how banks that benefited from MBS purchases during QE increased mortgage lending. This is important because this relates to the intended consequence of QE, i.e. additional mortgage lending. We investigate the new lending on two dimensions: riskiness and affordability.

As discussed in Section I.B.2, HMDA only includes rate data if the mortgage APR is 3 percentage points above the equivalent-maturity Treasury rate. As such, we analyze if banks increased

²³There is no estimated coefficient for *High MBS Holdings* in columns 2 and 4 because none of these banks move between the highest and lowest MBS terciles in this sample. The variable is therefore absorbed by the firm-bank fixed effect.

riskier loans (defined by the higher interest rate) to gain the additional market share. We use this subsample for the analysis in this section. Column 1 of Table X focuses on the dollar-weighted average interest rate spread charged by banks for the subsample of loans with rate data and column 2 focuses on the banks' market share of the loans in this subsample. We find that banks with higher MBS holdings offered a lower rate in response to MBS purchases but did not change their market share. This finding is reassuring as the MBS purchases reduced mortgage rates. Columns 3 and 4 re-conduct the analysis using the MBS holdings for each bank orthogonalized with respect to other bank characteristics. The results remain similar to those in columns 1 and 2.

Columns 5 and 6 repeat the analysis with the concentrated set of banks that securitize mortgages. In column 5, we find these banks lowered their average interest rate spread following MBS purchases. In column 6, the positive coefficient on the interaction term suggests that these banks do increase their market share of riskier loans in the state in a period when MBS asset purchases take place. The higher risk by these banks may be another potential unintended consequence of QE.

We now analyze how a bank's market share changes across its markets as a function of the housing affordability and QE. Housing affordability is measured as the ratio of housing prices and per capita income in the CBSA. The higher the ratio, the lower is the affordability. Less affordable housing markets can have higher default risk in case of an economic shock. Thus, banks lending more in such areas may be taking more balance sheet risk. Focusing on the CBSA in this case helps us to ensure that the income variation across the geographical unit is not too large.

Column 1 of Table XI documents the role of housing affordability on the bank's market share. There is no significant effect of housing prices on its own. Column 2 introduces an indicator for whether the bank is an active securitizer and for MBS purchases by the Federal Reserve. The significant coefficient of the triple interaction term in column 2 shows that in response to MBS purchases by the Federal Reserve, securitizer banks increase their market share more in areas where affordability of house prices is lower. Column 3 includes CBSA-level fixed effects in addition to the bank by year-quarter fixed effects and finds similar results.

A concern may be that the differences in housing affordability may be driven by differences in the level of economic activity, and banks are increasing market share as a response to higher demand for mortgages in areas with stronger economic activity. To address this, columns 4–6 instrument the housing affordability variable (and its interaction terms) with the instruments discussed in Section [I.B.2](#). The first-stage specifications for these columns are presented in Table [B.4](#) in the Appendix. In columns 4–6, we find results broadly consistent with our OLS results from columns 1–3. Thus, securitizer banks increase market share most in those CBSAs with lower affordability. These findings suggest that securitizer banks are taking more risk in response to QE stimulus. We find similar results if we focus on housing price levels directly (Appendix [B.1](#)).

IV Conclusion

Much research focuses on the negative effects of large downturns in the economy and the benefits of monetary policy support. In this paper, we consider the impact of quantitative easing on bank lending and firm investment.

We find that banks which benefit from MBS asset purchases increase mortgage lending. However, an important unintended consequence is that these active-MBS banks reduce commercial lending. The reduced lending has real effects. Firms which borrow from these banks decrease investment as a result. Treasury purchases do not lead to the same response. A separate finding is that the positive impact of Treasury purchases during quantitative easing through the bank lending channel on private investment seems to be small.

Policymakers have argued for the need to support important asset markets in order to increase consumer wealth, consumer demand, and real economic activity. When considering intervention in certain asset markets, such as the housing and Treasury markets, it is important to consider the potential asymmetric effects on banks and firms.

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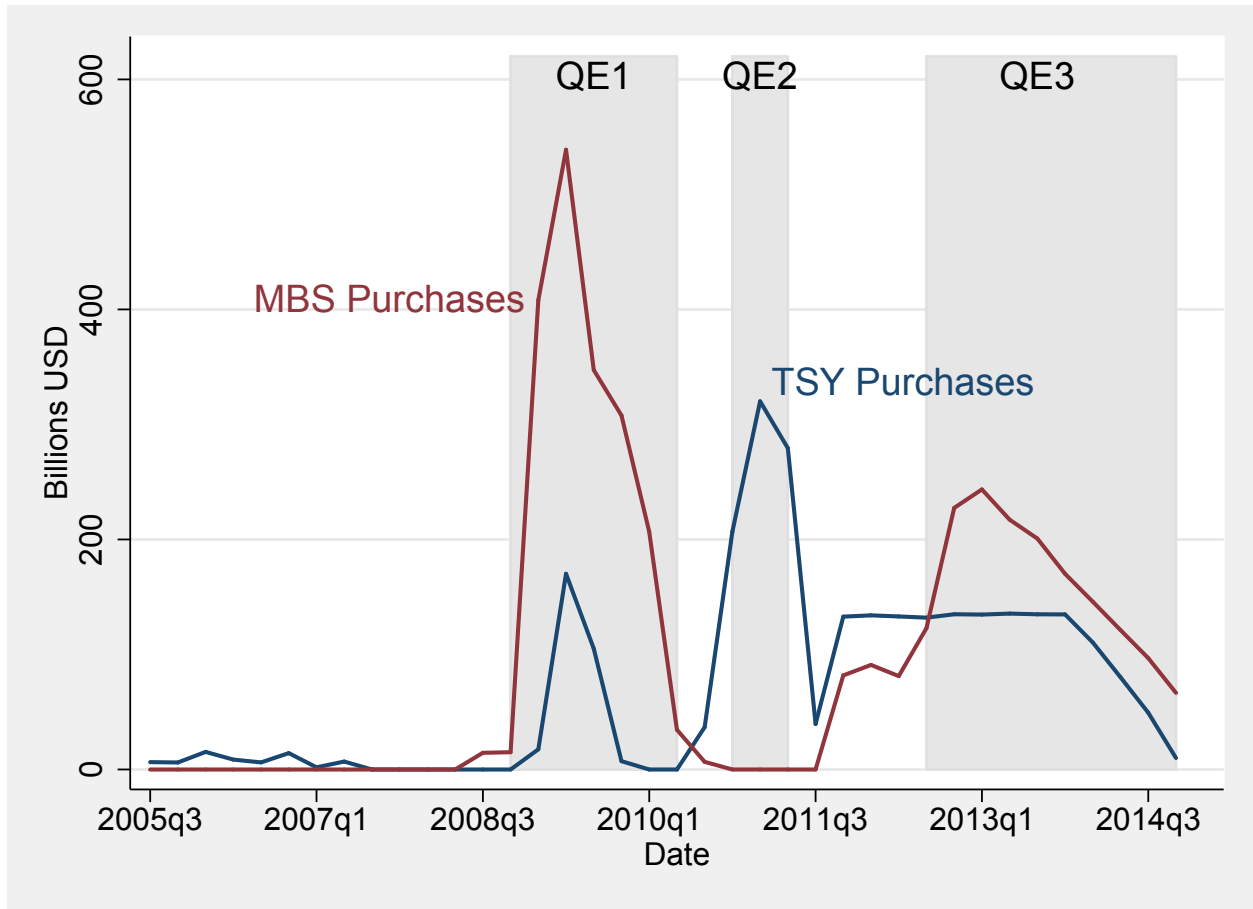


Figure 1: Quarterly totals of Treasury (TSY) and mortgage-backed security (MBS) purchases by the Federal Reserve. The MBS purchases include purchases of direct GSE/GOE obligations done in late 2008. Source: New York Federal Reserve.

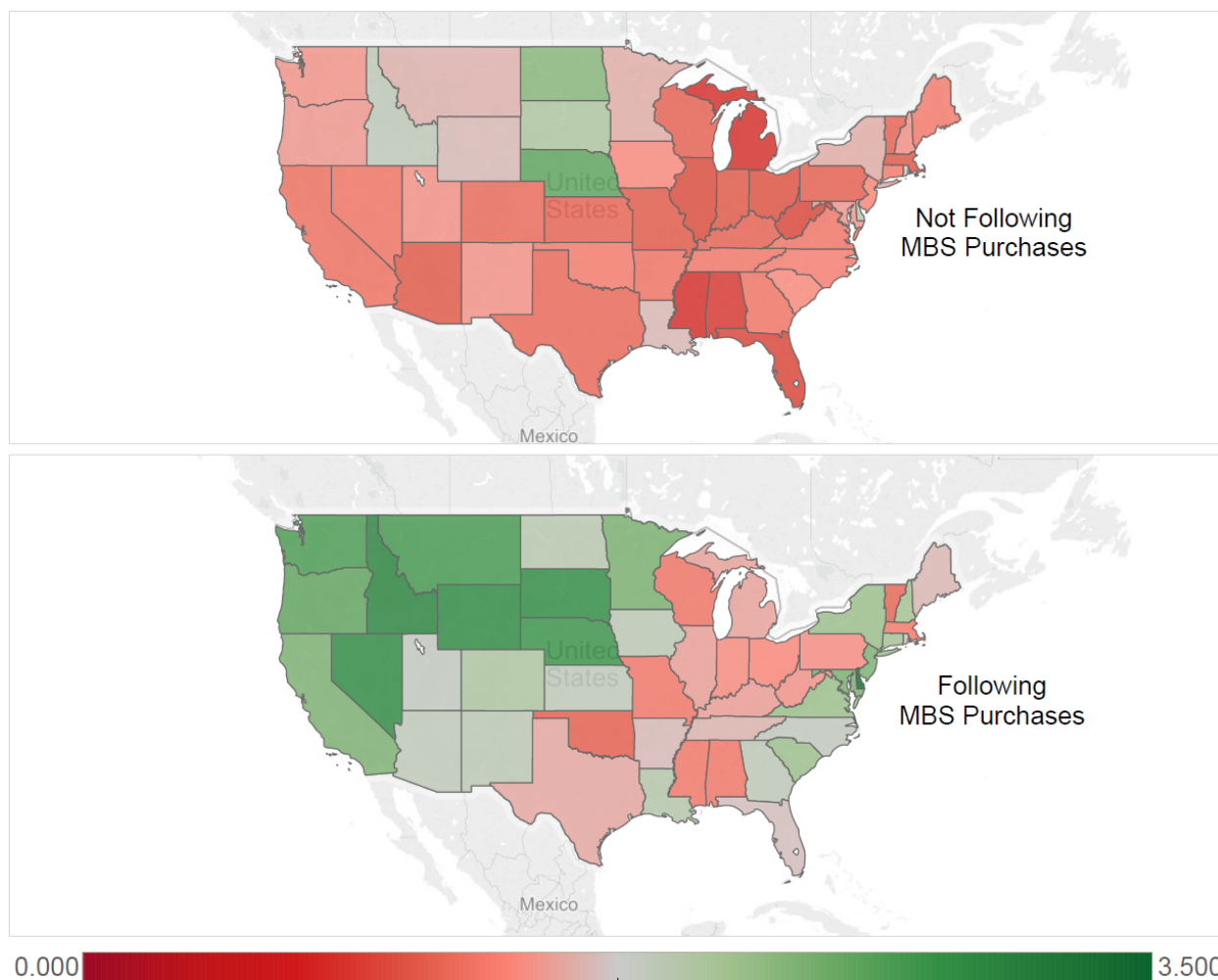


Figure 2: Average state-level mortgage origination market share for securitizer banks, in percentage points. Top panel includes years not following fourth-quarter MBS purchases (2007, 2008, 2009, 2012). Bottom panel includes years following fourth-quarter MBS purchases (2010, 2011, 2013, 2014).

Table I: Summary Statistics

This table presents summary statistics of the merged sample of bank holding companies and borrowing firms as obtained from Call Report, HMDA, Dealscan, and Compustat databases. Our sample period runs from 2005q4 through 2013q4. All variables are constructed at a quarterly frequency, with the exception of the mortgage market share and interest rate variables, which are computed at an annual frequency.

Panel A: Bank and Macroeconomic Variable Statistics						
	Mean	Std Dev	25th Pctile	Median	75th Pctile	# Obs.
<i>Bank Variables</i>						
MBS Holdings	7.01	8.32	0.21	4.02	10.8	162,858
Securities Holdings	14.5	11.5	5.71	11.8	20.5	162,858
U.S. Gov. Securities Holdings	8.25	8.95	1.69	5.48	11.7	162,858
C&I Loan Growth	1.58	13.8	-4.88	0.31	6.34	162,858
Bank's Size	12.2	1.36	11.3	12.0	12.9	162,858
Bank's Equity Ratio	10.4	2.79	8.60	9.83	11.5	162,858
Bank's Net Income	0.49	0.69	0.21	0.47	0.85	162,858
Bank's Cost of Deposits	1.08	0.83	0.43	0.83	1.55	162,858
Bank's Tier 1 Capital	15.0	5.89	11.1	13.4	16.9	162,858
Bank's Demand Deposits	12.0	7.02	6.86	11.0	15.6	162,858
Securitizer	0.0035	0.059	0	0	0	162,858
Change in Unemp. Rate, Bank's State(s)	0.048	0.48	-0.20	0	0.20	162,858
GSE/GOE Seller	0.25	0.43	0	0	0	21,912
National Mortgage Orig. Market Share (bps)	1.49	26.7	0.032	0.091	0.27	21,912
State-Level Mortgage Orig. Market Share (bps)	26.2	123.1	0.16	0.99	6.47	69,408
Average Rate, State Level (bps)	352.0	127.0	245.5	350.6	428.4	34,358
Rate-Related State-Level Market Share (bps)	105.9	264.8	4.48	19.2	72.0	34,358
CBSA-Level Mortgage Orig. Market Share (bps)	85.0	227.5	1.17	5.43	46.2	90,268
CBSA Housing Price Index	278.8	135.1	193.1	252.2	344.8	90,268
HPI CBSA to Per Capita Income	3.55	1.57	2.55	3.32	4.29	90,268
CBSA Land Unavailability	23.1	20.3	6.62	15.2	34.4	90,268
<i>Macroeconomic Variables</i>						
30-Year Mortgage Rate	5.17	1.07	4.37	5.06	6.18	33
TSY Purchases (Bil. USD)	70.3	88.0	1.88	15.3	134.0	33
MBS Purchases (Bil. USD)	95.3	142.8	0	6.65	200.8	33

Table I—Continued

Panel B: Relationship, Loan, and Firm Variable Statistics						
	Mean	Std Dev	25th Pctile	Median	75th Pctile	# Obs.
<i>Number of Relationships</i>						
Bank Holding Companies per Borrower	1.43	0.71	1	1	2	3,411
Borrowers per Bank Holding Company	82.6	217.5	2	5	69	59
<i>Length/Frequency of Relationships</i>						
Length of Relationship	5.38	3.45	3	5	6.63	916
Number of Loan Packages	2.25	1.74	1	2	3	4,602
Loan Facilities per Loan Package	1.80	1.27	1	1	2	10,336
<i>Loan Characteristics</i>						
Loan Amount	19.5	19.7	6.42	13.3	26.2	6,016
All In Drawn Spread (bps)	195.3	136.9	100	175	250	6,016
Maturity (months)	51.5	19.3	37	60	60	6,016
Takeover Loan	0.17	0.38	0	0	0	6,016
Revolving Credit Line	0.72	0.45	0	1	1	6,016
Term Loan	0.24	0.43	0	0	0	6,016
<i>Firm Variables</i>						
Investment	5.74	5.34	2.59	4.33	7.13	66,887
Cash Flow	12.2	31.8	3.21	8.38	19.4	66,887
Lagged Market-to-Book	1.66	0.89	1.12	1.41	1.89	66,887
Lagged Z-Score	0.59	1.41	0.26	0.75	1.21	66,887
Lagged Firm Size	7.42	1.73	6.27	7.40	8.56	66,887

Table II: Mortgage Market Share Regression

Columns 1 through 5 are panel fixed effect regressions. *Mortgage Origination Market Share* is the state-level market share (in basis points) for a given bank in a particular state and year. *High MBS Holdings* takes a value of 1 if the lending bank is in the top tercile by MBS securities to total assets, and a value of 0 if in the bottom tercile. *MBS Purchases* is the quarterly log-dollar amount of gross Federal Reserve MBS purchases from the fourth quarter of the prior year. *Securitizer* takes a value of 1 if a high-MBS bank reported non-zero securitization income and 0 otherwise. *Orthog. MBS Holdings* refers to whether the MBS terciles have been orthogonalized to other bank characteristics. Standard errors are clustered by bank.

	Mortgage Orig Market Share				
	(1)	(2)	(3)	(4)	(5)
High MBS Holdings	-4.060 (2.580)	-1.800 (2.440)	-2.592 (2.127)		
High MBS Holdings \times MBS Purchases	0.605** (0.266)	0.562** (0.246)	0.351* (0.198)		
Securitizer				-26.42 (35.86)	-23.19 (35.80)
Securitizer \times MBS Purchases				4.273** (2.009)	4.194** (1.983)
Bank's Size (excl. loans)	9.643*** (3.583)	11.32*** (3.457)	7.373*** (2.462)	8.408** (3.384)	9.989*** (3.301)
Bank's Equity Ratio	-0.0251 (0.769)	0.163 (0.737)	-0.126 (0.684)	-0.154 (0.691)	0.0518 (0.676)
Bank's Net Income	1.262 (1.414)	1.589 (1.366)	2.081* (1.146)	1.684 (1.282)	1.991 (1.260)
Bank's Cost of Deposits	-3.242 (4.795)	-2.423 (4.715)	-0.362 (4.536)	-1.753 (4.767)	-0.965 (4.695)
Change in Unemp. Rate, Bank's State(s)	-1.809** (0.826)	-1.105 (1.224)	-1.262 (1.045)	-1.716** (0.836)	-1.008 (1.182)
Orthog. MBS Holdings	No	No	Yes	No	No
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes
Year-Quarter Fixed Effects	Yes	No	No	Yes	No
State by Year-Quarter Fixed Effects	No	Yes	Yes	No	Yes
Observations	45582	45582	39993	45582	45582
Adjusted R^2	0.482	0.508	0.289	0.483	0.509

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table III: C&I Loan Growth

Columns 1 through 6 are panel fixed effect regressions. *C&I Loan Growth* is the growth rate in C&I loans between the current and prior quarter, scaled by 100. *High MBS Holdings* takes a value of 1 if the lending bank is in the top tercile by MBS securities to total assets, and a value of 0 if in the bottom tercile. *High Securities Holdings* takes a value of 1 if the lending bank is in the top tercile by all non-MBS securities to total assets, and a value of 0 if in the bottom tercile. *MBS Purchases* is the lagged quarterly log-dollar amount of gross Federal Reserve MBS purchases. *TSY Purchases* is the lagged quarterly log-dollar amount of gross Federal Reserve TSY purchases. *Securitizer* takes a value of 1 if a high-MBS bank reported non-zero securitization income and 0 otherwise. *Orthog. MBS/Sec. Holdings* refers to whether the MBS and securities terciles have been orthogonalized to other bank characteristics. Standard errors are clustered by bank.

	C&I Loan Growth					
	(1)	(2)	(3)	(4)	(5)	(6)
High MBS Holdings	0.421 (0.471)		0.524 (0.468)	0.726 (0.524)		
High MBS Holdings \times MBS Purchases	-0.0469** (0.0209)		-0.0452** (0.0209)	-0.0584** (0.0233)		
Securitizer					1.634 (1.298)	1.589 (1.292)
Securitizer \times MBS Purchases					-0.344*** (0.101)	-0.342*** (0.100)
High Securities Holdings		0.949* (0.563)	0.968* (0.563)	1.062* (0.642)		0.943* (0.563)
High Securities Holdings \times TSY Purchases		0.0928*** (0.0312)	0.0920*** (0.0312)	0.103*** (0.0337)		0.0929*** (0.0312)
Bank's Size (excl. loans)	0.335 (0.315)	0.0834 (0.328)	0.0775 (0.329)	0.229 (0.356)	0.355 (0.314)	0.0931 (0.327)
Bank's Equity Ratio	0.862*** (0.0624)	0.846*** (0.0621)	0.851*** (0.0621)	0.819*** (0.0710)	0.861*** (0.0625)	0.849*** (0.0621)
Bank's Net Income	0.0319 (0.151)	0.0399 (0.150)	0.0412 (0.150)	0.0217 (0.178)	0.0271 (0.151)	0.0370 (0.150)
Bank's Cost of Deposits	-0.867*** (0.331)	-0.908*** (0.331)	-0.918*** (0.331)	-1.010*** (0.371)	-0.871*** (0.331)	-0.924*** (0.331)
Change in Unemp. Rate, Bank's State(s)	-0.758 (1.267)	-0.830 (1.267)	-0.818 (1.267)	-1.211 (1.539)	-0.704 (1.266)	-0.771 (1.266)
Orthog. MBS/Sec. Holdings	No	No	No	Yes	No	No
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Bank's Primary State Year-Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	77950	77950	77950	64350	77950	77950
Adjusted R^2	0.0542	0.0546	0.0546	0.0518	0.0543	0.0547

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table IV: Impact of Monetary Stimulus on Firms

Columns 1 through 6 are panel fixed effect regressions. *Investment* is the firm's quarterly capital expenditures divided by lagged PPE, scaled by 100. *High MBS Holdings* takes a value of 1 if the lending bank is in the top tercile by MBS securities to total assets, and a value of 0 if in the bottom tercile. *High Securities Holdings* takes a value of 1 if the lending bank is in the top tercile by all non-MBS securities to total assets, and a value of 0 if in the bottom tercile. *Securitizer* takes a value of 1 if a high-MBS bank reported non-zero securitization income and 0 otherwise. *MBS Purchases* is the lagged quarterly log-dollar amount of gross Federal Reserve MBS purchases. *TSY Purchases* is the lagged quarterly log-dollar amount of gross Federal Reserve TSY purchases. *Additional Firm Interactions* include the firm variables (*Cash Flow*, *Lagged Market-to-Book*, *Lagged Z-Score*, *Lagged Firm Size*) interacted with *High MBS Holdings*, *High Securities Holdings*, or *Securitizer* variables, depending on the specification. *Orthog. MBS/Sec. Holdings* refers to whether the MBS and securities terciles have been orthogonalized to other bank characteristics. Standard errors are clustered by firm and bank.

	Investment					
	(1)	(2)	(3)	(4)	(5)	(6)
High MBS Holdings	-1.806 (1.336)		-2.155 (1.478)			
High MBS Holdings × MBS Purchases	-0.0530*** (0.0130)		-0.0672*** (0.0143)	-0.0480** (0.0241)		
Securitizer					-1.545 (1.419)	-2.027 (1.828)
Securitizer × MBS Purchases					-0.0458** (0.0222)	-0.0517** (0.0212)
High Securities Holdings		0.0760 (0.652)	0.151 (0.632)	-0.356 (0.659)		-0.130 (0.507)
High Securities Holdings × TSY Purchases		0.00722 (0.0153)	-0.00238 (0.0163)	0.00966 (0.0201)		-0.00478 (0.0169)
Cash Flow	0.00884*** (0.000765)	0.00289 (0.00274)	0.00693*** (0.00267)	0.00575 (0.00441)	0.00859*** (0.00216)	0.00663** (0.00266)
Lagged Market-to-Book	1.292*** (0.171)	1.022*** (0.0988)	1.089*** (0.172)	1.164*** (0.131)	1.405*** (0.157)	1.216*** (0.123)
Lagged Z-Score	0.441*** (0.103)	0.344*** (0.123)	0.335*** (0.0599)	0.656*** (0.139)	0.604*** (0.0877)	0.488*** (0.105)
Lagged Firm Size	0.0374 (0.275)	-0.545 (0.409)	0.0844 (0.301)	-0.199 (0.405)	-0.0114 (0.312)	0.0438 (0.353)
Bank's Size	0.271 (0.203)	0.0991 (0.233)	0.282 (0.179)	1.644*** (0.520)	0.170 (0.199)	0.203 (0.185)
Bank's Equity Ratio	0.00660 (0.0542)	0.00869 (0.0357)	-0.00374 (0.0454)	-0.304*** (0.106)	0.0110 (0.0469)	0.0124 (0.0417)
Bank's Net Income	-0.0194 (0.129)	-0.0246 (0.169)	-0.0282 (0.131)	-0.00361 (0.315)	-0.0311 (0.137)	-0.0411 (0.141)
Bank's Cost of Deposits	-0.166 (0.240)	-0.127 (0.254)	-0.0573 (0.234)	0.239 (0.830)	-0.256 (0.247)	-0.197 (0.247)
Change in Unemp. Rate, Bank's State(s)	-0.441 (0.273)	-0.330 (0.280)	-0.437 (0.278)	-0.723* (0.400)	-0.386 (0.257)	-0.383 (0.258)
Additional Firm Interactions	Yes	Yes	Yes	Yes	Yes	Yes
Orthog. MBS/Sec. Holdings	No	No	No	Yes	No	No
Firm-Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm State by Year-Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	32758	32758	32758	14234	32758	32758
Adjusted R ²	0.499	0.499	0.500	0.545	0.500	0.500

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Table V: Loan Amount Regression: Firms with Multiple Lenders

Columns 1 through 6 are panel fixed effect regressions. *Loan Amount* is the dollar amount of the facility divided by the lagged total assets of the firm and scaled by 100. *High MBS Holdings* takes a value of 1 if the lending bank is in the top tercile by MBS securities to total assets, and a value of 0 if in the bottom tercile. *High Securities Holdings* takes a value of 1 if the lending bank is in the top tercile by all non-MBS securities to total assets, and a value of 0 if in the bottom tercile. *MBS Purchases* is the lagged quarterly log-dollar amount of gross Federal Reserve MBS purchases. *TSY Purchases* is the lagged quarterly log-dollar amount of gross Federal Reserve TSY purchases. *Securitizer* takes a value of 1 if a high-MBS bank reported non-zero securitization income and 0 otherwise. *Loan Controls* include indicators for whether the facility is for takeover purposes, is a revolving credit line, or is a term loan. *Orthog. MBS/Sec. Holdings* refers to whether the MBS and securities terciles have been orthogonalized to other bank characteristics. Standard errors are clustered by firm and bank.

	Loan Amount					
	(1)	(2)	(3)	(4)	(5)	(6)
High MBS Holdings \times MBS Purchases	-0.0999** (0.0413)		-0.205*** (0.0764)	-0.496** (0.225)		
Securitizer \times MBS Purchases					-0.179** (0.0793)	-0.238** (0.106)
High Securities Holdings \times TSY Purchases		0.00380 (0.0466)	0.170* (0.0873)	0.0450 (0.116)		0.152* (0.0926)
Bank's Size	-0.138 (2.847)	0.152 (2.888)	0.170 (2.720)	38.06** (17.86)	-0.789 (2.887)	-0.562 (2.821)
Bank's Equity Ratio	0.350 (0.281)	0.306 (0.282)	0.0819 (0.282)	2.092* (1.093)	0.528 (0.340)	0.324 (0.354)
Bank's Net Income	1.263 (1.417)	1.235 (1.407)	1.200 (1.345)	7.522* (4.230)	1.115 (1.427)	0.994 (1.368)
Bank's Cost of Deposits	-3.608 (2.604)	-3.490 (2.537)	-4.509* (2.690)	-24.87** (10.11)	-4.608* (2.359)	-5.668** (2.428)
Loan Controls	Yes	Yes	Yes	Yes	Yes	Yes
Orthog. MBS/Sec. Holdings	No	No	No	Yes	No	No
Firm by Year-Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	400	400	400	274	400	400
Adjusted R^2	0.446	0.446	0.443	0.840	0.446	0.443

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table VI: Loan Growth Regression

Columns 1 through 6 are panel fixed effect regressions. *Log Loan Growth* is the log difference between the loan share for a specific bank to a specific firm in the four quarters after a given quarter compared to the four quarters before, expressed as a quarterly percentage. *High MBS Holdings* takes a value of 1 if the lending bank is in the top tercile by MBS securities to total assets, and a value of 0 if in the bottom tercile. *High Securities Holdings* takes a value of 1 if the lending bank is in the top tercile by all non-MBS securities to total assets, and a value of 0 if in the bottom tercile. *Securitizer* takes a value of 1 if a high-MBS bank reported non-zero securitization income and 0 otherwise. *MBS Purchases* is the lagged quarterly log-dollar amount of gross Federal Reserve MBS purchases. *TSY Purchases* is the lagged quarterly log-dollar amount of gross Federal Reserve TSY purchases. *Orthog. MBS/Sec. Holdings* refers to whether the MBS and securities terciles have been orthogonalized to other bank characteristics. Standard errors are clustered by firm and bank.

	Log Loan Growth					
	(1)	(2)	(3)	(4)	(5)	(6)
High MBS Holdings \times MBS Purchases	-1.014*** (0.307)		-0.959*** (0.331)	-1.680*** (0.387)		
Securitizer \times MBS Purchases					-0.933*** (0.297)	-0.865*** (0.287)
High Securities Holdings \times TSY Purchases		0.490** (0.225)	0.671*** (0.184)	0.746 (0.499)		0.438** (0.208)
Bank's Size	-16.50** (7.964)	-17.81** (8.893)	-15.44* (8.744)	-1.000 (8.830)	-16.25** (7.917)	-15.03* (8.487)
Bank's Equity Ratio	0.0663 (0.697)	0.463 (0.565)	0.529 (0.526)	-0.102 (1.558)	0.109 (0.646)	0.541 (0.529)
Bank's Net Income	-1.261 (1.689)	-0.255 (1.412)	0.160 (1.307)	6.053* (3.318)	-1.347 (1.733)	0.137 (1.374)
Bank's Cost of Deposits	3.677 (6.759)	0.582 (5.442)	2.866 (5.905)	5.490 (8.836)	2.237 (6.514)	1.024 (5.508)
Change in Unemp. Rate, Bank's State(s)	-4.213 (7.472)	-1.059 (7.563)	0.450 (6.770)	-1.440 (10.80)	-4.057 (7.618)	0.111 (7.307)
Orthog. MBS/Sec. Holdings	No	No	No	Yes	No	No
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1425	1425	1425	778	1425	1425
Adjusted R^2	0.324	0.323	0.325	0.444	0.323	0.324

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table VII: C&I Loan Growth and Bank Constraints

Columns 1 and 2 are panel fixed effect regressions. *C&I Loan Growth* is the growth rate in C&I loans between the current and prior quarter, scaled by 100. The constrained sample are those banks that are in the lowest tercile by both *Bank's Tier 1 Capital* and *Bank's Demand Deposits* and the unconstrained sample are those banks that are in the highest tercile for those two measures. *Securitizer* takes a value of 1 if a high-MBS bank reported non-zero securitization income and 0 otherwise. *High Securities Holdings* takes a value of 1 if the lending bank is in the top tercile by all non-MBS securities to total assets, and a value of 0 if in the bottom tercile. *MBS Purchases* is the lagged quarterly log-dollar amount of gross Federal Reserve MBS purchases. *TSY Purchases* is the lagged quarterly log-dollar amount of gross Federal Reserve TSY purchases. Standard errors are clustered by bank. The *Wald Test* provides the χ^2 statistic on whether the *Securitizer* \times *MBS Purchases* coefficient is statistically different across the two samples.

	C&I Loan Growth	
	Tier 1 Capital and Demand Deposits (Constrained)	(Unconstrained)
	(1)	(2)
Securitizer	0.263 (1.928)	9.251*** (1.187)
Securitizer \times MBS Purchases	-0.466*** (0.118)	-0.0204 (0.133)
High Securities Holdings	6.639* (3.627)	-0.242 (1.333)
High Securities Holdings \times TSY Purchases	-0.319 (0.307)	0.00892 (0.0731)
Bank's Size (excl. loans)	-1.183* (0.616)	1.553 (1.150)
Bank's Equity Ratio	0.763*** (0.141)	0.430** (0.173)
Bank's Net Income	0.456* (0.248)	-0.970* (0.538)
Bank's Cost of Deposits	-0.122 (0.559)	-1.212 (1.183)
Change in Unemp. Rate, Bank's State(s)	0.812 (1.854)	-15.99 (12.06)
<i>Wald Test:</i>		
(Constrained = Unconstrained)		6.27**
Bank Fixed Effects	Yes	Yes
Bank's Primary State Year-Quarter Fixed Effects	Yes	Yes
Observations	12017	11455
Adjusted R^2	0.155	0.0766

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table VIII: C&I Loan Growth: QE1 and Post QE1

Columns 1 through 3 are panel fixed effect regressions. *C&I Loan Growth* is the growth rate in C&I loans between the current and prior quarter, scaled by 100. *High MBS Holdings* takes a value of 1 if the lending bank is in the top tercile by MBS securities to total assets, and a value of 0 if in the bottom tercile. *High Securities Holdings* takes a value of 1 if the lending bank is in the top tercile by all non-MBS securities to total assets, and a value of 0 if in the bottom tercile. *MBS Purchases* is the lagged quarterly log-dollar amount of gross Federal Reserve MBS purchases. *TSY Purchases* is the lagged quarterly log-dollar amount of gross Federal Reserve TSY purchases. *Securitizer* takes a value of 1 if a high-MBS bank reported non-zero securitization income and 0 otherwise. *Orthog. MBS/Sec. Holdings* refers to whether the MBS and securities terciles have been orthogonalized to other bank characteristics. Standard errors are clustered by bank.

C&I Loan Growth			
	(1)	(2)	(3)
High MBS Holdings	0.447 (0.466)	0.649 (0.522)	
High MBS Holdings \times MBS Purchases, through QE1	-0.105*** (0.0251)	-0.110*** (0.0278)	
High MBS Holdings \times MBS Purchases, post QE1	0.0157 (0.0249)	-0.00650 (0.0279)	
Securitizer			1.526 (1.286)
Securitizer \times MBS Purchases, through QE1			-0.358*** (0.114)
Securitizer \times MBS Purchases, post QE1			-0.317*** (0.108)
High Securities Holdings	1.070* (0.564)	1.144* (0.645)	1.100* (0.564)
High Securities Holdings \times TSY Purchases, through QE1	-0.0162 (0.0402)	-0.00333 (0.0436)	-0.0114 (0.0402)
High Securities Holdings \times TSY Purchases, post QE1	0.147*** (0.0325)	0.157*** (0.0352)	0.139*** (0.0324)
Bank's Size (excl. loans)	0.127 (0.328)	0.282 (0.355)	0.113 (0.326)
Bank's Equity Ratio	0.849*** (0.0618)	0.819*** (0.0707)	0.853*** (0.0618)
Bank's Net Income	0.0221 (0.150)	-0.00547 (0.177)	0.0275 (0.150)
Bank's Cost of Deposits	-0.979*** (0.331)	-1.065*** (0.370)	-0.981*** (0.331)
Change in Unemp. Rate, Bank's State(s)	-0.833 (1.264)	-1.214 (1.535)	-0.782 (1.266)
Orthog. MBS/Sec. Holdings	No	Yes	No
Bank Fixed Effects	Yes	Yes	Yes
Bank's Primary State Year-Quarter Fixed Effects	Yes	Yes	Yes
Observations	77950	64350	77950
Banks	4913	4576	4913
Adjusted R^2	0.0551	0.0522	0.0549

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table IX: Investment Regression for Firm Constraints

Columns 1 through 4 are panel fixed effect regressions. *Investment* is the firm's quarterly capital expenditures divided by lagged PPE, scaled by 100. Firms in the bottom two terciles by total assets are marked as *Constrained* and firms in the top tercile by total assets are marked as *Unconstrained*. Firms without a public investment grade bond rating are marked as *Constrained* and firms with a public investment grade bond rating are marked as *Unconstrained*. Standard errors are clustered by firm and bank. The *Wald Test* provides the χ^2 statistic on whether the *MBS Holdings* \times *MBS Purchases* coefficient is statistically different across the two samples.

	Investment			
	Firm Size		Bond Rating	
	(Constrained) (1)	(Unconstrained) (2)	(Constrained) (3)	(Unconstrained) (4)
High MBS Holdings	2.055*** (0.500)		1.323*** (0.453)	
High MBS Holdings \times MBS Purchases	-0.0878*** (0.0289)	-0.0147** (0.00733)	-0.0565*** (0.0214)	0.0102 (0.00754)
High Securities Holdings	-0.0688 (0.587)	-0.302 (0.261)	-0.182 (0.576)	-0.260 (0.334)
High Securities Holdings \times TSY Purchases	0.00626 (0.0196)	0.00849 (0.0180)	0.0223 (0.0247)	-0.0263 (0.0169)
Cash Flow	0.00275 (0.00265)	0.00937*** (0.00149)	0.00324 (0.00224)	0.00987*** (0.00319)
Lagged Market-to-Book	1.166*** (0.160)	0.586*** (0.165)	1.183*** (0.137)	0.925*** (0.0909)
Lagged Z-Score	0.474*** (0.0972)	0.921*** (0.102)	0.465*** (0.106)	0.544* (0.324)
Lagged Firm Size	-1.219** (0.579)	-0.380 (0.377)	-0.865* (0.457)	0.332 (0.511)
Bank's Size	0.146 (0.194)	1.645** (0.722)	0.500* (0.261)	-0.351 (0.360)
Bank's Equity Ratio	0.0904 (0.0643)	-0.124 (0.0755)	0.0695 (0.0641)	-0.0541 (0.0360)
Bank's Net Income	0.0866 (0.169)	-0.0853 (0.0860)	0.0488 (0.165)	-0.155* (0.0862)
Bank's Cost of Deposits	-0.331 (0.282)	0.320 (0.327)	-0.243 (0.251)	-0.472 (0.299)
Change in Unemp. Rate, Bank's State(s)	-0.575 (0.367)	-0.242 (0.152)	-0.661** (0.287)	-0.526 (0.397)
<i>Wald Test:</i>				
(Constrained = Unconstrained)		6.01**		8.65***
Firm-Bank Fixed Effects	Yes	Yes	Yes	Yes
Firm's State by Year-Quarter Fixed Effects	Yes	Yes	Yes	Yes
Observations	19451	13064	24055	8458
Adjusted R^2	0.477	0.623	0.483	0.673

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table X: Mortgage Market APR Regression

Columns 1 through 6 are panel fixed effect regressions. *Avg. Rate* is the dollar-weighted average rate spread (in basis points over equivalent-maturity Treasury security) for the bank in a specific state. *Rate Mkt. Share* is the state-level market share for the portion of the market in which the rate spread is reported. *MBS Purchases* is the quarterly log-dollar amount of gross Federal Reserve MBS purchases from the fourth quarter of the prior year. *Securitizer* takes a value of 1 if a high-MBS bank reported non-zero securitization income and 0 otherwise. *Orthog. MBS Holdings* refers to whether the MBS terciles have been orthogonalized to other bank characteristics. Standard errors are clustered by bank.

	Avg. Rate (1)	Rate Mkt. Share (2)	Avg. Rate (3)	Rate Mkt. Share (4)	Avg. Rate (5)	Rate Mkt. Share (6)
High MBS Holdings	23.26*** (8.790)	-4.626 (12.13)	25.00** (10.41)	-10.35 (11.07)		
High MBS Holdings \times MBS Purchases	-0.865** (0.344)	0.758 (1.311)	-0.888** (0.361)	0.958 (0.992)		
Securitizer					-8.320 (9.107)	-220.9*** (77.37)
Securitizer \times MBS Purchases					-1.684** (0.654)	16.52** (6.533)
Bank's Size (excl. loans)	6.281 (5.159)	-2.759 (14.99)	4.190 (4.999)	2.676 (10.48)	5.499 (5.047)	-3.553 (13.30)
Bank's Equity Ratio	-0.527 (1.057)	-1.133 (3.801)	-0.315 (1.110)	-1.345 (2.414)	-0.887 (1.101)	-3.420 (3.534)
Bank's Net Income	-2.584 (1.694)	1.835 (4.271)	-3.072* (1.784)	3.534 (3.660)	-2.712 (1.725)	4.808 (3.458)
Bank's Cost of Deposits	14.08*** (4.558)	-3.684 (15.57)	9.484* (5.021)	11.18 (11.98)	12.76*** (4.567)	5.467 (15.91)
Change in Unemp. Rate, Bank's State(s)	0.574 (2.704)	-6.562 (4.063)	4.127 (2.599)	-3.957 (2.745)	0.496 (2.733)	-3.695 (3.238)
Orthog. MBS Holdings	No	No	Yes	Yes	No	No
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
State by Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	21732	21732	18559	18559	21732	21732
Adjusted R^2	0.663	0.442	0.654	0.374	0.663	0.450

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table XI: CBSA-Level Mortgage Market Share

Columns 1 through 6 are panel fixed effect regressions. *CBSA Mortgage Origination Market Share* is the CBSA-level market share (in basis points) for a given bank in a particular CBSA and year. *CBSA HPI to Per Capita Income* is the CBSA-level housing price index divided by the CBSA-level per capita income index. *MBS Purchases* is the quarterly log-dollar amount of gross Federal Reserve MBS purchases from the fourth quarter of the prior year. *Securitizer* takes a value of 1 if a high-MBS bank reported non-zero securitization income and 0 otherwise. Columns 4 through 6 use the CBSA-specific unavailable land measure times the national mortgage interest rate and its interactions with *Securitizer* and *MBS Purchases* as instruments for *CBSA HPI to Per Capita Income* and its interactions. Standard errors are clustered by bank.

	Mortgage Origination Market Share					
	(OLS)	(OLS)	(OLS)	(IV)	(IV)	(IV)
	(1)	(2)	(3)	(4)	(5)	(6)
CBSA HPI to Per Capita Income	-5.664 (3.501)	-8.470*** (1.659)	-6.204 (4.819)	-6.703 (5.718)	-10.52*** (3.055)	-7.596 (8.311)
CBSA HPI to Per Capita Income \times MBS Purchases		-0.211 (0.151)	-0.171 (0.217)		-0.130 (0.317)	-0.103 (0.396)
Securitizer \times CBSA HPI to Per Capita Income		9.342 (7.305)	8.030 (7.389)		5.077 (13.18)	3.525 (13.97)
Securitizer \times CBSA HPI to Per Capita Income \times MBS Purchases		5.033** (1.979)	5.022** (2.014)		7.281** (3.095)	7.224** (3.188)
Bank by Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
CBSA Fixed Effects	No	No	Yes	No	No	Yes
Observations	57521	57521	57521	57521	57521	57521
Adjusted R^2	0.245	0.253	0.281	0.244	0.252	0.280

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Appendix: For Review and Online Publication Only

A Data Appendix

A.1 Loan Data and Firm-Bank Lending Relationships

Dealscan provides information on syndicated and sole-lender loan packages on the majority (more than 75%) of the value of commercial loans in the U.S. since 1995. To establish a lending relationship, we consider the presence of any loan between the bank and borrowing firm to be evidence of a relationship. In the case of syndicated loans with multiple lenders, following Bharath, Dahiya, Saunders, and Srinivasan (2011), we consider the relationship bank to be the one which serves as lead agent on the loan. The length of the relationship is defined as follows: it begins in the first year-quarter that we observe a loan being originated between the firm and bank and ends when the last loan observed between the firm and bank matures, according to the original loan terms. Firms and banks are considered in an active relationship both in year-quarters that new loans are originated and year-quarters in which no new loan originations occur with that bank. Dealscan provides loan origination information, which gives us information on the borrower, the lender (or lenders in the case of a loan syndicate), and the terms of the loan package, including the size, interest rate, maturity, and type of loan or loans being originated.

The summary statistics for the loan interest rate, measured by the all-in drawn rate over LIBOR, relative loan size as scaled by the borrowing firm's lagged total assets, and months to loan maturity are included in Panel A of Table I. Variable definitions and details on variable construction for these and other variables are included in Table A.1.

The median relationship last five years and contains one distinct loan package. Although loan packages can have many individual loan facilities, the majority of our packages contain one or two separate facilities only. For those observations without sufficient maturity data to determine the relationship length, we assume the median sample relationship length of five years.

For syndicated loans where multiple lenders are present, it is important to determine the bank

leading the lending relationship. In determining the lead agent on a loan, we follow the same procedure as Chakraborty, Goldstein, and MacKinlay (2016).²⁴

For our bank balance sheet variables, we use Call Report data from each quarter, aggregated to the bank holding company (BHC) level, using the *RSSD9348* variable. We also aggregate the HMDA mortgage data to the BHC-level in a similar manner. There is a significant amount of consolidation in the U.S. banking sector during our sample period. As such, we update the current holding company for lenders over time. The Summary of Deposits data is helpful for this task, as are historical press releases about different mergers between banks. We assume that the relationship between borrower and lender continues under the new bank holding company for the length of the loan, and any subsequent loans under that same Dealscan lender. The main difference is that the bank characteristics that we use as controls change with mergers to reflect the new bank holding company.

A.2 Firm Data

We link borrowers from Dealscan to quarterly Compustat data using the link file from Chava and Roberts (2008). From Compustat, we use several firm-specific variables in our analysis. These variables include investment, market-to-book ratio, cash flow, firm size, and Altman’s Z-score. All firm and bank variables that are ratios are winsorized at the 1 and 99 percentiles, with the exception of the cash flow variable.²⁵ As we are focusing on how financial intermediaries affect borrowing firms’ investment decisions, we exclude any borrowing firms that are financial companies. Panel B of Table I includes the summary statistics for these variables.

²⁴Specifically, we use the following ranking hierarchy: 1) lender is denoted as “Admin Agent”, 2) lender is denoted as “Lead bank”, 3) lender is denoted as “Lead arranger”, 4) lender is denoted as “Mandated lead arranger”, 5) lender is denoted as “Mandated arranger”, 6) lender is denoted as either “Arranger” or “Agent” and has a “yes” for the lead arranger credit, 7) lender is denoted as either “Arranger” or “Agent” and has a “no” for the lead arranger credit, 8) lender has a “yes” for the lead arranger credit but has a role other than those previously listed (“Participant” and “Secondary investor” are also excluded), 9) lender has a “no” for the lead arranger credit but has a role other than those previously listed (“Participant” and “Secondary investor” are also excluded), and 10) lender is denoted as a “Participant” or “Secondary investor”. For a given loan package, the lender with the highest title (following our ten-part hierarchy) is considered the lead agent.

²⁵The cash flow variable is winsorized at the 2.5 and 97.5 percentiles because of more extreme outliers. The main results are robust to winsorizing the cash flow variable at the 1 and 99 percentiles.

B Additional Robustness Tests

B.1 Alternative Mortgage and Security Exposure Variables

As an alternative measure of securities holdings, Table B.2 restricts securities holdings to Treasury and other U.S. government securities and finds similar results to Table III.

Regarding bank exposure to the Federal Reserve’s MBS purchases, our two principal measures are the amount of MBS holdings and whether the bank is an active MBS securitizer. We now consider an alternative variable to capture differences in mortgage market activity across banks: *GSE/GOE Seller*. A bank is marked as a GSE/GOE seller if it sells some of its originated loans to the government sponsored or owned enterprises (FNMA, FHMLC, GNMA) in a given year. As this is based on HMDA data, it is only available on annual basis.

Table B.3 repeats the analysis of Table II using the alternative variable mortgage exposure variable. Columns 1 and 2 show that banks that are *GSE/GOE Sellers* increase their state-level mortgage market share in response to MBS purchases. This finding is consistent with the main exposure measures used in Table II. Columns 3–6 perform a similar analysis but instead of separate state-level markets consider a national-level mortgage market share. We find for our three exposure measures (*High MBS Holdings*, *Securitizer*, and *GSE/GOE Seller*) similar positive and statistically significant increases in mortgage origination market share following increases in Fed MBS purchases.

Table XI analyzes how a bank’s market share changes as a function of the CBSA-level housing affordability and QE. In Table B.5, we directly use house prices in a CBSA, rather than affordability, to check if results remain similar. This table suggests that, as before, banks that benefit more from MBS asset purchases increase their lending more in areas with higher house prices. Table B.6 presents the first-stage regressions for the effect of our instruments on the bank’s CBSA-level housing price measure.

B.2 Continuous Balance Sheet Variables

Our main results on firm-level investment are reported in Section [II.C](#) by dividing banks into terciles on the basis of the exposure of banks' balance sheets to MBS and securities holdings. The terciles approach addresses concerns about large skew in banks' balance sheet exposure to the two asset classes. In this section, we employ continuous variables to measure the exposure of banks to MBS and other non-MBS securities. The result remain robust to this treatment.

Table [B.7](#) reports how firm investment responds to asset purchases conditional on the lending banks' holdings in terms of MBS and TSY. All specifications, as before, show a negative impact of MBS purchases on firm investment if the MBS holdings of the lending bank are higher. On the other hand, the impact of TSY purchases is positive, although the results are not significant in most specifications.

Table A.1: Variable Definitions

Variable Definitions		
	Definition	Data Sources
<i>Bank Variables</i>		
MBS Holdings	Balance sheet mortgage-backed securities (RCFD8639) plus trading asset mortgage-backed securities (RCFD G379 + G380 + G381 + K197 + K198) divided by total assets (RCFD2170). Scaled by 100.	Call Report
Securities Holdings	Total balance sheet securities (RCFD8641) minus balance sheet MBS holdings (RCFD8639), divided by total assets (RCFD2170). Scaled by 100.	Call Report
U.S. Gov. Securities Holdings	U.S. Treasury securities (RCFD0211 + RCFD1287 + RCON3531) plus U.S. government agency obligations (RCFD1289 + RCFD1294 + RCFD1293 + RCFD1298 + RCON3532), divided by total assets (RCFD2170). Scaled by 100.	Call Report
C&I Loan Growth	Quarterly growth in total commercial and industrial loans. Total C&I loans are the sum of balance sheet C&I loans (RCFD1766) and trading asset C&I loans (RCFDF614). Scaled by 100.	Call Report
Bank's Size	Log of total assets (RCFD2170)	Call Report
Bank's Equity Ratio	Total equity capital (RCFD3210) divided by total assets (RCFD2170). Scaled by 100.	Call Report
Bank's Net Income	Net income (RIAD4340) divided by total assets (RCFD2170). Scaled by 100.	Call Report
Bank's Cost of Deposits	Interest on deposits (RIAD4170) divided by total deposits (RCFD2200). Scaled by 100.	Call Report
Bank's Tier 1 Capital	Tier 1 capital (RCFD8274) divided by risk-weighted assets (RCFDA223). Scaled by 100.	Call Report
Bank's Demand Deposits	Total demand deposits (RCFD2210) divided by total assets (RCFD2170). Scaled by 100.	Call Report
Securitizer	Indicator that bank reports non-zero net securitization income (RIADB493) and is in the highest tercile of <i>MBS Holdings</i> .	Call Report
Change in Unemp. Rate, Bank's State(s)	Quarterly change in unemployment rate (as a %) where bank has deposits, weighted by most recently available summary of deposits.	Summary of Deposits, FRED
GSE/GOE Seller	Indicator that bank sold originated mortgages to Fannie Mae, Freddie Mac, or Ginnie Mae in a given year.	HMDA
National Mortgage Origination Market Share (bps)	Bank's share of the mortgage origination market (nationwide). Measured annually in basis points.	HMDA
State-Level Mortgage Origination Market Share (bps)	Bank's share of the mortgage origination market, for a given state-level market. Measured annually in basis points.	HMDA
Average Rate, State Level (bps)	Dollar-weighted average APR of originated mortgages, for a given state-level market. APR is reported as spread over equivalent-maturity Treasury.	HMDA
Rate-Related State-Level Market Share (bps)	Bank's share of the mortgage origination market for subset of mortgages where rate spread reported, for a given state-level market. Measured annually in basis points.	HMDA

Table A.1—Continued

Variable Definitions		
	Definition	Data Sources
<i>Bank Variables (continued)</i>		
CBSA-Level Mortgage Origination Market Share (bps)	Bank's share of the mortgage origination market, for a given CBSA-level market. Measured annually in basis points.	HMDA
CBSA Housing Price Index	CBSA-level housing price index.	FHFA
CBSA HPI to Per Capita Income	CBSA-level HPI divided by CBSA-level per capita income index. Both indices scaled such that 100=\$50,000.	FHFA, BEA
CBSA Land Unavailability	Percent of land unavailable for development in a specific CBSA.	Saiz (2010)
<i>Macroeconomic Variables</i>		
30-Year Mortgage Rate	Quarterly average of 30-year conventional mortgage rate, as a percent.	FRED
TSY Purchases (Bil. USD)	Amount of Treasury securities purchased by the Federal Reserve in a given quarter.	New York Fed
MBS Purchases (Bil. USD)	Amount of MBS purchased by the Federal Reserve in a given quarter	New York Fed
<i>Loan Characteristics</i>		
Loan Amount	Loan facility amount divided by the borrowing firm's prior quarter's book assets. Scaled by 100.	Dealscan, Compustat
All In Drawn Spread (bps)	Basis point spread over LIBOR for each dollar of loan facility drawn.	Dealscan
Maturity (months)	Loan facility maturity (in months) at origination.	Dealscan
Takeover Loan	Indicator that loan purpose is an acquisition line, LBO, MBO, or takeover.	Dealscan
Revolving Credit Line	Indicator that loan facility is a revolving credit line.	Dealscan
Term Loan	Indicator that loan facility is a term loan.	Dealscan
<i>Firm Variables</i>		
Investment	Quarterly capital expenditures divided by prior quarter's net PPE. Scaled by 100.	Compustat
Cash Flow	Quarterly income before extraordinary items plus depreciation and amortization divided by prior quarter's net PPE. Scaled by 100.	Compustat
Lagged Market-to-Book	Book assets plus closing stock price times shares outstanding minus common equity, all divided by book assets, all from prior quarter.	Compustat
Lagged Z-Score	Sum of 3.3 times pre-tax income, sales, 1.4 times retained earnings, 1.2 times the difference between current assets and current liabilities, all divided by book assets. All variables from prior quarter.	Compustat
Lagged Firm Size	Log of book assets from prior quarter.	Compustat

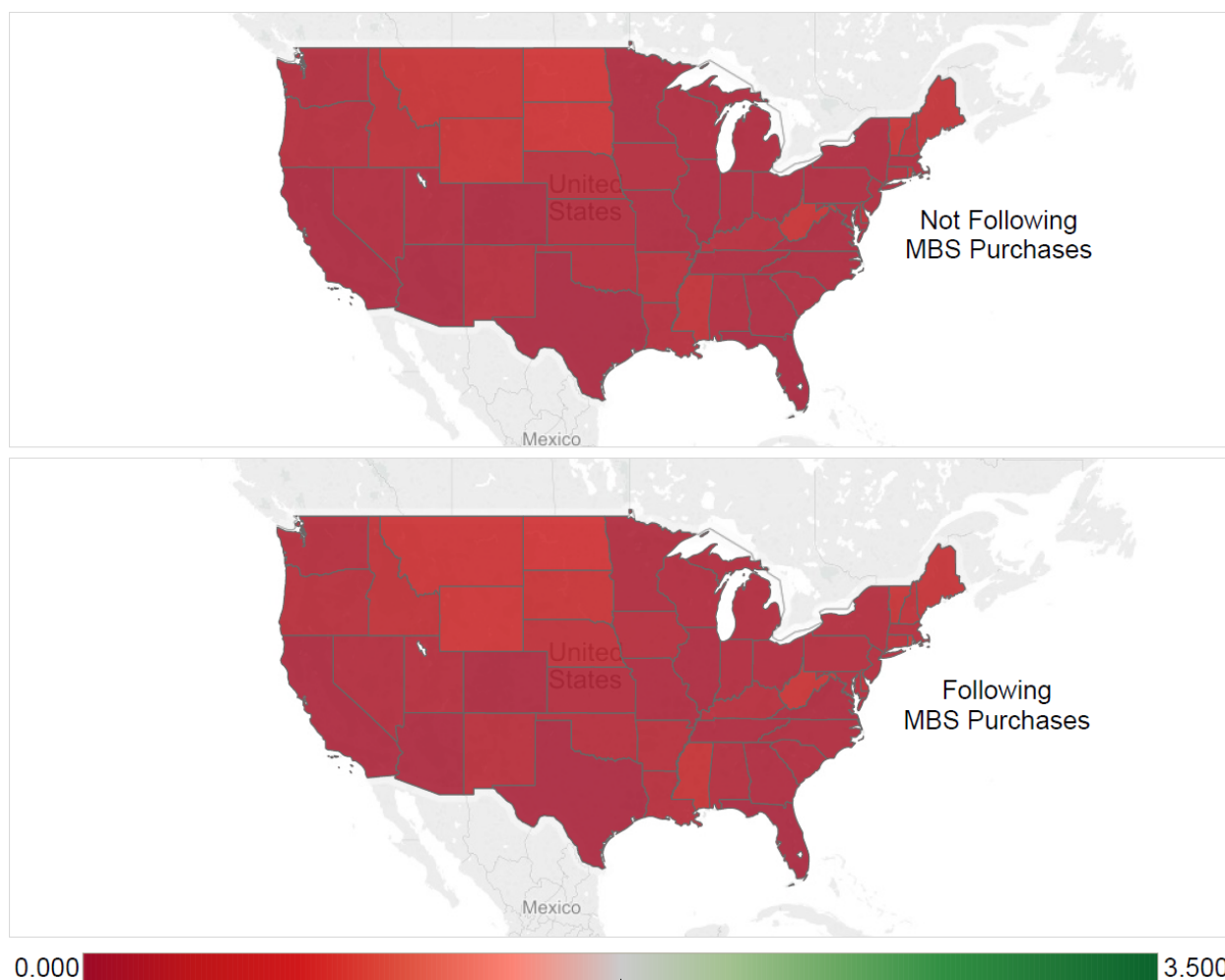


Figure B.1: Average state-level mortgage origination market share for non-securitizer banks, in percentage points. Top panel includes years not following fourth-quarter MBS purchases (2007, 2008, 2009, 2012). Bottom panel includes years following fourth-quarter MBS purchases (2010, 2011, 2013, 2014).

Table B.2: C&I Loan Growth: Alternative Securities Variable

Columns 1 through 6 are panel fixed effect regressions. *C&I Loan Growth* is the growth rate in C&I loans between the current and prior quarter, scaled by 100. *High MBS Holdings* takes a value of 1 if the lending bank is in the top tercile by MBS securities to total assets, and a value of 0 if in the bottom tercile. *High Gov. Securities Holdings* takes a value of 1 if the lending bank is in the top tercile by all U.S. federal government securities to total assets, and a value of 0 if in the bottom tercile. *MBS Purchases* is the lagged quarterly log-dollar amount of gross Federal Reserve MBS purchases. *TSY Purchases* is the lagged quarterly log-dollar amount of gross Federal Reserve TSY purchases. *Securitizer* takes a value of 1 if a high-MBS bank reported non-zero securitization income and 0 otherwise. *Orthog. MBS/Sec. Holdings* refers to whether the MBS and securities terciles have been orthogonalized to other bank characteristics. Standard errors are clustered by bank.

	C&I Loan Growth					
	(1)	(2)	(3)	(4)	(5)	(6)
High MBS Holdings	0.683 (0.480)		0.757 (0.482)	0.837 (0.558)		
High MBS Holdings × MBS Purchases	-0.0533** (0.0216)		-0.0496** (0.0216)	-0.0537** (0.0236)		
Securitizer					1.639 (1.242)	1.647 (1.243)
Securitizer × MBS Purchases					-0.353*** (0.0937)	-0.351*** (0.0937)
High Gov. Securities Holdings		0.0473 (0.431)	0.0818 (0.434)	0.599 (0.504)		0.0500 (0.431)
High Gov. Securities Holdings × TSY Purchases		0.0913*** (0.0288)	0.0892*** (0.0288)	0.0726** (0.0305)		0.0909*** (0.0288)
Bank's Size (excl. loans)	0.412 (0.321)	0.279 (0.332)	0.280 (0.333)	0.339 (0.365)	0.426 (0.319)	0.291 (0.332)
Bank's Equity Ratio	0.915*** (0.0670)	0.910*** (0.0669)	0.917*** (0.0669)	0.888*** (0.0768)	0.912*** (0.0671)	0.913*** (0.0670)
Bank's Net Income	0.0202 (0.158)	0.0360 (0.157)	0.0363 (0.157)	0.0564 (0.181)	0.0154 (0.158)	0.0325 (0.157)
Bank's Cost of Deposits	-1.356*** (0.346)	-1.365*** (0.345)	-1.375*** (0.346)	-1.240*** (0.398)	-1.361*** (0.345)	-1.382*** (0.345)
Change in Unemp. Rate, Bank's State(s)	0.00620 (1.369)	-0.0621 (1.370)	-0.0514 (1.368)	-1.677 (1.921)	0.0470 (1.368)	-0.0163 (1.367)
Orthog. MBS/Sec. Holdings	No	No	No	Yes	No	No
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Bank's Primary State Year-Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	75838	75838	75838	63137	75838	75838
Adjusted R^2	0.0553	0.0554	0.0555	0.0521	0.0553	0.0555

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B.3: Mortgage Market Share Regression: Alternative Specifications

Columns 1 through 6 are panel fixed effect regressions. *State Mortgage Orig Market Share* is the state-level market share (in basis points) for a given bank in a particular state and year. *National Mortgage Orig Market Share* is the national market share (in basis points) for a given bank in a particular year. *GSE/GOE Seller* takes a value of 1 if the lending bank sold mortgages to a GSE or GOE in the current year and 0 otherwise. *High MBS Holdings* takes a value of 1 if the lending bank is in the top tercile by MBS securities to total assets, and a value of 0 if in the bottom tercile. *MBS Purchases* is the quarterly log-dollar amount of gross Federal Reserve MBS purchases from the fourth quarter of the prior year. *Securitizer* takes a value of 1 if a high-MBS bank reported non-zero securitization income and 0 otherwise. *Orthog. MBS Holdings* refers to whether the MBS terciles have been orthogonalized to other bank characteristics. Standard errors are clustered by bank.

	State Mortgage Orig Market Share		National Mortgage Orig Market Share			
	(1)	(2)	(3)	(4)	(5)	(6)
GSE/GOE Seller	1.167 (4.143)	1.045 (4.108)				-0.0373 (0.403)
GSE/GOE Seller \times MBS Purchases	0.868*** (0.281)	0.810*** (0.252)				0.122** (0.0492)
High MBS Holdings			-0.490*** (0.181)	-0.314** (0.128)		
High MBS Holdings \times MBS Purchases			0.0622*** (0.0237)	0.0381*** (0.0141)		
Securitizer					-17.63** (8.230)	
Securitizer \times MBS Purchases					1.496* (0.877)	
Bank's Size (excl. loans)	10.48 (7.093)	12.37* (6.544)	1.165*** (0.419)	0.554** (0.274)	1.314* (0.766)	1.380* (0.809)
Bank's Equity Ratio	0.580 (0.838)	0.750 (0.846)	0.0535 (0.0853)	0.0406 (0.0529)	0.0701 (0.0656)	0.0913 (0.0718)
Bank's Net Income	0.301 (1.049)	0.579 (1.006)	0.0175 (0.118)	0.0812 (0.0763)	0.0214 (0.0939)	-0.00185 (0.0992)
Bank's Cost of Deposits	-5.096 (6.935)	-4.773 (6.915)	-0.693 (0.493)	-0.745* (0.385)	-0.834 (0.614)	-0.914 (0.653)
Change in Unemp. Rate, Bank's State(s)	-1.615** (0.674)	-1.476 (0.958)	-0.0737** (0.0372)	-0.0339 (0.0414)	-0.0470 (0.0367)	-0.0847*** (0.0326)
Orthog. MBS Holdings	No	No	Yes	Yes	No	No
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter Fixed Effects	Yes	No	Yes	Yes	Yes	Yes
State by Year-Quarter Fixed Effects	No	Yes	No	No	No	No
Observations	69408	69408	14264	12382	21912	21912
Adjusted R^2	0.566	0.583	0.943	0.963	0.914	0.913

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B.4: CBSA-Level Mortgage Market Share: First Stage

Columns 1 through 9 are the associated first-stage regressions for Table XI. *CBSA HPI* is the housing price index for each CBSA. *CBSA Land Unavailability* is the percent of land unavailable for development in the CBSA. *Unavailability* \times *Mortgage Rate* is *CBSA Land Unavailability* interacted with the current 30-year mortgage rate (as a percentage). *MBS Purchases* is the quarterly log-dollar amount of gross Federal Reserve MBS purchases from the fourth quarter of the prior year. *Securitizer* takes a value of 1 if the high-MBS bank reported non-zero securitization income and 0 otherwise. Standard errors are clustered by bank.

	Column 4			Column 5			Column 6		
	CBSA HPI to Per Capita Income (1)	CBSA HPI to Per Capita Income (2)	CBSA HPI to Per Capita Inc. \times MBS Purchases (3)	CBSA HPI to Per Capita Inc. \times MBS Purchases (4)	Securitizer \times CBSA HPI to Per Capita Inc. \times MBS Purchases (5)	CBSA HPI to Per Capita Income (6)	CBSA HPI to Per Capita Inc. \times MBS Purchases (7)	Securitizer \times CBSA HPI to Per Capita Inc. \times MBS Purchases (8)	Securitizer \times CBSA HPI to Per Capita Inc. \times MBS Purchases (9)
CBSA Land Unavailability	2.509*** (0.0877)	2.478*** (0.100)	-0.0646 (0.0592)	-2.63e-10 (7.18e-10)	-1.16e-09 (1.31e-08)				
Unavailability \times Mortgage Rate	0.636*** (0.0650)	0.757*** (0.0838)	0.0304* (0.0169)	9.82e-11 (3.53e-10)	4.32e-10 (5.77e-09)	0.900*** (0.0274)	1.000* (0.532)	0.0158 (0.0114)	0.0833 (0.0634)
Unavailability \times MBS Purchases		-0.0306*** (0.00618)	2.143*** (0.0925)	4.24e-11 (1.39e-10)	1.87e-10 (1.97e-09)	-0.0327*** (0.00148)	2.128*** (0.0895)	-0.000116 (0.000625)	-0.000651 (0.00297)
Unavailability \times Mortgage Rate \times MBS Purchases		-0.0596*** (0.00894)	0.0921 (0.0591)	6.64e-12 (3.44e-11)	2.92e-11 (6.21e-10)	-0.0607*** (0.00274)	0.0711 (0.0530)	-0.0000551 (0.0000938)	-0.00176 (0.00462)
Securitizer \times Unavailability		0.868*** (0.182)	0.223 (0.172)	3.346*** (0.160)	0.158 (0.163)	0.0864* (0.0478)	-4.713*** (1.078)	3.288*** (0.142)	-0.158 (0.150)
Securitizer \times Unavailability \times Mortgage Rate		0.0765 (0.173)	-0.121 (0.109)	0.834*** (0.146)	-0.0902 (0.109)	0.0311 (0.0545)	-0.464 (1.069)	0.822*** (0.131)	-0.145 (0.172)
Securitizer \times Unavailability \times MBS Purchases		0.0114 (0.0161)	0.979*** (0.147)	-0.0191 (0.0154)	3.121*** (0.115)	-0.00647 (0.00429)	0.871*** (0.138)	-0.0221 (0.0149)	3.109*** (0.118)
Securitizer \times Unavailability \times Mortgage Rate \times MBS Purchase		0.0118 (0.0163)	0.219*** (0.0840)	-0.0478*** (0.0132)	0.312*** (0.0599)	0.00362 (0.00469)	0.191* (0.107)	-0.0485*** (0.0118)	0.310*** (0.0592)
Bank by Year-Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CBSA Fixed Effects	No	No	No	No	No	Yes	Yes	Yes	Yes
Observations	57521	57521	57521	57521	57521	57521	57521	57521	57521
Adjusted R^2	0.346	0.348	0.818	0.813	0.861	0.929	0.919	0.835	0.869

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B.5: CBSA-Level Mortgage Market Share

Columns 1 through 6 are panel fixed effect regressions. *CBSA Mortgage Origination Market Share* is the CBSA-level market share (in basis points) for a given bank in a particular CBSA and year. *CBSA HPI* is the CBSA-level housing price index. *MBS Purchases* is the quarterly log-dollar amount of gross Federal Reserve MBS purchases from the fourth quarter of the prior year. *Securitizer* takes a value of 1 if the bank reported non-zero securitization income in the current year and 0 otherwise. Columns 4 through 6 use the CBSA-specific unavailable land measure times the national mortgage interest rate and its interactions with *Securitizer* and *MBS Purchases* as instruments for *CBSA HPI* and its interactions. Standard errors are clustered by bank.

	Mortgage Origination Market Share					
	(OLS)	(OLS)	(OLS)	(IV)	(IV)	(IV)
	(1)	(2)	(3)	(4)	(5)	(6)
CBSA HPI	-0.0804** (0.0335)	-0.111*** (0.0185)	-0.0730 (0.0607)	-0.0656 (0.0562)	-0.104*** (0.0296)	-0.0775 (0.0914)
CBSA HPI \times MBS Purchases		-0.00116 (0.00154)	-0.00102 (0.00168)		-0.000967 (0.00298)	-0.000766 (0.00392)
Securitizer \times CBSA HPI		0.124 (0.0854)	0.105 (0.0849)		0.0468 (0.141)	0.0363 (0.149)
Securitizer \times CBSA HPI \times MBS Purchases		0.0421** (0.0172)	0.0426** (0.0177)		0.0768** (0.0329)	0.0764** (0.0337)
Bank by Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
CBSA Fixed Effects	No	No	Yes	No	No	Yes
Observations	57521	57521	57521	57521	57521	57521
Adjusted R^2	0.246	0.251	0.278	0.245	0.249	0.276

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B.6: CBSA-Level Mortgage Market Share: First Stage

Columns 1 through 9 are the associated first-stage regressions for Table B.5. *CBSA HPI* is the housing price index for each CBSA. *CBSA Land Unavailability* is the percent of land unavailable for development in the CBSA. *Unavailability* \times *Mortgage Rate* is *CBSA Land Unavailability* interacted with the current 30-year mortgage rate (as a percentage). *MBS Purchases* is the quarterly log-dollar amount of gross Federal Reserve MBS purchases from the fourth quarter of the prior year. *Securitizer* takes a value of 1 if the high-MBS bank reported non-zero securitization income and 0 otherwise. Standard errors are clustered by bank.

	Column 4			Column 5			Column 6		
	CBSA HPI	CBSA HPI	CBSA HPI \times MBS Purchases	Securitizer \times CBSA HPI	Securitizer \times CBSA HPI \times MBS Purchases	CBSA HPI	CBSA HPI \times MBS Purchases	Securitizer \times CBSA HPI	Securitizer \times CBSA HPI \times MBS Purchases
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
CBSA Land Unavailability	256.2*** (6.910)	253.6*** (7.815)	-15.47*** (4.603)	-0.000000242 (0.000000172)	-0.00000284 (0.00000187)				
Unavailability \times Mortgage Rate	58.27*** (5.389)	74.24*** (6.817)	6.319*** (1.487)	9.04e-08 (6.63e-08)	0.00000106 (0.000000645)	88.38*** (2.586)	100.3** (41.89)	1.354 (0.872)	7.299 (5.188)
Unavailability \times MBS Purchases		-2.924*** (0.499)	223.2*** (7.803)	3.91e-08 (2.76e-08)	0.000000458 (0.000000314)	-2.677*** (0.132)	224.5*** (7.259)	0.0251 (0.0521)	0.0928 (0.260)
Unavailability \times Mortgage Rate \times MBS Purchases		-6.465*** (0.711)	2.394 (4.579)	6.11e-09 (4.47e-09)	7.16e-08 (5.20e-08)	-6.522*** (0.268)	0.924 (4.022)	0.000305 (0.0706)	-0.138 (0.357)
Securitizer \times Unavailability		39.90*** (12.65)	4.417 (14.00)	293.5*** (9.936)	-11.05 (13.40)	-0.730 (5.731)	-274.8** (107.9)	290.9*** (8.429)	-28.95 (18.27)
Securitizer \times Unavailability \times Mortgage Rate		25.17** (12.43)	1.925 (9.011)	99.41*** (10.04)	8.244 (8.946)	5.237 (5.431)	-122.3 (94.00)	97.42*** (8.897)	-1.534 (13.96)
Securitizer \times Unavailability \times MBS Purchases		2.454** (1.147)	68.56*** (13.17)	-0.471 (1.066)	291.7*** (10.43)	-0.0421 (0.512)	53.99*** (12.70)	-0.742 (1.005)	290.7*** (10.53)
Securitizer \times Unavailability \times Mortgage Rate \times MBS Purchases		-1.283 (1.328)	10.86 (8.143)	-7.748*** (1.077)	13.25** (6.690)	-0.499 (0.542)	17.51* (9.098)	-7.667*** (0.950)	13.93** (6.453)
Bank by Year-Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CBSA Fixed Effects	No	No	No	No	No	Yes	Yes	Yes	Yes
Observations	57521	57521	57521	57521	57521	57521	57521	57521	57521
Adjusted R ²	0.325	0.328	0.275	0.134	0.115	0.952	0.679	0.230	0.161

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Table B.7: Impact of Monetary Stimulus on Firms

Columns 1 through 4 are panel fixed effect regressions. *Investment* is the firm's quarterly capital expenditures divided by lagged PPE, scaled by 100. *MBS Holdings* is the ratio of the bank's MBS securities to total assets from the prior quarter, scaled by 100. *Securities Holdings* is the ratio of the bank's non-MBS securities to total assets from the prior quarter, scaled by 100. *MBS Purchases* is the lagged quarterly log-dollar amount of gross Federal Reserve MBS purchases. *TSY Purchases* is the lagged quarterly log-dollar amount of gross Federal Reserve TSY purchases. *Orthog. MBS/Sec. Holdings* refers to whether the MBS and securities holdings have been orthogonalized to other bank characteristics. Standard errors are clustered by firm and bank.

	Investment			
	(1)	(2)	(3)	(4)
MBS Holdings	0.0381* (0.0211)		0.0382* (0.0209)	0.0359* (0.0211)
MBS Holdings \times MBS Purchases	-0.00276*** (0.000916)		-0.00271*** (0.000966)	-0.00229** (0.000893)
Securities Holdings		0.00745 (0.0300)	0.00357 (0.0274)	0.0245 (0.0334)
Securities Holdings \times TSY Purchases		0.000194 (0.00122)	0.000181 (0.00132)	-0.00187 (0.00176)
Cash Flow	0.00694*** (0.00190)	0.00696*** (0.00189)	0.00694*** (0.00190)	0.00695*** (0.00190)
Lagged Market-to-Book	1.441*** (0.0615)	1.449*** (0.0639)	1.441*** (0.0614)	1.441*** (0.0618)
Lagged Z-Score	0.433*** (0.0943)	0.439*** (0.0960)	0.433*** (0.0943)	0.436*** (0.0946)
Lagged Firm Size	-0.516 (0.466)	-0.521 (0.466)	-0.516 (0.466)	-0.518 (0.465)
Bank's Size	-0.0386 (0.151)	-0.0992 (0.150)	-0.0377 (0.148)	-0.0972 (0.154)
Bank's Equity Ratio	0.0139 (0.0341)	-0.0122 (0.0270)	0.0148 (0.0333)	0.0239 (0.0389)
Bank's Net Income	-0.0102 (0.118)	0.0423 (0.135)	-0.0159 (0.127)	0.0105 (0.125)
Bank's Cost of Deposits	-0.349** (0.178)	-0.395** (0.178)	-0.347* (0.177)	-0.409** (0.192)
Change in Unemp. Rate, Bank's State(s)	-0.304 (0.311)	-0.322 (0.317)	-0.311 (0.325)	-0.314 (0.318)
Orthog. MBS/Sec. Holdings	No	No	No	Yes
Firm-Bank Fixed Effects	Yes	Yes	Yes	Yes
Firm State by Year-Quarter Fixed Effects	Yes	Yes	Yes	Yes
Observations	66887	66887	66887	66887
Adjusted R^2	0.472	0.472	0.472	0.472

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$