Monetary Stimulus and Bank Lending

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Abstract

In recent business cycle downturns, monetary policymakers worldwide have sought to stimulate their economies by conducting asset purchases. The U.S. Federal Reserve purchased both agency mortgage-backed securities (MBS) and Treasury (TSY) securities, which are generally thought to be comparable in credit quality and stimulative effects. This paper investigates the effect of such purchases on mortgage lending, commercial lending, and firm investment using micro-level data. We find that MBS and TSY purchases have asymmetric effects. In response to MBS purchases, banks that are active in the MBS market increase their mortgage origination market share, compared to other banks. At the same time, these banks reduce commercial lending. As a result, firms that borrow from these banks decrease investment. The effect of TSY purchases is either positive, as expected, or insignificant in most cases. Our results suggest different effects depending on the type of asset purchased, that MBS purchases cause distortionary effects across banks and firms, and that TSY purchases did not cause a large positive stimulus to the economy through the bank lending channel.

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The past decade has seen unprecedented monetary policy interventions in the United States, Europe, and Japan. After setting short-term interest rates to near zero, the Federal Reserve embarked on several rounds of asset purchases, known as Quantitative Easing, to further influence markets.[1] Policymakers, investors, and academics alike have wondered about the actual impact of such unconventional policies.

To address this question, we construct a novel and comprehensive micro-level panel dataset that consists of U.S. Compustat firms hand-matched with the set of U.S. banks from which the firms obtain financing for years 2005–2013 at the quarterly level. This paper uses the panel to trace the impact of monetary stimulus at the aggregate level through the lending banks down to individual firm decisions. By exploiting the heterogeneity among banks in terms of their exposure to mortgage-backed securities (MBS) and securities markets in general, our approach allows us to measure the impact of monetary stimulus on (i) firm-level investment decisions; (ii) bank-level credit supply decisions in (a) the commercial and industrial (C&I) loan market and (b) the mortgage market; and (iii) inter-bank reallocation of mortgage market share in response to monetary policy. These micro-level effects are then aggregated to identify the impact of the monetary stimulus on the economy. The expectation is that banks with higher exposure to mortgage markets and those that hold more securities in general would experience an improvement in balance sheets due to asset purchases, leading to positive spillover effects, including C&I loans to firms, ultimately increasing firm investment (Bernanke, 1983; Bernanke and Gertler, 1989; Kiyotaki and Moore, 1997; Stein, 1998; Kashyap and Stein, 2000; Bernanke, 2012).

Our analysis provides three significant results. First, focusing on the real effects of monetary stimulus on firm investment, we find that the impact of TSY and MBS purchases are asymmetric as

[1] In September 2014, the European Central Bank (ECB) announced two new purchase programs, namely the ABS purchase program (ABSPP) and the third covered bond purchase program (CBPP3). The programs "will enhance transmission of monetary policy, support provision of credit to the euro area economy and, as a result, provide further monetary policy accommodation." In March 2015, the Eurosystem started the purchase of bonds issued by euro area central governments and certain agencies, international, and supranational institutions located in the euro area. In June 2016, corporate bond purchases through the corporate sector purchase program (CSPP) started. See the ECB website regarding open market operations at `https://www.ecb.europa.eu/mopo/implement/omo/html/index.en.html`. The Japanese Central Bank (JCB) has also purchased assets, including government bonds, commercial paper, corporate bonds, J-REITs, and equity ETFs (`https://www.boj.or.jp/en/mopo/measures/mkt_ope/index.htm/`).

far as stimulating private investment is concerned. Our back of the envelope calculations that aggregate micro-level effects show that for each dollar invested in MBS purchases, aggregate private investment by firms that borrowed from banks with high MBS market exposure *decreases* by 3.69 cents. In contrast, for banks with high securities holdings, a dollar invested in TSY markets leads to no statistically or economically significant effect in the most exhaustive specification.[2] Second, we focus on the bank lending channel. We find that for each additional dollar of MBS purchases, loan amounts decline by 1.08 cents. In contrast, each dollar of TSY purchases increases loan amount of banks with high securities holdings by 1.62 cents. Third, we investigate the effects on the mortgage market. We find that banks that securitize mortgages benefit disproportionately from MBS purchases, an effect not observed for TSY purchases since the structures of the two markets are different. Given that approximately $1.76 trillion worth of MBS were purchased, securitizer banks gained an additional market share of $103 billion in terms of mortgage origination, and received $648 million as accompanying fees. These results suggest that TSY and MBS purchases have different effects on the real economy and monetary policy transmission is crucially dependent on the type of asset purchased.

These results have important implications for monetary policy transmission theories. Bernanke and Gertler (1989) and Kiyotaki and Moore (1997), among others, emphasize the positive effect of an increase in asset prices on real investments. In this paper, we empirically show that positive shocks to different asset classes may not have homogeneous effects on bank lending and the real side of the economy. Our results do not say directly whether the net effect of asset purchases in general equilibrium is positive or negative. We just document the heterogeneous relation between various classes of asset purchases, bank lending, and firm investment through the bank lending channel. We suggest that policymakers should be cognizant of these dissimilar effects of monetary policy tools on bank lending.

This paper explores the impact of the aggregate monetary stimulus on the economy through the bank lending channel. The literature shows that shocks to financial institutions affect their

[2]If we do not control for economic conditions at the firm's location, then we find that a dollar invested in TSY markets leads to a positive private investment of 3.37 cents for banks with high securities holdings.

ability to lend and end up impacting the firms that borrow from them (Bernanke, 1983; Stein, 1998; Kashyap and Stein, 2000). The impact 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). During the financial crisis, asset purchases helped banks' balance sheets so that their constraints are alleviated. In turn, if firms received financing then their constraints were also expected to be addressed. This paper investigates to what extent this channel stimulated the economy and distinguishes the impact of the two types of assets purchases.

The mortgage markets and Treasury market are obviously different. The primary mortgage market is where banks compete for origination of loans to homeowners, while secondary markets include loan sales and securitized products. Researchers have discussed that the "primary-secondary spread" in the mortgage market—the spread between mortgage rates and MBS yields—were at historically high values during quantitative easing (Dudley, 2012; Fuster, Goodman, Lucca, Madar, Molloy, and Willen, 2013). Scharfstein and Sunderam (2015) show that high concentration in mortgage lending reduces the sensitivity of mortgage rates and refinancing activity to mortgage-backed security (MBS) yields, increasing the primary-secondary spread. In contrast, the corresponding spread in the Treasury market is comparatively negligible.[3] A key point of our paper is to draw attention to this fact that the stimulus transmission mechanisms of the two asset markets are different. Further, the industrial organization of mortgage and MBS markets and TSY markets are also very different, as they involve different sets of participants. Hence, it is intuitive that the stimulus effects will be different based on utilized asset classes. This observation is important beyond U.S. monetary policy, as the ECB is experimenting with corporate bond purchases and the JCB is purchasing equity ETFs.

We find that banks which are most active in the MBS market, as measured by the level of

[3]The spread between on-the-run and off-the-run Treasury securities is known as the "G-spread" and is within 1-5 basis points on average depending on maturity and time-period in question. See `https://www.treasury.gov/connect/blog/Pages/Examining-Liquidity-in-On-the-Run-and-Off-the-Run-Treasury-Securities.aspx`. In comparison, the primary-secondary spread in the mortgage market is approximately 200 bps over the last two decades. See `https://www.newyorkfed.org/research/epr/2013/1113fust.html`.

their MBS assets, the reporting of securitization income, or sales of mortgages to the government-sponsored or government-owned agencies (GSE/GOEs), respond most strongly to MBS purchases. Specifically, the banks that securitize mortgages and thus benefit directly from MBS purchases increase their mortgage origination market share in response to MBS purchases by approximately $103 billion, as compared to their peers. In this group of banks, the effects are more pronounced for those banks that operate in regions with higher housing prices. Focusing on each bank's own set of geographic markets, market share gains are largest in those markets with the highest housing prices for that bank. These findings are consistent with banks having an incentive to originate, bundle, and securitize more mortgage loans—particularly high-value mortgage loans—in response to the demand increase created by the Federal Reserve. This phenomenon is similar in spirit to research on firms with deeper pockets gaining market share during business cycle downturns (Chevalier and Scharfstein, 1996). Not all banks benefit equally from the increased MBS asset purchases. It is also notable that mortgage origination by banks that benefit from MBS purchases are not tilted towards areas with lower house prices, even after adjusting for demand-side effects.

At the same time, these banks reduce commercial lending. Compared to other banks, securitizing banks reduce loan amounts by $19 billion when the Federal Reserve purchased a total of $1.7 trillion of MBS securities.[4] In contrast, the purchase of an additional $1.68 trillion of TSY securities led to an additional $27 billion of additional loans. It is noteworthy that these securitizing banks are larger banks and likely face fewer capital constraints.[5] Yet, the results show a pronounced shift away from C&I lending when the Federal Reserve is purchasing MBS securities.

Using our micro-level panel data, we find that firms that borrow from these banks receive less capital and reduce investment as a result. Specifically, firms reduce their quarterly investment by as much as 95 basis points (bps) of a standard deviation following one pp increased MBS purchases at the mean when their lending bank has higher MBS exposure. While the effect at micro-level may seem small, given that the gross private domestic investment per quarter in the

[4]See `https://fred.stlouisfed.org/series/MBST` for MBS holdings of the U.S. Federal Reserve and `https://fred.stlouisfed.org/series/TREAST` for the TSY holdings.

[5]The median securitizing bank in our sample has $7.8 trillion more in total assets than the median non-securitizing bank.

sample period was $2.4 trillion on average, this conservatively translates to $64.8 billion lower investment due to MBS purchases. The finding is driven by firms which have access to fewer alternative sources of external capital but not completely. For reasons unrelated to the borrowing firm, the lending bank restricts capital in favor of stronger opportunities in the mortgage market. In comparison, firms do not experience negative investment effects following Treasury purchases. We find firms that borrowed from banks with higher Treasury and other non-MBS securities holdings are not reducing investment in response to Treasury purchases by the Federal Reserve. However, in most specifications, they are not increasing investment either suggesting a limited impact of TSY purchases as a stimulus policy.

The phenomenon of crowding out of capital from one sector to the economy by another sector during booms has been theoretically argued (Farhi and Tirole, 2012) and empirically shown (Chakraborty, Goldstein, and MacKinlay, 2016). Chakraborty, Goldstein, and MacKinlay (2016) find that during the U.S. housing boom, banks in stronger housing markets reduce commercial lending in favor of more mortgage activity, and firms that borrowed from these banks have to reduce investment as a result. Our paper shows that after the boom ended, a different mechanism crowds out capital away from firms: Asset market purchases combined with the attempts by better-positioned banks to gain market share in real estate lending led to less C&I lending. In addition, our paper evaluates the effects of the Quantitative Easing program in the U.S. on commercial lending and the mortgage market.

Three contemporary papers also investigate separate aspects of Quantitative Easing (QE) 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. Rodnyanski and Darmouni (2016) investigate the effect of QE on bank lending behavior and find that the third round of QE (QE3) had significant positive effects on bank lending. QE2 had no significant impact, and QE1 had a

smaller impact that QE3. Kandrac 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. Our paper traces the impact of TSY and MBS purchases through the banks' balance sheets on investment decisions of individual borrowing firms. We also test for credit supply changes due to QE by comparing loan amounts obtained by the firms. Finally, we explore the impact of MBS purchases on the industrial organization of loan origination in each geography. Thus, our work relates to and complements the research discussed above. Finally, Heider, Saidi, and Schepens (2016) investigate the impact of negative interest rates on the lending behavior of banks and finds that there are potential risks to financial stability due to additional risk taking by banks.

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

I Hypothesis Development

During the recent financial crisis, monetary policymakers made a large effort to support the housing market and capital markets in general (Mishkin and White, 2014). In addition to keeping short-term rates close to zero, policymakers attempted to reduce long-term interest rates by purchasing Treasuries and MBS assets. The motivations included supply-side arguments such as reducing financing costs for banks through lower depository rates and higher value of assets on the balance sheet, and demand-side arguments such as higher consumer demand through a wealth effect due to improvement in asset prices.

Unfortunately, both the supply-side and demand-side channels have faced significant frictions due to the state of the economy during and since the financial crisis. Scharfstein and Sunderam (2015) show that banks that enjoy higher market power may not pass-through the benefits of lower rates in the secondary markets to consumers. On the demand side, Mian, Rao, and Sufi (2013)

and Eggertsson and Krugman (2012) argue that the large debt overhang on the balance sheets of households reduce any wealth effect benefits. In this paper, we ask three questions as detailed below.

I.A Do TSY and MBS Purchases have a Similar Impact on Investment?

Our paper evaluates the individual impact of the two asset classes used in Quantitative Easing on private investment at the Compustat firm-level through the bank lending channel. From the perspective of investors in fixed income capital markets, Treasuries and agency MBS are quite similar. While Treasuries are backed by the full faith and credit of the U.S. government, there has been a long-standing expectation that securities guaranteed by the different agencies (Fannie Mae, Freddie Mac, and Ginnie Mae) and the debt of these agencies themselves will also be protected against default by the U.S. government.[6] This expectation was realized during the financial crisis. After the crisis, Treasury and agency MBS markets are getting treated by the industry participants effectively as one market. In February 2015, the Treasury Market Practices Group was created to support the integrity and efficiency of Treasury, agency debt, and agency MBS markets.[7]

The first hypothesis that we are interested in is whether TSY and MBS purchases are in fact the same in terms of their stimulative effects on private investment through the bank lending channel:
(H1) *The impact of asset purchases on (a) bank lending and (b) firm investment is the same for TSY and MBS purchases.*

To ensure that our hypothesis test is not affected by aggregate economic factors, we exploit cross-sectional variation in the exposure of the lending bank to MBS and security holdings in general. Our cross-sectional approach is valid under the assumption that the magnitude of the effect of asset purchases varies across banks at a given point in time. This variation could be due to the amount of those assets held by a bank or how the purchases affect the profitability of future loan activity.

[6] Ginnie Mae is different since it is explicitly government owned.

[7] The Charter of the Treasury Market Practices Group, a private-sector organization sponsored by the Federal Reserve Bank of New York is available here: `http://www.newyorkfed.org/TMPG/tmpg_charter_02262015.pdf`.

As we will show, certain banks are securitizers of mortgages and they should benefit more from MBS purchases and hence respond more as well.

I.B How did Quantitative Easing Effect Commercial Lending?

Our second question investigates the effect of quantitative easing on commercial lending. Banks with access to the MBS market could still be using a fraction of the advantage gained to lend in C&I markets. Further, banks that are unable to compete in the residential lending market may be making a complementary switch to lending in the C&I loan market. In addition, Treasury purchases also transmit reduction in rates to all fixed-income markets, and that could increase demand for capital by firms. To empirically investigate these possibilities, we test the following hypothesis:

(H2) *In the cross-section of U.S. banks, asset purchases translated to higher C&I lending.*

It is important to note that the net effect in equilibrium on C&I lending is an empirical question, and may provide different answers in different countries and periods, based on, among other things, the structure of the mortgage market, the importance of public debt financing, or the sectoral composition of the economy. As before, empirical tests are necessarily cross-sectional given one aggregate shock with varying bank-level exposures to the shock.

I.C Did MBS Purchases Affect Lender Industrial Organization?

While investors may not see a large difference in the credit quality of TSY compared to that of agency MBS, the Treasury market and the agency mortgage markets have important organizational differences that affect how they transmit monetary policy. Banks compete with each other to provide real estate loans to consumers at the primary lending rate, and then some of these loans are sold or securitized at the secondary interest rate (the yield to maturity of the MBS). The higher the primary rate compared to the secondary rate, the higher the incentive for banks to originate new loans. If MBS rates are reduced through MBS purchases by Federal Reserve, the expectation of policymakers is that this reduction in rates will be passed through to the primary rate by banks (Bernanke, 2012). Banks will transmit this rate reduction when they originate more loans

or refinance loans while competing for business with other lenders. Thus, competition between originators of mortgages is an essential part of the transmission mechanism of Quantitative Easing in the case of MBS purchases.

The Treasury market does not have such a split between the primary/auctions market and the seasoned Treasury market; there is only one originator of TSY securities—the U.S. Treasury Department. The mechanism through which TSY purchases increase lending is through the general reduction of all interest rates in the fixed-income securities market and securities market in general. This is because long-term Treasury rates provide the reference points for almost all rates, including corporate bond yields and mortgage yields. Compared to the Treasury market, where a rate reduction benefits asset prices in all fixed income markets, a stimulus to the mortgage markets helps market participants in the mortgage market relatively more. Even among the mortgage market participants, the participants in the (secondary) MBS market are the direct beneficiaries, with competition driving the pass-through of reduction in rates to other participants.

Given this beneficial situation for banks with MBS market access compared to competing banks without access, business cycle downturns provide an ideal opportunity for the former set of banks to increase market share. Gaining market share is especially beneficial in geographical areas with higher profitability. Further, capital market imperfections such as limited capital mean that the interest rates offered by the constrained banks may be higher as they need to boost short-term profits, thus exacerbating the advantage of banks with access to MBS markets. Research has suggested this mechanism in theory (Greenwald, Stiglitz, and Weiss, 1984; Klemperer, 1987) and shown it empirically in the case of supermarkets (Chevalier and Scharfstein, 1996). This provides us our final testable hypothesis:

(H3) *In the case of MBS purchases and business cycle downturns, banks that have access to the secondary market seek to gain market share from banks without such access. This is especially the case in more profitable geographies.*

For all these questions, we conduct back of the envelope calculations to aggregate micro-level impacts estimated at the firm or bank-level to the macroeconomic level.

II Data

Our analysis uses four different panels of data. Our first 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 second panel again uses the relationships between firms and banks, but focuses only on the quarters in which loans are originated. The third and fourth panels are used to investigate the effect of asset purchases on the bank's commercial loan activity and mortgage origination, 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.

Given our focus on asset purchases made by the Federal Reserve, our main analysis focuses on the period from 2005q3 through 2013q3.[8] Section II.A discusses how we determine firm-bank lending relationships, along with the relevant firm, bank, and loan data. In Section II.B, we discuss some features of the agency MBS market and how we measure bank involvement in the mortgage market. Section II.C covers the Federal Reserve's asset purchase programs in more detail.

II.A Commercial Lending Relationships

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 A of Table I provides statistics on

[8]The third quarter of 2005 is the first quarter with any asset purchase data, and the third 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.

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. 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 our firm variables. Specific variable definitions can be found Table A.1 in the Appendix.

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. Our measure of C&I loan growth and other bank-level control variables are constructed from the Call Report data.[9] In our sample period, we match 265 largest Dealscan lenders to 59 bank holding companies in the Call Report data that are the most active commercial lenders in the U.S.[10] 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.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 also calculate each bank's market share for each individual CBSA market in which it reports activity.[11] This data captures both the mortgages that remain on the bank's balance sheet and those that are sold to other financial

[9] As 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.

[10] Of these 265 lenders, 243 lenders (and 54 bank holding companies) have borrowers that can be matched to Compustat and are included in our main sample.

[11] Core-based statistical area (CBSA) is the new standard as of 2003 for U.S. geographic areas, replacing the older metropolitan statistical area (MSA) standards.

institutions or the government sponsored or owned agencies (GSE/GOEs). Summary statistics are included in Panel B of Table I.

II.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.[12] The majority of agency MBS purchases undertaken by the Federal Reserve occurred in the TBA market.

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. The second variable we use to capture secondary market involvement is 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.[13] A third measure, *GSE/GOE Seller*, is an indicator for banks which

[12] See Gao, Schultz, and Song (2016) for more details on the structure of the MBS market.

[13] At any given year-quarter, the number is actually lower. The average percent of bank year-quarter observations

sell originated mortgages to the GSE/GOEs in a given year.[14]

II.B.2 Housing Market Exposure

To capture differences in primary mortgage markets across banks, we include a measure of housing prices per bank holding company. As in Chakraborty, Goldstein, and MacKinlay (2016), we use the Federal Housing Finance Agency (FHFA) House Price Index (HPI) data as the basis for this variable. To determine the exposure of each bank to different state-level housing prices, we use the summary of deposits data from June of each year, aggregated to the BHC level for the next four quarters. Using the percent of deposits in each state as weights, we create a measure of housing prices which is specific to each bank and each year-quarter. Additional details about our HPI measure are included in Appendix A.5.

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.[15] We calculate this measure at the bank level (analogous to the bank-level HPI measure). 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.

with recent non-zero securitization income is only .008%.

[14]This variable captures more banks than the *Securitizer* indicator, as about 25% of banks sell mortgages to GSE/GOEs in our sample. As this variable generates similar results to other two categorization variables, we use it mainly in our robustness analysis in the Appendix.

[15]Saiz (2010) calculates slope maps for the continental United States using U.S. Geological Survey (USGS) data. The measure is the share of land within 50 km of each CBSA that has a slope of more than 15% or is covered by lakes, ocean, wetlands, or other internal water bodies. We convert these measures from the old MSA to the newer CBSA standards.

II.C Federal Reserve Asset Purchases

Also 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, $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.

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), TSY 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 TSY purchases. Table II lists the primary dealers over our sample

period in descending order by amount of the securities purchased or sold.

III Empirical Results

Section III.A analyzes if TSY and MBS purchases transmit easier monetary policy to the real economy in a similar manner. Sections III.B and III.C investigate the impact of asset purchases on bank lending in the commercial and industrial loan market and the mortgage market, respectively.

III.A Firm Investment

The first question that we address is if the impact of Treasury purchases and MBS purchases are different (H1). 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.

Two important issues must be addressed before we can identify the desired effect. First, since the asset purchases were driven by prevailing economic conditions including demand-side effects, we cannot identify the impact of asset purchases by considering average bank lending or firm investment in a given quarter. Instead, we consider the differential response among banks in a given quarter based on their exposure to the asset purchases, and the subsequent differences among firms depending on which banks they borrow from. We measure differences in bank exposure to asset purchases using two variables: the amount of MBS holdings as a percent of total assets and the amount securities holdings as a percent of total assets.

The second issue is 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 remove any persistent differences across lending relationships. Still, it is possible that firm-demand for capital and investment

changes over time in a way that is correlated with the lending bank's holdings, such as local economic conditions. So in addition to standard firm-level controls, in many specifications we include firm's state by year-quarter fixed effects. These fixed effects remove any common economic shocks to all firms headquartered in a given state, regardless of their lending bank's location. Finally, in Section III.B, we focus on changes in loan amounts for firms with multiple bank relationships, where we can most completely remove any firm-demand factors from consideration.

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:

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

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 banks. Throughout our analysis, we use the log transform of the dollar amounts of the purchases.[16] Banks are divided into terciles based on what fraction of assets are held as MBS and Securities including TSY. In these specifications, we focus on the subset of banks which are in either the highest or lowest terciles of MBS holdings or securities holdings.[17] All specifications include controls for the bank's size, equity ratio, net income, and cost of deposits from the prior quarter. We also include changes in the unemployment rate in the bank's states to capture economic conditions where the bank is active. These controls are in addition to firm-level characteristics that include 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.[18]

[16] Specifically, we use $\log(1+x)$, where x is dollar amount purchased in a year-quarter in millions. We find similar results if we use a binary variable for year-quarters with or without asset purchases.

[17] We present similar specifications that instead use continuous versions of the MBS and securities holdings variables over the full sample in Table B.2 of Appendix B.1.

[18] Also included are the firm-bank fixed effects (α_{ij}) and the year-quarter or firm's state by year-quarter fixed effects (γ_{s_it}).

Table III 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. Column (1) presents the investment results for firms over the entire panel, 2005q4 to 2013q3.[19] The results show that asset purchases, whether MBS or TSY, are associated with periods of lower firm investment. Since there are no year-quarter fixed effects, this negative association could be driven by plummeting aggregate demand following the financial crisis. Column (2) exploits the heterogeneity of bank holdings to differentiate the effect of asset purchases on firms through their lending banks. We include interaction terms between asset purchases and corresponding asset holdings (TSY/MBS) to capture the heterogeneous impact of monetary policy on banks, and ultimately firms. The coefficients show that firms that borrow from banks that have higher non-MBS securities holdings (including Treasuries) invest more in the following TSY purchases. However, firms that borrow from banks that have more MBS holdings do not invest more following increases in MBS purchases. As before, this column also does not include year-quarter fixed effects.

An important concern is that the firm-level effects are driven by the business cycle (at the national level). Column (3), therefore, includes year-quarter fixed effects to address this concern.[20] We find that, just as in column (2), firms that borrowed from banks with higher MBS holdings *decreased* investment following higher MBS purchases from the Federal Reserve. The mean quarterly purchase of TSY and MBS during our sample period is 70.3 billion USD and 95.3 billion USD, respectively. One percentage point (pp) of additional MBS purchases from the mean, which amounts to 953 million USD per quarter, led to a decrease of 95 bps of a standard deviation in terms of firm-level investment.[21] 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, consider a few

[19] Since we use asset purchases from the prior year-quarter, we start our investment analysis in 2005q4.

[20] The year-quarter fixed effects absorb the coefficients for *MBS Purchases* and *TSY Purchases* in this specification.

[21] The calculation is $-0.0506 \times 0.01 \times 1/5.34 = 95$ bps. We use 5.34 and not 0.0534 since the investment numbers are scaled by 100.

points. 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 5.75% of net PP&E per quarter. Let us assume that firm-bank relationships are equally distributed across banks. This is a conservative estimate since larger banks have more relationships. Furthermore, using Census data, Axtell (2001) shows that distribution of firm sizes in the U.S. follows Zipf's law. Given that our estimation approach gives firms equal weights and in the data firm size distribution is positively skewed, 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.

Under these assumptions, we obtain an estimate of 35.1 million USD decrease in private investment due to one pp higher MBS purchases.[22] Thus, for each dollar invested in MBS purchases, firms that borrowed from banks with high MBS holdings decrease investment by 3.69 cents. This is a statistically and economically significant negative effect on firm investment for firms that borrowed from banks with high MBS holdings. In contrast, the impact of TSY purchases is positive. One pp of additional TSY purchases from the mean, which amounts to 703 million USD per quarter leads to an increase of 64 bps of standard deviation in terms of firm-level investment.[23] As before, this leads to a 23.7 million USD increase in private investment.[24] Thus for each dollar invested in Treasury purchases, firms that borrowed from banks with high securities holdings increase investment by 3.37 cents. Note that the TSY effect is not statistically significant in this case. This evidence shows that the impact of asset purchases through a bank lending channel is asymmetric for TSY and MBS purchases.

One may still be concerned that the effects are driven by more regional time-varying economic conditions such as reduced local demand which are omitted in the specification. Columns (4)-(6) address such concerns by including the firm's state by year-quarter fixed effects which absorb any time-varying state-level factors. The negative investment result for MBS purchases remains in this

[22] See `https://fred.stlouisfed.org/series/GPDIC1` for real gross private domestic investment. The calculation is $-0.0506 \times 0.01 \times 1/5.75 \times 2394.81/3 \times 0.5 = -35.1$M.

[23] The calculation is $-0.0341 \times 0.01 \times 1/5.34 = 64$ bps.

[24] The calculation is $-0.0341 \times \times 0.01 \times 1/5.75 \times 2394/3 \times 0.5 = 23.7$M.

specification. Column (5) only includes TSY purchases with firm's state by year-quarter fixed effects and the results are not statistically significant.[25] Column (6), which is our most exhaustive specification corroborates the asymmetric effects of MBS and TSY purchases: a one pp increase in MBS purchases leads to firms that borrow from banks with high MBS holdings reducing their investment by 96 bps of a standard deviation.

Focusing on the bank lending channel, these results suggest that TSY purchases and MBS purchases are unequal instruments for transmitting monetary policy preferences of lower long-term interest rates. Importantly, we do not find statistically significant evidence that Treasury purchases affect firm investment through its lending bank in the most exhaustive specification. At the same time, our results show a negative effect of MBS purchases on firm investment through the bank lending channel. Clearly, increasing firm investment was not the sole goal of monetary policy. However, a reduction in firm investment related to MBS purchases is a noteworthy outcome.

III.B Commercial Lending and Asset Purchases

III.B.1 Loan Level Evidence

In this section, we directly investigate the amount of credit supply by banks to firms in response to asset purchases to identify the supply-side impacts of Quantitative Easing. As in Section III.A, 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

[25] An observation that is valid throughout the paper is that the negative effects of MBS purchases are statistically and economically significant. However, the positive effects of Treasury purchases are not. Nonetheless, all specifications show an asymmetric impact of MBS and TSY purchases on firm investment.

bank j is:

$$\begin{aligned}\text{Loan Amount}_{ijt} = \beta_1 \text{Loan Controls}_{ij} + \beta_2 \text{Asset Purchase Variables}_{t-1} + \beta_3 \text{Bank Variables}_{jt-1} \\ + \beta_4 \text{Bank Asset Hldgs}_{jt-1} \times \text{Asset Purch Vars}_{t-1} + \alpha_j + \theta_{it} + \varepsilon_{ijt}. \qquad (2)\end{aligned}$$

The coefficients of interest are, as before, the vector of β_4. Table IV reports the results. Columns (1)–(3) 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.[26] Columns (4)–(6) focus specifically on banks that securitize mortgages and other debt products. These banks, as we argue in Section II.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 III.A, the specification 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 a given quarter leads to 3.44 bps lower loan amounts from banks to firms when the bank is in the top tercile of MBS holdings among U.S. banks. In other words, given that the aggregate amount of commercial loans is approximately \$1.33 trillion during the sample period,[27] and again assuming an equal distribution of firm-bank relationships across terciles—an assumption that gives a conservative estimate of the effect—our back of the envelope calculation suggests that one pp additional MBS purchases led to 3.8 million lesser loans by banks with more MBS holdings.[28]

[26] Because 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.

[27] See `https://fred.stlouisfed.org/series/BUSLOANS` for data on commercial and industrial loans of all commercial banks in the U.S.

[28] Calculation is $0.0866 \times 0.01 \times 1.33\text{T}/3 \times 0.01 = 0.00383$ B. We did not conduct a firm size distribution skew adjustment here because the sample of firms is those that borrow from multiple banks. These are large firms and hence our estimates are conservative, to begin with.

Column (2) does not find statistically significant effects for TSY purchases. Column (3), which includes both types of asset purchases, shows that for one standard deviation increase in MBS purchases, loan amounts by banks with higher MBS holdings decrease by 9.27 bps. In contrast, for one standard deviation higher TSY purchases, loan amounts increase by 9.06 bps on average. These translate into changes of -10.3 million and 11.4 million dollars, respectively, in loan amounts when we continue our back of the envelope calculations. In other words, for each additional dollar of MBS purchases, loan amounts decline by 1.08 cents. In contrast, each dollar of TSY purchases increases loan amount of banks with high MBS holdings by 1.62 cents. These are significant effects at the micro-level of monetary policy at the macro-level.

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 (4)–(6) investigate this question. Indeed, we find that MBS purchases led to a negative effect approximately almost eight times stronger than in Column (1) when we focus only on banks that are securitizers. One standard deviation higher MBS purchases leads to 26 bps lower loan amounts from securitizer banks. Thus, loan amounts decreased the most among the securitizing banks compared to other non-securitizer banks. Column (5) suggests that even TSY purchases do not have a positive effect in the case of securitizers. This suggests that the positive effects of TSY purchases that we observe in some instances may not be very robust. This is an important result because readers may have the prior that TSY purchases should lead to more commercial and industrial lending. However, we do not find an increase in the amount of credit in response to TSY purchases. Finally, Column (6) includes both asset purchases in the same specification and corroborates the observation that MBS and TSY 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.

III.B.2 Bank Level Evidence

So far, we discuss loan-level evidence that suggests asymmetric effects of TSY and MBS purchases and a negative effect of MBS purchases on the credit supply to firms. However, we focus on a subsample of loans to address concerns regarding endogeneity of credit supply to firm demand. We now expand the analysis to include all commercial and industrial lending by a bank. As above, 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 V reports the loan growth in commercial and industrial lending as a response to MBS and TSY purchases. As before, Columns (1)–(3) identify the effects on credit supply depending on whether the bank is in the top tercile of MBS or securities holdings as a fraction of assets. Columns (4)–(6) focus on securitizer banks to identify the effect of the monetary stimulus on lending at the bank level. 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 remain the bank-level interaction terms with MBS and TSY purchases. Column (1) shows that the loan-level evidence holds true in this case as well. Banks that are in top tercile of MBS holdings, and 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 6.54 bps (annualized). Column (2) shows that banks with high holdings of securities reacted positively to TSY purchases in terms of C&I lending. One standard deviation additional TSY purchases at the mean leads to 10.80 bps additional C&I loan growth, again annualized. Column (3) includes both MBS and TSY purchases and finds that the marginal effects from columns (1) and (2) remain similar in magnitude and statistically similar.

Columns (4)–(6) focus on banks that securitize to confirm that the observed effects are stronger for banks that benefit more from MBS purchases. Indeed, we again find effects seven times stronger in Column (4) compared to Column (1); one standard deviation additional MBS purchases

at the mean leads to 46.45 bps less C&I loan growth for securitizing banks.[29] In our sample, the average annual seasonally adjusted loan growth rate is only 5.25 pp per year. In dollar terms, loan growth is approximately $69.44 billion per year.[30]

Assuming one-third of the total loan volume is originated by the securitizers, loan growth is depressed by approximately 107.5 million dollars 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 28.4 cents per year. Given that QE has led to approximately 1.76 trillion dollars of MBS holdings,[31] this translates into a reduction of 4.98 billion dollars in terms of loan growth. Importantly, the effect of MBS purchases on C&I loan growth is not positive.

In the case of securitizing banks, Column (5) finds no statistically significant positive effect of TSY purchases. As before, readers may have the prior that TSY purchases should lead to more commercial and industrial lending, but that is not what we find for securitizer banks. These effects remain similar in magnitude in Column (6) when both types of purchases are included together.

In sum, this section shows that commercial and industrial loans face an asymmetric impact of MBS and TSY purchases, and the effect of MBS purchases is negative.

III.C Mortgage Lending and Asset Purchases

So far, we have discussed the impact of Quantitative Easing in the U.S. on C&I lending. Given we find C&I lending declines for those banks most affected by the MBS purchases, then a natural question is how does their mortgage activity change? 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

[29] The calculation is $-0.292 \times 4 \times 0.01 \times (\log(142.8 + 95.3) - \log(95.3)) = 46.45$ bps.

[30] See `https://fred.stlouisfed.org/series/CILACBQ158SBOG` for loan growth rate data and `https://fred.stlouisfed.org/series/BUSLOANS` for dollar amount change data.

[31] See `https://fred.stlouisfed.org/series/MBST` for MBS holdings of the Federal Reserve and `https://fred.stlouisfed.org/series/TREAST` for TSY holdings data.

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.

III.C.1 Mortgage Market Share Gains for MBS Holding Banks

This section investigates the change in mortgage origination market share of banks in a specific quarter and state in response to asset purchases, depending on the banks' exposure to the MBS market. As before, 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. 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 the 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 state s in year t is as follows:

$$\begin{aligned}\text{Mort Orig Mkt Share}_{jst} = \alpha_j + \beta_1 \text{Asset Purch Vars}_{t-1} + \beta_2 \text{Bank Vars}_{jt-1} \\ + \beta_3 \text{Bank Asset Hldgs}_{jt-1} \times \text{Asset Purch Vars}_{t-1} + \gamma_{st} + \varepsilon_{jst}. \quad (3)\end{aligned}$$

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 asset purchases with exposure for the bank to the MBS market. Table VI 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 0.233 bps in terms of MBS origination market share for a bank with high MBS holdings.[32] Given that the average origination market share of a bank in a state is 26.2 bps, this is approximately a 0.89% higher market share for a bank in a quarter. Given that the average mortgage origination during our sample period is 498.45 billion

[32]The calculation is $0.586 * (\log(142.8+95.3) - \log(95.3)) * 0.0001 = 0.233$ bps

USD,[33] and assuming an equal distribution of market share for banks with high MBS holdings and those without, this means a 1.45B USD additional market share for the banks with high MBS holdings.[34] Given the lender fees during the period is approximately 62.77 bps of the loan amount for a 30 year mortgage, our back of the envelope calculation suggests a transfer of 9.1 million USD of fees from banks with low MBS holdings per quarter to banks with high MBS holdings *ceteris paribus*, i.e. if the mortgage origination size remains constant across periods.[35] Column (2) introduces state by year fixed effects and finds that the coefficient of interest retains similar magnitude and statistical significance. For the total purchase of 1.76 trillion USD, this translates to a total gain of 114 million dollars in fees and 18.2 billion dollars of additional market share for banks with high MBS holdings.

Since securitizer banks are even more likely to participate in the MBS market, Column (3) focuses on the gain in annual market share of securitizer banks following MBS asset purchases. We find that the effects are approximately 6 times stronger in this case. One standard deviation higher MBS purchases in a quarter at the mean leads to a gain of 1.34 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 (4) shows that securitizer banks gained an additional market share of $103 billion due to the total MBS purchases, and obtained 648 million in terms of accompanying fees.

III.C.2 Strategic Mortgage Origination by Securitizing Banks

The previous section showed that some of the credit supply due to the reduction in C&I lending may have been allocated to housing credit. This section focuses on which areas received the additional housing credit. The section argues that MBS purchases to securitizing banks led to additional housing credit, especially in areas where house prices were higher and thus mortgages

[33] Data is from the mortgage bankers association `http://www.mba.org`.

[34] The calculation is $498.45/3 \times 0.89\% = 1.45$B.

[35] See `https://fred.stlouisfed.org/series/MORTPTS30US` for data on origination fees and discount points.

were more profitable per dollar lent, even after controlling for the demand of housing. This result may imply that banks are allocating additional capital to housing markets which are relatively doing better. The identification, in this case, is driven by cross-sectional differences in the state-level market share of banks with high MBS holdings between housing markets with high and low relative prices conditional on additional MBS purchases as a stimulative policy.

Table VII considers the determinants of change in mortgage share at the bank holding company level for each state, as measured in basis points. Because the data is only available at an annual frequency, all lagged variables in these specifications are as of the fourth quarter of the prior year. All columns include bank and state by year fixed effects to control for aggregate economic variables and bank-specific time-invariant characteristics. In addition to the bank controls included in prior sections, here we include *Housing Price Index, Bank's State(s)*, which measures the weighted-average state-level housing price index for a specific bank, using its deposits as weights. (See Section II.B.2 for additional details.) Throughout Table VII we demean *Housing Price Index, Bank's State(s)* at the sample mean to aid in interpretting the various interaction terms.

Column (1) shows that banks that have a larger footprint in more expensive areas in terms of housing prices on average have a lower market share. Column (2) shows that banks that have higher MBS holdings, following an increase in housing prices in the area where they have branches, have a lower market share. Column (2) also corroborates the findings in Table VI that following MBS purchases, banks with high MBS holdings gain market share. However, the variable of most interest in this table is the interaction term between *High MBS Holdings*$\times$*HPI*$\times$*MBS Purchases*, which shows that in addition to the effect discussed earlier, banks in higher-priced housing markets increase market share most of the high-MBS banks. Thus, banks with high MBS holdings that benefit from MBS purchases are not lending more in low-priced markets, but rather strategically lending in the better-priced markets.

A concern may be that the differences in housing price index 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. Thus, it is not supply-side driven

increase in credit, but rather economic activity and consumer demand that drives the gain in market share for banks. Note that Column (2) already includes state by year effects which should alleviate this concern, as we are essentially considering changes in market share among banks in the same state and time. Nonetheless, following Chakraborty, Goldstein, and MacKinlay (2016), Column (3) instruments the housing price variable (and its interaction terms) with the land unavailability and mortgage rate instruments. Land unavailability in an area is clearly exogenous to the economic conditions in an area, and aggregate mortgage rates are also independent of local economic activity. The effect of the instruments on housing prices is presented in Table B.3 in the Appendix. The coefficient for the interaction term remains similar in terms of magnitude but loses statistical significance because of an increase in the standard error.

To gain additional confidence in our argument, we look at the sample of securitizers where the effect should be stronger. As before, the effects in Column (5) and (6) are respectively four and six times stronger in the sample of securitizing banks. In our most exhaustive specification, Column (6) shows that one standard deviation additional purchases of MBS at the mean leads the securitizer banks to increase market share by an additional 3.54% of the mean market share of the bank in areas where housing prices are one standard deviation higher than the mean house price in the bank's geography.

Overall, we find that banks which can originate and securitize mortgages are responding to higher MBS purchases by increasing mortgage market share. Across these banks, the increases are largest for those situated in higher-priced housing prices. It appears that these banks are responding to the increased profit opportunities in the MBS market, and all the more so in those markets where the value of residential loans is higher relative to the costs of originating them.

Combining the fact that stronger beneficiaries of MBS purchases are lending less in terms of C&I loans with the finding that banks with more exposure to housing markets lent more in real estate as a response to MBS purchases, suggests that banks that benefited from MBS purchases may have attempted to consolidate their position in real estate lending markets using new found capital. Business cycle downturns provide an ideal opportunity to increase market share to firms

that have deeper pockets. Capital market imperfections such as limited access to MBS markets provide banks with access an advantage over other banks which they translate into higher market share (see Chevalier and Scharfstein, 1996, who find a similar effect in supermarkets).

IV Additional Discussion and Robustness

Section IV.A reports which banks are responding to MBS purchases in terms of C&I lending. Section IV.B investigates the impact of asset purchases based on whether firms are capital constrained. Section IV.C utilizes data at the Core Based Statistical Area (CBSA) level to show that our results do not depend on geographical resolution. Appendix B reports additional robustness tests.

IV.A Firm Investment and Secondary Market Exposure

Section III.A shows that TSY and MBS purchases by the Federal Reserve have asymmetric effects om C&I lending. C&I lending does not increase. Table VIII investigates the bank lending channel further, dividing the sample of borrowing firms depending on whether their banks are more active in the secondary mortgage market, as measured by our *Securitizer* variable. Banks that are more active in this market should benefit more from asset purchases, especially MBS purchases, and thus should respond more.

Table VIII presents the results. We find that the negative effect of the bank's MBS holdings and Federal Reserve MBS purchases is concentrated among the securitizer banks. For a one standard deviation increase in MBS purchases, firms that borrow from banks that have high MBS holdings and are securitizers reduce their investment by 48 bps, and this effect is stronger than the effects reported for all high MBS holding banks in Table III. This effect is statistically significant at the 1% level and is statistically different from the same coefficient for the non-securitizer banks' sample which cannot be distinguished from zero.[36]

[36]There is no estimated coefficient for *High MBS Holdings* in column (2) 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.

This effect shows that even within the group of banks that are active securitizers, differences in mortgage activity (as reflected by higher MBS holdings), result in lower investment levels for borrowing firms. This result complements those reported in Tables V and VI respectively, which show that securitizer banks differentially increase their mortgage market share and decrease C&I loan growth in response to higher housing prices.

IV.B 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.[37] In columns (1) and (2), we split the firms based on firm size and interact the amount of MBS and TSY purchases with the lending bank's exposure to the respective asset classes. The table finds that the negative investment effect of a bank having higher MBS holdings during increased 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 TSY purchases is negligible in both categories when we split the sample by firm-level constraints. This again is an important result if

[37]There 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.

the prior is that TSY purchases positively affect firm investment decisions.

IV.C CBSA-Level Mortgage Market Share

This section repeats the analysis in Section III.C at the finer CBSA level. Specifically, we look at how a bank's market share changes across the CBSAs in which it is active, as a function of the CBSA-level housing prices and the Federal Reserve's TSY and MBS purchases. In this table, we control for any differences across banks and time periods by including bank by year-quarter fixed effects. The most exhaustive specifications also include CBSA fixed effects. Our identifying variation for the effects is across markets for each particular bank in each particular year-quarter. Here we demean the CBSA-level housing prices by the sample average to aid in interpreting the interaction terms.

Column (1) of Table X documents the role of CBSA housing prices 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. We find that securitizing banks have higher market share in the CBSAs with higher housing prices. Column (2) also shows that for a one standard deviation increase in MBS purchases by the Federal Reserve, the securitizer banks increase their market share by an additional 9.88% of mean share in CBSAs with one standard deviation higher house prices. Column (3) includes CBSA level fixed effects in addition to the bank by year quarter fixed effects. Because the coefficient estimates do not change significantly, the results are not driven by persistent differences in CBSAs.

Columns (4) through (6) re-perform the analysis of Columns (1) through (3) but use an instrumental variables approach to address the potential endogeneity of housing prices to local economic activity. We attempt to isolate variation in housing prices that is unrelated to other economic activity using our IV approach. We find results broadly consistent with our OLS results from Columns (1) through (3). If anything, the coefficient in Column (6) on the triple interaction term *Securitizer*$\times$*CBSA HPI*$\times$*MBS Purchases* is 50% stronger.

Complementing our results in Section III.C, we find that focusing on the various CBSA markets

where securitizer banks are active, these banks increase market share most in those CBSAs with the highest housing prices. This suggests a reallocation of effort and resources within each bank's set of active mortgage origination markets in response to the Federal Reserve's MBS purchases.

V 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 are active in the secondary mortgage market capture mortgage origination market share in response to increased MBS purchases from banks that do not benefit as much from MBS purchases. At the same time, these active-MBS banks reduce commercial lending. Firms which borrow from these banks decrease investment as a result. TSY purchases do not lead to the same response. A separate finding is that the positive impact of TSY 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. Stimulating policies may have lasting effects on the industrial organization of sectors of the economy, depending on the heterogeneity of financial health of banks in that lending market.

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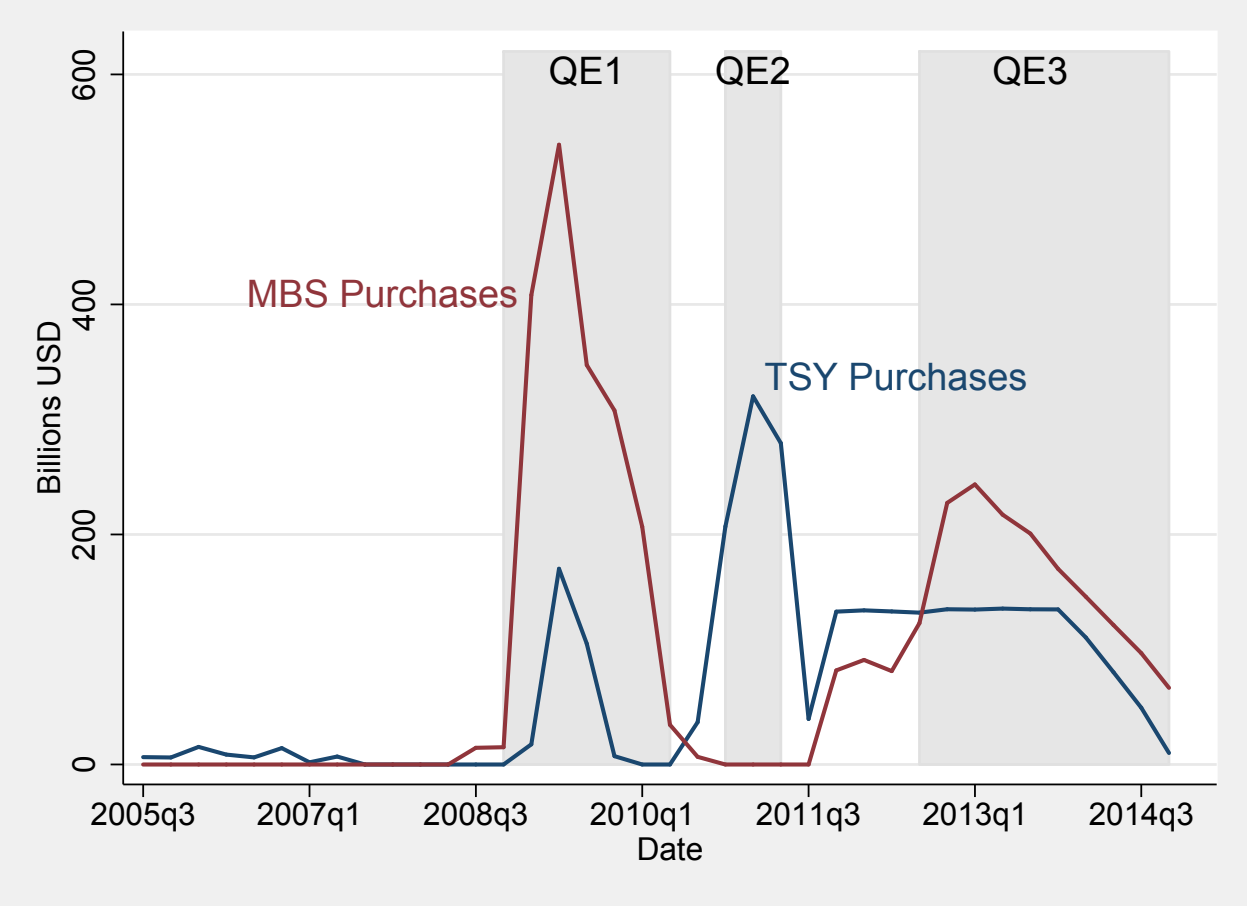

Figure 1: Quarterly totals of Treasury and mortgage-backed security purchases by the Federal Reserve. Source: New York Federal Reserve.

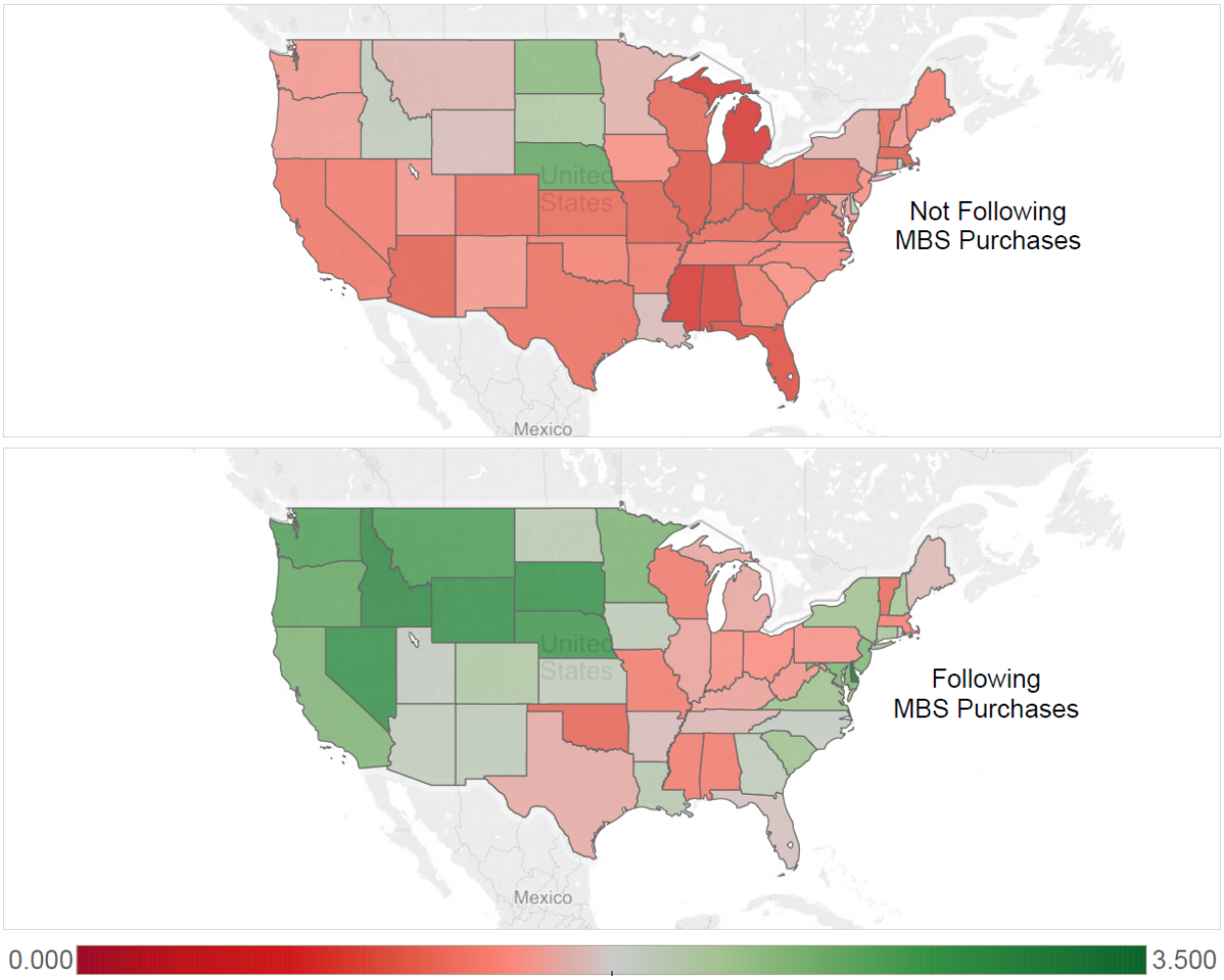

Figure 2: Average state-level mortgage origination market share for securitizer banks, in percentage points. Top panel includes years not following fourth-quarter MBS purchases (2007, 2008, 2009, 2012). Bottom panel includes years following fourth-quarter MBS purchases (2010, 2011, 2013, 2014)

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.

Panel A: Relationship and Loan Statistics						
	Mean	Std Dev	25th Pctile	Median	75th Pctile	# Obs.
Number of Relationships						
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
Length/Frequency of Relationships						
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
Loan Characteristics						
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

Table I—*Continued*

Panel B: Firm, Bank, and Macroeconomic Variable Statistics						
	Mean	Std Dev	25th Pctile	Median	75th Pctile	# Obs.
Firm Variables						
Investment	5.75	5.34	2.59	4.34	7.13	66,555
Cash Flow	12.2	32.0	3.22	8.39	19.5	66,555
Lagged Market-to-Book	1.66	0.89	1.12	1.41	1.89	66,555
Lagged Z-Score	0.59	1.41	0.26	0.75	1.21	66,555
Lagged Firm Size	7.43	1.73	6.27	7.40	8.57	66,555
Bank Variables						
MBS Holdings	7.01	8.32	0.21	4.02	10.8	161,739
Securities Holdings	14.5	11.6	5.73	11.8	20.5	161,739
C&I Loan Growth	0.67	12.4	-5.00	0.30	6.12	161,739
Bank's Size	12.2	1.36	11.3	12.0	12.9	161,739
Bank's Equity Ratio	10.3	2.77	8.60	9.83	11.5	161,739
Bank's Net Income	0.49	0.69	0.21	0.47	0.85	161,739
Bank's Cost of Deposits	1.08	0.83	0.43	0.83	1.55	161,739
Securitizer	0.0081	0.090	0	0	0	161,739
Primary Dealer	0.0020	0.045	0	0	0	161,739
Change in Unemp. Rate, Bank's State(s)	0.052	0.48	-0.20	0	0.20	161,739
Housing Price Index, Bank's State(s)	318.7	120.9	239.9	276.1	342.5	161,739
Land Unavailability, Bank's State(s)	19.0	13.5	8.94	17.5	26.1	161,739
GSE/GOE Seller	0.25	0.43	0	0	0	21,912
National Mortgage Orig. Mkt. Share (bps)	1.49	26.7	0.032	0.091	0.27	21,912
State-Level Mortgage Orig. Mkt. Share (bps)	26.2	123.1	0.16	0.99	6.47	69,408
CBSA-Level Mortgage Orig. Mkt. Share (bps)	85.0	227.6	1.17	5.43	46.2	90,376
CBSA Housing Price Index	278.8	135.1	193.1	252.1	344.8	90,376
CBSA Land Unavailability	23.1	20.3	6.42	15.2	34.4	90,376
Macroeconomic Variables						
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 II: Asset Purchase Counterparties

The table reports statistics on counterparties for the Federal Reserve's asset purchases and sales. Amounts are in billions USD.

	Total Amount Purchased or Sold	
Primary Dealer	MBS	TSY
Credit Suisse Securities (USA) LLC	657.358	228.770
Morgan Stanley & Co. LLC	396.813	486.529
Goldman, Sachs & Co.	316.826	342.576
Deutsche Bank Securities Inc.	545.748	107.378
Barclays Capital Inc.	269.858	296.170
Merrill Lynch, Pierce, Fenner & Smith Inc.	435.512	85.342
Citigroup Global Markets Inc.	309.473	128.049
RBS Securities Inc.	211.817	165.868
J.P. Morgan Securities LLC	276.733	94.438
BNP Paribas Securities Corp.	124.075	105.183
UBS Securities LLC	120.266	71.818
Nomura Securities International, Inc.	76.411	81.418
RBC Capital Markets, LLC	20.575	66.732
Mizuho Securities USA Inc.	6.700	72.523
Daiwa Capital Markets America Inc.	13.450	59.470
HSBC Securities (USA) Inc.	0.000	52.425
Jefferies & Company, Inc.	5.350	37.568
BMO Capital Markets Corp.	0.000	34.227
Bank of Nova Scotia, New York Agency	0.000	30.363
SG Americas Securities, LLC	0.000	24.103
Cantor Fitzgerald & Co.	9.175	13.032
MF Global Inc.	0.000	3.097
Banc of America Securities LLC	0.000	1.496
G.X. Clarke & Co.	0.000	0.105
Cabrera Capital Markets, LLC	0.000	0.076
Loop Capital Markets LLC	0.000	0.003
Mischler Financial Group, Inc.	0.000	0.001

Table III: 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. *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 firm and bank.

	Investment					
	(1)	(2)	(3)	(4)	(5)	(6)
MBS Purchases	-0.0701***	-0.0436***				
	(0.00996)	(0.0132)				
High MBS Holdings	0.385	0.461	0.314	0.489		0.504
	(0.398)	(0.361)	(0.365)	(0.399)		(0.404)
High MBS Holdings × MBS Purchases		-0.0319*	-0.0506***	-0.0520***		-0.0514***
		(0.0193)	(0.0170)	(0.0124)		(0.0130)
TSY Purchases	-0.0212*	-0.0322***				
	(0.0118)	(0.00882)				
High Securities Holdings	-0.669	-0.909	-0.631		-0.311	-0.112
	(0.671)	(0.672)	(0.639)		(0.571)	(0.565)
High Securities Holdings × TSY Purchases		0.0500***	0.0341		0.0120	0.00704
		(0.0128)	(0.0234)		(0.0137)	(0.0148)
Cash Flow	0.00398*	0.00400*	0.00434*	0.00408*	0.00408*	0.00409*
	(0.00227)	(0.00226)	(0.00223)	(0.00229)	(0.00229)	(0.00229)
Lagged Market-to-Book	1.216***	1.212***	1.191***	1.110***	1.117***	1.111***
	(0.109)	(0.106)	(0.119)	(0.133)	(0.135)	(0.133)
Lagged Z-Score	0.487***	0.486***	0.480***	0.458***	0.463***	0.458***
	(0.138)	(0.136)	(0.134)	(0.113)	(0.114)	(0.113)
Lagged Firm Size	-0.325	-0.346	-0.497	-0.528	-0.534	-0.528
	(0.270)	(0.284)	(0.339)	(0.407)	(0.405)	(0.406)
Bank's Size	-0.608	-0.654*	-0.113	0.281	0.152	0.288
	(0.420)	(0.383)	(0.214)	(0.205)	(0.189)	(0.183)
Bank's Equity Ratio	0.0890	0.0786	0.0306	0.00826	0.0144	0.00969
	(0.0589)	(0.0720)	(0.0507)	(0.0557)	(0.0454)	(0.0534)
Bank's Net Income	0.238*	0.297**	-0.0878	-0.0422	-0.0629	-0.0406
	(0.130)	(0.126)	(0.153)	(0.163)	(0.182)	(0.163)
Bank's Cost of Deposits	-0.145	-0.182**	-0.174	-0.151	-0.214	-0.155
	(0.0898)	(0.0831)	(0.236)	(0.236)	(0.241)	(0.231)
Change in Unemp. Rate, Bank's State(s)	-0.292**	-0.306**	-0.479	-0.385	-0.320	-0.372
	(0.146)	(0.154)	(0.368)	(0.386)	(0.407)	(0.398)
Firm-Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter Fixed Effects	No	No	Yes	No	No	No
Firm's State by Year-Quarter Fixed Effects	No	No	No	Yes	Yes	Yes
Observations	32459	32459	32459	32459	32459	32459
Firms	2334	2334	2334	2334	2334	2334
Banks	48	48	48	48	48	48
Adjusted R^2	0.483	0.483	0.488	0.491	0.491	0.491

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

Table IV: 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 the bank reported non-zero securitization income in the most recent four quarters 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. Standard errors are clustered by firm and bank.

	Loan Amount					
	(1)	(2)	(3)	(4)	(5)	(6)
High MBS Holdings × MBS Purchases	-0.0866**		-0.233***			
	(0.0435)		(0.0902)			
High Securities Holdings × TSY Purchases		0.0544	0.257**			
		(0.0612)	(0.120)			
Securitizer				2.313	1.145	10.97***
				(1.659)	(1.433)	(3.209)
Securitizer × MBS Purchases				-0.664**		-0.943***
				(0.295)		(0.257)
Securitizer × TSY Purchases					-0.341*	-0.592***
					(0.184)	(0.137)
Bank's Size	-1.011	-1.044	-1.353	-0.587	1.493	-4.042*
	(2.560)	(2.535)	(2.458)	(2.571)	(2.417)	(2.174)
Bank's Equity Ratio	0.404	0.303	0.0478	0.295	-0.251	0.494
	(0.283)	(0.296)	(0.305)	(0.375)	(0.474)	(0.408)
Bank's Net Income	1.799	2.023	2.200*	4.905**	1.401	4.986***
	(1.312)	(1.332)	(1.305)	(2.037)	(1.248)	(1.361)
Bank's Cost of Deposits	-2.876	-2.637	-3.563	-2.591	-4.742	-5.245**
	(2.705)	(2.671)	(2.832)	(2.182)	(3.497)	(2.328)
Change in Unemp. Rate, Bank's State(s)	3.426	5.175	6.599	25.11**	-0.588	16.53***
	(4.280)	(4.815)	(4.988)	(10.50)	(6.258)	(5.854)
Loan Controls	Yes	Yes	Yes	Yes	Yes	Yes
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	400	400	400
Firms	151	151	151	151	151	151
Banks	23	23	23	23	23	23
Adjusted R^2	0.851	0.851	0.850	0.850	0.850	0.850

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

Table V: C&I Loan Growth

Columns (1) through (6) are Panel Fixed Effect Regressions, with fixed effects at the bank holding company and year-quarter levels. *C&I Loan Growth* is the log difference 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 the bank reported non-zero securitization income in the most recent four quarters and 0 otherwise. All continuous independent variables are scaled by their respective standard deviations. Standard errors are clustered by bank.

	C&I Loan Growth					
	(1)	(2)	(3)	(4)	(5)	(6)
High MBS Holdings	0.786*		0.870**			
	(0.413)		(0.411)			
High MBS Holdings × MBS Purchases	-0.0411**		-0.0396**			
	(0.0196)		(0.0196)			
High Securities Holdings		0.806	0.848*			
		(0.505)	(0.505)			
High Securities Holdings × TSY Purchases		0.0766***	0.0761***			
		(0.0287)	(0.0286)			
Securitizer				1.678	0.0624	1.473
				(1.126)	(1.324)	(1.386)
Securitizer × MBS Purchases				-0.292***		-0.296***
				(0.105)		(0.105)
Securitizer × TSY Purchases					-0.0174	0.0292
					(0.117)	(0.118)
Bank's Size (excl. loans)	0.503*	0.267	0.282	0.499*	0.488*	0.499*
	(0.281)	(0.290)	(0.291)	(0.280)	(0.280)	(0.280)
Bank's Equity Ratio	0.670***	0.653***	0.661***	0.666***	0.663***	0.666***
	(0.0537)	(0.0534)	(0.0536)	(0.0536)	(0.0536)	(0.0536)
Bank's Net Income	0.437***	0.445***	0.444***	0.435***	0.438***	0.435***
	(0.133)	(0.133)	(0.133)	(0.134)	(0.134)	(0.134)
Bank's Cost of Deposits	-0.325	-0.362	-0.369	-0.332	-0.317	-0.332
	(0.294)	(0.294)	(0.294)	(0.294)	(0.294)	(0.294)
Change in Unemp. Rate, Bank's State(s)	1.376	1.327	1.366	1.388	1.343	1.384
	(1.079)	(1.084)	(1.083)	(1.073)	(1.079)	(1.073)
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Bank's Primary State Year-Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	77386	77386	77386	77386	77386	77386
Banks	4870	4870	4870	4870	4870	4870
Adjusted R^2	0.0440	0.0442	0.0443	0.0440	0.0439	0.0440

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

Table VI: State-Level Mortgage Market Share

Columns (1) through (4) 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 the bank reported non-zero securitization income in the current year and 0 otherwise. Standard errors are clustered by bank.

	Mortgage Origination Market Share			
	(1)	(2)	(3)	(4)
High Bank MBS Holdings	-3.507	-1.543		
	(2.635)	(2.520)		
High Bank MBS Holdings × MBS Purchases	0.586**	0.573**		
	(0.280)	(0.264)		
Securitizer			-23.36	-21.03
			(27.81)	(27.72)
Securitizer × MBS Purchases			3.381**	3.327**
			(1.685)	(1.659)
Bank's Size (excl. loans)	9.236**	11.02***	8.073**	9.755***
	(3.674)	(3.559)	(3.458)	(3.392)
Bank's Equity Ratio	-0.0832	0.125	-0.238	-0.0103
	(0.810)	(0.772)	(0.747)	(0.729)
Bank's Net Income	1.292	1.519	1.704	1.890
	(1.444)	(1.403)	(1.325)	(1.319)
Bank's Cost of Deposits	-3.454	-2.694	-2.243	-1.578
	(4.942)	(4.819)	(4.878)	(4.791)
Change in Unemp. Rate, Bank's State(s)	1.546	0.397	1.372	0.169
	(1.595)	(2.441)	(1.501)	(2.344)
Bank Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	No	Yes	No
State by Year Fixed Effects	No	Yes	No	Yes
Observations	42517	42517	42517	42517
Banks	2838	2838	2838	2838
Adjusted R^2	0.500	0.525	0.501	0.526

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

Table VII: State-Level Mortgage Market Share and Housing Prices

Columns (1) through (6) 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. *Housing Price Index, Bank's State(s)* is the housing price index for each bank using its state-level deposits as weights. *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 the bank reported non-zero securitization income in the current year and 0 otherwise. Columns (4) and (6) use the bank's unavailable land measure, national mortgage interest rate, and their interactions with *High MBS Holdings* (Column 4), *Securitizer* (Column 6), and *MBS Purchases* (Columns 4 and 6) as instruments for *Housing Price Index, Bank's State(s)* and its interactions. Standard errors are clustered by bank.

	Mortgage Origination Market Share					
	(OLS)	(OLS)	(IV)	(OLS)	(OLS)	(IV)
	(1)	(2)	(3)	(4)	(5)	(6)
Housing Price Index, Bank's State(s)	-0.0667*	-0.0293	0.0351	-0.0658*	-0.0125	0.0291
	(0.0356)	(0.0245)	(0.0273)	(0.0371)	(0.0226)	(0.0281)
HPI × MBS Purchases		-0.000663	-0.0000430		0.00123	-0.000755
		(0.000846)	(0.00107)		(0.00116)	(0.00121)
High MBS Holdings	2.039	-1.083	-1.365			
	(1.738)	(2.550)	(2.524)			
High MBS Holdings × HPI		-0.0588*	-0.0702			
		(0.0318)	(0.0558)			
High MBS Holdings × MBS Purchases		0.501**	0.480**			
		(0.216)	(0.206)			
High MBS Holdings × HPI × MBS Purchases		0.00492**	0.00400			
		(0.00201)	(0.00348)			
Securitizer				-4.100	-3.595	-20.41
				(22.33)	(28.80)	(27.05)
Securitizer × HPI					-0.201**	-0.0117
					(0.0884)	(0.0416)
Securitizer × MBS Purchases					1.538	2.181
					(1.550)	(1.428)
Securitizer × HPI × MBS Purchases					0.0193**	0.0246**
					(0.00753)	(0.0107)
Bank's Size (excl. loans)	10.89***	10.64***	11.10***	10.75***	10.21***	10.72***
	(3.204)	(3.069)	(3.249)	(3.129)	(3.265)	(3.585)
Bank's Equity Ratio	0.176	0.117	0.108	0.127	-0.0257	-0.0705
	(0.729)	(0.693)	(0.699)	(0.738)	(0.661)	(0.681)
Bank's Net Income	1.696	1.707	1.521	1.714	1.969	1.802
	(1.329)	(1.311)	(1.290)	(1.322)	(1.224)	(1.256)
Bank's Cost of Deposits	-2.633	-2.402	-2.437	-2.651	-1.186	-1.367
	(4.622)	(4.383)	(4.447)	(4.649)	(4.501)	(4.659)
Change in Unemp. Rate, Bank's State(s)	-0.104	-0.150	0.269	-0.0757	-0.0291	0.514
	(2.244)	(2.257)	(2.323)	(2.249)	(2.264)	(2.425)
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
State by Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	45479	45479	45479	45479	45479	45479
Banks	3063	3063	3063	3063	3063	3063
Adjusted R^2	0.502	0.503	0.502	0.502	0.504	0.503

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

Table VIII: Investment Regression by Banks' Exposure to MBS Market

Columns (1) and (2) are Panel Fixed Effect Regressions. *Investment* is the firm's quarterly capital expenditures divided by lagged PPE, scaled by 100. Banks without securitization income are designated as *Non-Securitizer* and banks with securitization income are designated as *Securitizer*. The *Wald Test* provides the χ^2 statistic on whether the *High MBS Holdings* $\times$ *MBS Purchases* coefficient is statistically different across the two samples. Standard errors are clustered by firm and bank.

	Investment	
	(Non-Securitizer)	(Securitizer)
	(1)	(2)
High MBS Holdings	-1.445	
	(1.431)	
High MBS Holdings × MBS Purchases	-0.000189	-0.0700***
	(0.0259)	(0.0168)
High Securities Holdings	1.517	-0.800
	(1.170)	(0.830)
High Securities Holdings × TSY Purchases	-0.00975	0.00852
	(0.0490)	(0.0437)
Cash Flow	0.00612*	0.00312
	(0.00372)	(0.00287)
Lagged Market-to-Book	1.551***	0.983***
	(0.188)	(0.149)
Lagged Z-Score	0.432***	0.286**
	(0.105)	(0.134)
Lagged Firm Size	0.141	-0.696
	(0.799)	(0.505)
Bank's Size	-0.174	-0.134
	(1.626)	(0.363)
Bank's Equity Ratio	-0.309	-0.0354
	(0.193)	(0.0407)
Bank's Net Income	-0.320	0.0758
	(0.372)	(0.217)
Bank's Cost of Deposits	0.394	0.0685
	(0.519)	(0.359)
Change in Unemp. Rate, Bank's State(s)	-0.375	-0.0188
	(0.794)	(0.632)
Wald Test:		
(Non-Securitizer = Securitizer)	5.10**	
Firm-Bank Fixed Effects	Yes	Yes
Firm's State by Year-Quarter Fixed Effects	Yes	Yes
Observations	5986	25986
Firms	658	1988
Banks	37	17
Adjusted R^2	0.473	0.521

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. 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 *High MBS Holdings* $\times$ *MBS Purchases* coefficient is statistically different across the two samples.

	Investment			
	Firm Size		Bond Rating	
	(Constrained)	(Unconstrained)	(Constrained)	(Unconstrained)
	(1)	(2)	(3)	(4)
High MBS Holdings	2.039***		1.336***	
	(0.526)		(0.466)	
High MBS Holdings $\times$ MBS Purchases	-0.0857***	-0.0136*	-0.0564***	0.0122**
	(0.0271)	(0.00698)	(0.0206)	(0.00546)
High Securities Holdings	-0.0263	-0.525	-0.181	-0.316
	(0.634)	(0.438)	(0.644)	(0.406)
High Securities Holdings $\times$ TSY Purchases	0.00984	0.0108	0.0269	-0.0237
	(0.0194)	(0.0207)	(0.0231)	(0.0185)
Cash Flow	0.00232	0.00938***	0.00289	0.00974***
	(0.00266)	(0.00154)	(0.00227)	(0.00321)
Lagged Market-to-Book	1.153***	0.574***	1.173***	0.924***
	(0.160)	(0.164)	(0.138)	(0.0919)
Lagged Z-Score	0.471***	0.921***	0.465***	0.560*
	(0.0980)	(0.105)	(0.106)	(0.327)
Lagged Firm Size	-1.229**	-0.387	-0.881*	0.334
	(0.574)	(0.380)	(0.453)	(0.503)
Bank's Size	0.102	1.614**	0.496*	-0.419
	(0.196)	(0.713)	(0.258)	(0.398)
Bank's Equity Ratio	0.0843	-0.121*	0.0623	-0.0631
	(0.0699)	(0.0733)	(0.0668)	(0.0452)
Bank's Net Income	0.0129	-0.0838	-0.0184	-0.167***
	(0.188)	(0.0756)	(0.183)	(0.0261)
Bank's Cost of Deposits	-0.350	0.279	-0.270	-0.492
	(0.287)	(0.297)	(0.251)	(0.313)
Change in Unemp. Rate, Bank's State(s)	-0.391	0.0334	-0.326	-0.139
	(0.501)	(0.388)	(0.418)	(0.349)
Wald Test:				
(Constrained = Unconstrained)	6.62**		10.32***	
Firm-Bank Fixed Effects	Yes	Yes	Yes	Yes
Firm's State by Year-Quarter Fixed Effects	Yes	Yes	Yes	Yes
Observations	19256	12955	23809	8403
Firms	1701	807	1931	511
Banks	45	24	47	23
Adjusted R^2	0.477	0.622	0.483	0.672

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

Table X: 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. *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 Housing Price Index* and its interactions. Standard errors are clustered by bank.

	CBSA Mortgage Origination Market Share					
	(OLS)	(OLS)	(OLS)	(IV)	(IV)	(IV)
	(1)	(2)	(3)	(4)	(5)	(6)
CBSA Housing Price Index	-0.0573	-0.114***	-0.188*	-0.0465	-0.0913***	-0.164
	(0.0378)	(0.0195)	(0.0993)	(0.0357)	(0.0269)	(0.111)
CBSA HPI × MBS Purchases		0.000271	-0.00192		-0.00212	-0.00517
		(0.00129)	(0.00167)		(0.00227)	(0.00395)
Securitizer × CBSA HPI		0.157***	0.148***		0.125	0.120
		(0.0549)	(0.0549)		(0.0771)	(0.0836)
Securitizer × CBSA HPI × MBS Purchases		0.0254**	0.0247**		0.0382**	0.0372**
		(0.0107)	(0.00998)		(0.0176)	(0.0176)
Bank by Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
CBSA Fixed Effects	No	No	Yes	No	No	Yes
Observations	90376	90376	90376	90376	90376	90376
Banks	2298	2298	2298	2298	2298	2298
Adjusted R^2	0.399	0.403	0.419	0.399	0.403	0.419

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, 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 Bharath, Dahiya, Saunders, and Srinivasan (2011).[38]

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.[39] 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.

A.3 Bank Mergers

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.

[38] Specifically, 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.

[39] The 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.

A.4 Bank Data

For our analysis of bank balance sheets, we use Call Report data from each quarter, aggregated to the bank holding company (BHC) level. Our bank analysis focuses on two key variables: securities holdings and MBS holdings. Securities holdings is defined as total balance sheet securities minus mortgage-backed securities, divided by total assets. MBS holdings is defined as mortgage-backed securities divided by total assets. The mortgage-backed securities (MBS) include two major types: (1) traditional pass-through securities and (2) other security types, including collateralized mortgage obligations (CMOs), real estate mortgage investment conduits (REMICs), and stripped MBS. The banks also denote whether these securities are composed of mortgages guaranteed by the government sponsored or owned agencies (FNMA, FHLMC, GNMA) or non-agency mortgages. The average BHC MBS holdings in our sample is 7.01% and the average non-MBS securities holdings (which includes Treasuries) is 14.5%.

A.5 Index for Banks' Exposure to the Housing Market

The Federal Housing Finance Agency (FHFA) House Price Index (HPI) data is the basis for our *Housing Price Index, Bank's State(s)* variable. The HPI is a weighted, repeat-sales index, which measures average price changes in repeat sales or refinancings. The homes included in the HPI are individual single-family residential properties on which at least two mortgages were originated and subsequently purchased by Fannie Mae or Freddie Mac. The state-level housing price indices are normalized to 100 in the first quarter of 1980.

One issue that arises is comparability across state price indices. Because all the state-level FHFA indices are set to 100 in 1980, the index value of 100 corresponds to different dollar amounts in each state.[40] If unadjusted, the price level of banks located in high-price states will be understated compared to banks located in lower-price states. As the geography of deposit bases for each bank holding company are varying annually, this mismeasurement will not be fixed by a BHC-level

[40]This problem is even more apparent in the CBSA data, where the indices are set to 100 in 1995. If unadjusted, all banks, regardless of geographical deposit variation, would have a value of 100 in that year.

fixed effect. To address this issue, we adjust each state's HPI so that its index level corresponds to the same dollar amount. Specifically, we use the estimated median house price in the fourth quarter of 2000 divided by the state HPI from the fourth quarter of 2000 to find the state's index value in dollars.[41] We then scale each state's index so that an index value of 100 corresponds to $50,000 in every state.[42] For our analysis at the CBSA-market level, we use the housing price index for that specific CBSA from the FHFA.

B Additional Robustness Tests

B.1 Continuous Balance Sheet Variables

Our main results on firm-level investment are reported in Section III.A 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 securities. The result remain robust to this treatment.

Table B.2 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.

B.2 Alternative Mortgage Exposure Variable

In Section III.C, we consider the effect of asset purchases on mortgage origination market share. Our two principal measures are the amount of MBS holdings and whether the bank is an active securitizer. In this section, we consider an alternative variable to capture differences in mortgage

[41] Estimated median house price data is available for select years on the FHFA website (`http:\www.fhfa.gov`).

[42] We perform the same correction for the CBSA-level housing price indices such that 100 again corresponds to $50,000.

market activity across banks: *GSE/GOE Seller*. As discussed in Section II, 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.

Table B.4 repeats the analysis of Tables VI and VII using the alternative variable. Columns (1) shows that banks that are *GSE/GOE Seller* have a larger market share but the results are not statistically significant. The coefficient on the interaction term in Column (2) shows that in response to MBS purchases, GSE/GOE Seller banks increase market share more, and the results are statistically and economically significant. Column (3) shows that as in the main results, within the GSE/GOE seller banks, the banks that experience higher housing prices increase mortgage origination share more in response to MBS purchases. This result holds for the specification where housing price variables are instrumented as well (column (4)).

Finally, we have used state-level mortgage market share in our analysis to ensure that we are capturing state-level heterogeneity. Further, the state-level seems an appropriate level for considering competition for market share. Table B.5 shows that all the results obtained in Table VI of Section III.C are robust to switching to a national mortgage origination market share as the dependent variable.

Table A.1: Variable Definitions

Variable Definitions		
	Definition	Data Sources
Loan Characteristics		
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
Firm Variables		
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
Bank Variables		
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
C&I Loan Growth	Log difference between current and prior quarter's 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
Securitizer	Indicator that bank reports non-zero net securitization income (RIADB493) in the most recent four quarter	Call Report
Primary Dealer	Indicator that bank is a primary dealer for the New York Fed.	New York Fed

Table A.1—*Continued*

Variable Definitions		
	Definition	Data Sources
Bank Variables (continued)		
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
Housing Price Index, Bank's State(s)	Weighted state-level housing price index. Bank-specific weighting determined by most recently available summary of deposits.	Summary of Deposits, FHFA
Land Unavailability, Bank's State(s)	Percent of land unavailable for development in specific CBSAs, averaged to state-level using population for weights. Bank-specific weighting determined by most recently available summary of deposits.	Summary of Deposits, Census (2000), Saiz (2010)
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
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 Land Unavailability	Percent of land unavailable for development in a specific CBSA.	Saiz (2010)
Macroeconomic Variables		
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

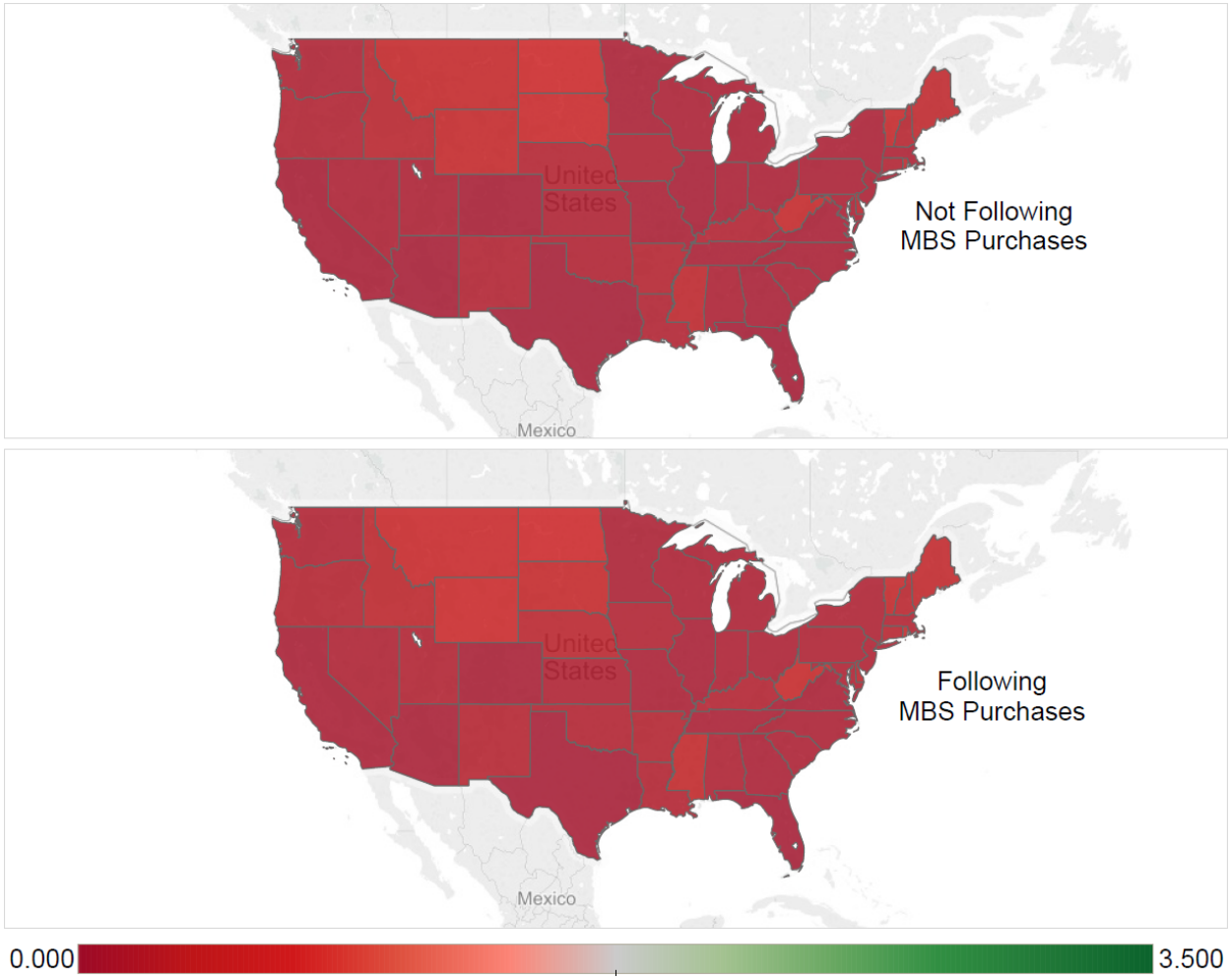

Figure B.1: Average state-level mortgage origination market share for non-securitizer banks, in percentage points. Top panel includes years not following fourth-quarter MBS purchases (2007, 2008, 2009, 2012). Bottom panel includes years following fourth-quarter MBS purchases (2010, 2011, 2013, 2014).

Table B.2: 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. *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. Standard errors are clustered by firm and bank.

	Investment					
	(1)	(2)	(3)	(4)	(5)	(6)
MBS Purchases	-0.0473***	-0.0250				
	(0.00626)	(0.0203)				
MBS Holdings	0.0161	0.0242	0.0423**	0.0376*		0.0377*
	(0.0169)	(0.0170)	(0.0204)	(0.0211)		(0.0210)
MBS Holdings × MBS Purchases		-0.00196	-0.00307***	-0.00277***		-0.00273***
		(0.00182)	(0.00102)	(0.000922)		(0.000954)
TSY Purchases	-0.0125**	-0.0370***				
	(0.00567)	(0.00681)				
Securities Holdings	-0.0403	-0.0925***	-0.0213		0.00500	0.000896
	(0.0278)	(0.0274)	(0.0265)		(0.0304)	(0.0276)
Securities Holdings × TSY Purchases		0.00588***	0.00184		0.000316	0.000296
		(0.00185)	(0.00177)		(0.00122)	(0.00131)
Cash Flow	0.00638***	0.00644***	0.00691***	0.00690***	0.00692***	0.00690***
	(0.00170)	(0.00171)	(0.00170)	(0.00177)	(0.00176)	(0.00176)
Lagged Market-to-Book	1.543***	1.538***	1.498***	1.434***	1.442***	1.434***
	(0.0592)	(0.0588)	(0.0591)	(0.0639)	(0.0663)	(0.0638)
Lagged Z-Score	0.492***	0.489***	0.463***	0.433***	0.439***	0.433***
	(0.104)	(0.101)	(0.0924)	(0.0926)	(0.0944)	(0.0926)
Lagged Firm Size	-0.419	-0.432	-0.605	-0.522	-0.527	-0.522
	(0.374)	(0.378)	(0.440)	(0.467)	(0.467)	(0.467)
Bank's Size	-0.221	-0.308	-0.224	-0.0627	-0.125	-0.0629
	(0.239)	(0.216)	(0.259)	(0.148)	(0.146)	(0.145)
Bank's Equity Ratio	-0.0657	-0.0698	0.0351	0.0150	-0.0119	0.0152
	(0.0565)	(0.0542)	(0.0340)	(0.0339)	(0.0268)	(0.0335)
Bank's Net Income	0.233**	0.237**	-0.0483	-0.0134	0.0389	-0.0173
	(0.117)	(0.121)	(0.135)	(0.120)	(0.135)	(0.129)
Bank's Cost of Deposits	-0.155***	-0.165***	-0.397*	-0.342*	-0.390**	-0.341*
	(0.0596)	(0.0620)	(0.204)	(0.182)	(0.183)	(0.184)
Change in Unemp. Rate, Bank's State(s)	-0.358**	-0.405***	-0.207	-0.217	-0.218	-0.218
	(0.139)	(0.133)	(0.265)	(0.252)	(0.301)	(0.280)
Firm-Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter Fixed Effects	No	No	Yes	No	No	No
Firm State by Year-Quarter Fixed Effects	No	No	No	Yes	Yes	Yes
Observations	66555	66555	66555	66555	66555	66555
Firms	2676	2676	2676	2676	2676	2676
Banks	53	53	53	53	53	53
Adjusted R^2	0.456	0.456	0.463	0.469	0.469	0.469

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

Table B.3: Housing Price Index, Bank's State(s)

Columns (1) through (5) are Panel Fixed Effect Regressions. *Housing Price Index, Bank's State(s)* is the housing price index for each bank using its state-level deposits as weights. *Land Unavailability, Bank's State(s)* is the percent of land unavailable for development across the bank's states, weighted by its state-level deposits. *Unavailability × Mortgage Rate* is *Land Unavailability, Bank's State(s)* interacted with the current 30-year mortgage rate (as a 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. *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. Standard errors are clustered by bank.

	Housing Price Index, Bank's State(s)				
	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)
	(1)	(2)	(3)	(4)	(5)
Land Unavailability, Bank's State(s)	3.297***	3.618***	3.600***	3.651***	3.458***
	(1.169)	(1.161)	(1.164)	(1.169)	(1.125)
Unavailability × Mortgage Rate	1.241***	1.302***	1.301***	1.297***	1.288***
	(0.163)	(0.164)	(0.164)	(0.164)	(0.164)
High MBS Holdings		3.979	4.905		
		(3.493)	(3.663)		
High MBS Holdings × MBS Purchases			-0.145		
			(0.211)		
Securitizer				1.499	7.092
				(6.084)	(10.52)
Securitizer × MBS Purchases					-1.166
					(1.351)
Bank's Size (excl. loans)		-5.405	-5.462	-5.709	-5.386
		(3.679)	(3.713)	(3.673)	(3.551)
Bank's Equity Ratio		-0.305	-0.302	-0.315	-0.263
		(0.722)	(0.719)	(0.720)	(0.702)
Bank's Net Income		3.538***	3.546***	3.538***	3.403***
		(0.801)	(0.804)	(0.802)	(0.771)
Bank's Cost of Deposits		2.127	2.092	2.070	1.651
		(2.628)	(2.589)	(2.638)	(2.540)
Change in Unemp. Rate, Bank's State(s)		-14.71***	-14.74***	-14.65***	-14.54***
		(2.472)	(2.468)	(2.466)	(2.443)
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes
State by Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	45479	45479	45479	45479	45479
Banks	3063	3063	3063	3063	3063
Adjusted R^2	0.976	0.977	0.977	0.977	0.977

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

Table B.4: State-Level Mortgage Market Share, Alternative Variable

Columns (1) through (4) 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. *Housing Price Index, Bank's State(s)* is the housing price index for each bank using its state-level deposits as weights. *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. *MBS Purchases* is the quarterly log-dollar amount of gross Federal Reserve MBS purchases from the fourth quarter of the prior year. Column (4) uses the bank's unavailable land measure, national mortgage interest rate, and their interactions with *GSE/GOE Seller* and *MBS Purchases* as instruments for *Housing Price Index, Bank's State(s)* and its interactions. Standard errors are clustered by bank.

	Mortgage Origination Market Share			
	(OLS)	(OLS)	(OLS)	(IV)
	(1)	(2)	(3)	(4)
Housing Price Index, Bank's State(s)	-0.155*	-0.150*	-0.0939	-0.156**
	(0.0889)	(0.0873)	(0.0697)	(0.0780)
HPI × MBS Purchases			-0.00238	-0.00753**
			(0.00161)	(0.00369)
GSE/GOE Seller	5.004	0.956	2.411	2.424
	(3.592)	(4.070)	(4.038)	(3.792)
GSE/GOE Seller × MBS Purchases		0.710***	0.580***	0.643***
		(0.204)	(0.186)	(0.194)
GSE/GOE Seller × HPI			-0.0930**	-0.103**
			(0.0437)	(0.0476)
GSE/GOE Seller × HPI × MBS Purchases			0.00656***	0.00870*
			(0.00242)	(0.00505)
Bank's Size (excl. loans)	12.06**	11.86**	11.29**	11.34**
	(5.958)	(5.884)	(5.588)	(5.542)
Bank's Equity Ratio	0.821	0.738	0.695	0.667
	(0.829)	(0.808)	(0.777)	(0.769)
Bank's Net Income	1.176	1.128	1.059	1.316
	(0.891)	(0.892)	(0.869)	(0.962)
Bank's Cost of Deposits	-4.979	-4.648	-4.281	-3.597
	(6.719)	(6.639)	(6.316)	(6.232)
Change in Unemp. Rate, Bank's State(s)	1.169	0.668	0.925	0.804
	(1.318)	(1.297)	(1.334)	(1.504)
Bank Fixed Effects	Yes	Yes	Yes	Yes
State by Year Fixed Effects	Yes	Yes	Yes	Yes
Observations	69296	69296	69296	69296
Banks	3514	3514	3514	3514
Adjusted R^2	0.582	0.582	0.583	0.583

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

Table B.5: National Mortgage Market Share

Columns (1) through (6) are Panel Fixed Effect Regressions. *National Mortgage Origination Market Share* is the national-level market share (in basis points) for a given bank in a particular 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 the bank reported non-zero securitization income in the current year and 0 otherwise. *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. Standard errors are clustered by bank.

	National Mortgage Origination Market Share					
	(1)	(2)	(3)	(4)	(5)	(6)
High MBS Holdings	-0.205**	-0.563***				
	(0.0982)	(0.195)				
High MBS Holdings × MBS Purchases		0.0585***				
		(0.0225)				
Securitizer			-11.05*	-17.66**		
			(5.695)	(8.248)		
Securitizer × MBS Purchases				1.502*		
				(0.880)		
GSE/GOE Seller					1.186*	0.341
					(0.682)	(0.874)
GSE/GOE Seller × MBS Purchases						0.134**
						(0.0620)
Bank's Size (excl. loans)	0.918***	0.936***	0.992*	0.964*	0.972*	0.987*
	(0.317)	(0.319)	(0.540)	(0.518)	(0.539)	(0.544)
Bank's Equity Ratio	0.0507	0.0479	0.0730	0.0639	0.0869	0.0835
	(0.0824)	(0.0818)	(0.0658)	(0.0620)	(0.0693)	(0.0678)
Bank's Net Income	0.0588	0.0491	0.0533	0.0587	0.0464	0.0299
	(0.112)	(0.115)	(0.0832)	(0.0819)	(0.0791)	(0.0838)
Bank's Cost of Deposits	-0.648	-0.644	-0.861	-0.783	-0.907	-0.868
	(0.486)	(0.484)	(0.631)	(0.589)	(0.641)	(0.624)
Change in Unemp. Rate, Bank's State(s)	0.186**	0.180**	0.115	0.0896	0.131*	0.0842
	(0.0914)	(0.0897)	(0.0717)	(0.0646)	(0.0718)	(0.0573)
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14264	14264	21912	21912	21912	21912
Banks	2820	2820	3409	3409	3409	3409
Adjusted R^2	0.943	0.943	0.913	0.914	0.913	0.913

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