Quantitative Easing and Shadow Banks

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Abstract

This paper investigates the impact of Quantitative Easing on shadow banks in the mortgage market via the origination channel. We find that the Federal Reserve's mortgage-backed securities (MBS) purchases stimulate shadow banks' securitization activities significantly and make shadow banks become more reliant on Fannie Mae, Freddie Mac and Ginnie Mae to finance their lending activities. Also, we find a positive effect of MBS purchases on shadow banks' mortgage origination, and this effect is larger in counties with higher shadow banking exposures. Moreover, the impact of MBS purchases on shadow banks is nearly twice as much as that on traditional banks. We provide the evidence that the surge in the mortgage origination of shadow banks is driven by the increase in the mortgages originated to riskier borrowers instead of conventional borrowers.

JEL Classification: E51; E52; G21; G23

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1. Introduction

Following the global financial crisis of 2007-2008, the Federal Reserve introduced a series of unconventional monetary policies to revive the economic activity. Meanwhile, the shadow banking system expanded dramatically (Buchak et al., 2018). Whether it is a coincidence or there is some relationship between them? Though, a large literature attributes the rising of shadow banking system to the tightening regulations on traditional banks (e.g. see Irani et al., 2020; Farhi and Tirole, 2018; Ordonez, 2018) and contractionary monetary policy (e.g. see Elliott et al., 2019; Xiao, 2020; Nelson, Pinter and Theodoridis, 2016), the literature on unconventional monetary policy and shadow banks is still scant.

Against this background, this paper investigates whether, and how, the implementation of Quantitative Easing (QE) by the Federal Reserve influences shadow banks in the mortgage market during the post-crisis period. To further understand the intensity of this impact, we compare the scale of the effect on shadow banks with that on traditional banks. Following Plantin (2014), we use the term 'shadow banks' to refer to the financial institutions that function essentially the same as traditional banks but finance their loans through the issuance of money-like liabilities and are not subject to the prudential regulations on traditional banks.

In particular, we find that the Federal Reserve's MBS purchases stimulate shadow banks' securitization activities significantly and make shadow banks become more reliant on government-sponsored enterprises (GSEs) like Fannie Mae and Freddie Mac and government-owned enterprises (GOEs) such as Ginnie Mae to finance their lending activities. Also, we find a positive effect of MBS purchases on shadow banks' mortgage origination. Specifically, the magnitude of this impact on shadow banks is nearly twice as much as that on traditional banks. Furthermore, we provide the evidence that the surge in the mortgage origination of shadow banks is driven by the increase in the mortgages originated to riskier borrowers instead of conventional borrowers. Finally, we demonstrate that the difference between the mortgage rates provided by shadow banks and traditional banks is insignificant during the QE period.

In QE, the Federal Reserve authorized the Federal Reserve Bank of New York (FRBNY)

to purchase a series of long-term securities such as mortgage-backed securities (MBS) and Treasury securities through open market operations. This paper concentrates on the impact of MBS purchases on shadow banks based on the following two reasons. First, a large literature focusing on the heterogeneous effects of these targeted assets on credit supply in the market suggests that MBS purchases stimulate the originations of mortgages and corporate loans, while the effect of Treasury security purchases is insignificant (Rodnyansky and Darmouni, 2017; Chakraborty, Goldstein and MacKinlay, 2020; Luck and Zimmermann, 2020). Specifically, Rodnyansky and Darmouni (2017) suggest that Treasury security purchases have a much more muted effect due to the fact that only a small fraction of bank assets are Treasury securities.

Second, unlike traditional banks who have access to deposits to finance their loans, shadow banks rely heavily on the originate-to-distribute model (Gete and Reher, 2020; Echeverry, Stanton and Wallace, 2016). In this model, shadow banks borrow the short-term fund from the warehouse lenders to finance their mortgage originations; and these mortgages in return are used as the collaterals for the fund borrowed. Shadow banks, then, securitize and sell the mortgages in the secondary markets to repay the warehouse lenders. Therefore, shadow banks' funding ability is heavily dependent on the efficiency of the secondary markets for mortgages and MBS. The Federal Reserve's substantial MBS purchases assure the participants in the market that there would be a reliable buyer under all market conditions, which greatly improves the market functioning.

Theoretically, the Federal Reserve's MBS purchases affect shadow banks' mortgage origination through two primary channels. The first is the 'portfolio balance channel' (Bernanke, 2012), also named as the 'net-worth channel' (Rodnyansky and Darmouni, 2017). The premise underlying this channel is that different categories of financial assets cannot be perfectly substituted. The imperfect substitutability among financial assets makes their price and yield be susceptible to the changes in supply. The substantial MBS purchases by the FRBNY in the To-Be-Announced (TBA) market results in a shortage of MBS supply, which leads purchasers to compete more aggressively for the remaining MBS in the market. As a result, the Federal Reserve's MBS purchases lower the yield and raise the price of MBS. Meanwhile, when the

investors turn to other financial assets due to the shortage of MBS, the prices of these financial assets will increase and the yield of them will decrease as well. Therefore, in this channel, shadow banks benefit from the rising price of financial assets on their balance sheets. With more equity and lower leverage, shadow banks are motivated to expand their mortgage originations.

The second is the 'origination channel' (Chakraborty, Goldstein and MacKinlay, 2020). After originating a mortgage, shadow bank has three choices: (1) holding the mortgage on the balance sheet to receive the coupon benefits while bearing the interest rate risk and prepayment risk, (2) converting the mortgages into MBS and having them guaranteed by Fannie Mae, Freddie Mac or Ginnie Mae, and (3) selling the mortgages to Fannie Mae, Freddie Mac or Ginnie Mae directly. For the second choice, shadow banks also need to decide whether to hold the MBS or sell it to the FRBNY in the TBA market. These choices demonstrate that shadow banks can improve their balance sheets by reallocating the asset side via swapping the relatively illiquid MBS or mortgages to equity with FRBNY, Fannie Mae, Freddie Mac and Ginnie Mae. The Federal Reserve's substantial MBS purchases assure the market participants that there will be a reliable buyer in the MBS market under all market conditions, which greatly improve the market efficiency. Since the originated mortgages can be easily converted into equity, shadow banks have a strong incentive to originate more mortgages.

Rodnyansky and Darmouni (2017) provide the evidence of the portfolio balance channel based on the bank balance sheet data from the Consolidated Reports of Condition and Income (Call Reports). They find that banks with relatively more MBS holdings experienced a sharp rise in the mark-to-market value of equity, assets, and gains on securities during the first round of QE. As the balance sheet information of shadow banks is unavailable, the portfolio balance channel for shadow banks cannot be examined. Therefore, we focus on the origination channel in this paper. More specifically, we corroborate the effectiveness of the origination channel for shadow banks by demonstrating that MBS purchases stimulate both mortgage securitization and mortgage origination activities of shadow banks.

An important variable in this paper is county's shadow banking exposure. Unlike the

issuance of ordinary loans which only requires the assessment of borrower's characteristics such as credit score, income and asset, the origination of mortgages also requires the lenders to have soft information of local real estate market, for example, the long-term trend for domestic housing price. A large literature shows that smaller banks are more reliant on soft information to manage risks (see e.g. Berger et al., 2005; Stein, 2002; Liberti and Mian, 2009) than larger banks which control the risks through archiving economies of scale and diversification (Zarutskie, 2013). Similar to smaller banks, shadow banks do not have sufficient fund to finance their mortgage originations, and it is hard for them to reduce the risks through the same approaches as that of larger banks. Therefore, shadow banks should also rely heavily on soft information and are prone to increase the credit supply in counties where they already have a strong presence. To examine this assumption, following the strategy in Elliott et al. (2019), this paper calculates the county's exposure to shadow banking activity as the share of mortgages originated by shadow banks. We employ the interaction between MBS purchases and shadow banking exposures to allow for the differential effects of MBS purchases across counties with different shadow banking exposures.

Our analyses take many steps to eliminate the contaminating effects. Following the strategy in Khwaja and Mian (2008), we employ the county-by-year fixed effects to remove the impact of any county-specific time-varying characteristics, especially the mortgage demand, on the results. Thus, the supply and demand factors are disentangled. To remove the biases caused by the endogenous determination of shadow banking exposures, following Chakraborty, Goldstein and MacKinlay (2020), this paper estimates the cross-variation in shadow banking exposures that can be explained by counties' characteristics including unemployment rate, per capital personal income, median household income, real GDP, subprime credit score population, household debt to income ratio, median housing price, population and inflation, and calculates the residuals as the orthogonalized shadow banking exposures. To further condition away the potential biases stemming from the endogenous determination of shadow banking exposures, we follow the strategy in Rodnyansky and Darmouni (2017) by employing a standard propensity score matching (PSM) approach.

A key focus of this paper is to compare the magnitude of the impact of MBS purchases on shadow banks with that on traditional banks. The conventional tests including Wald test and Chow test are designed to examine the coefficients across time series data in which several assumptions are required. As the panel data regression is unlikely to satisfy all these assumptions, following Cleary (1999), we employ the Fisher's permutation test to examine the significance of the difference[2].

This paper starts by investigating the impact of MBS purchases on shadow banks' securitization activities. Since the amount of MBS sold by shadow banks is unavailable, we follow the strategy in Gete and Reher (2020) by quantifying the shadow banks' securitization activities as the amount of mortgages sold and calculating the dependence of shadow banks on the originate-to-distribute model as the ratio of mortgages sold to total mortgage originations. We find a positive impact of MBS purchases on the securitization activities of shadow banks. Economically, a 1% increase in MBS purchases leads to the growth rate of mortgages sold by shadow banks increases by about 3.95 bps. We also show that MBS purchases make shadow banks be more reliant on the originate-to-distribute model. As Fannie Mae, Freddie Mac and Ginnie Mae play a dominant role in the originate-to-distribute model, shadow banks become more dependent on these institutions during the QE period.

Then, we study the relationship between MBS purchases and shadow banks' mortgage origination. We find a positive impact of MBS purchases on shadow banks' mortgage origination. More specifically, the impact on the mortgage origination growth rate of shadow banks is nearly twice as much as that of traditional banks, and this effect is larger in counties with higher shadow banking exposures. Economically, a 1% increase in MBS purchases leads to an increase in the mortgage origination growth rate of shadow banks by about 3.20 bps. After controlling the demand side factors by comparing the amount of mortgages originated in the same county in the same year by different financial institutions, we find that MBS purchases

[2] This method is also widely used in the recent literature such as Guariglia and Yang (2018), Dessaint et al. (2019) and Guo et al. (2021).

lead shadow banks to originate a significantly larger amount of mortgages than traditional banks. Quantitatively, a 1% increase in MBS purchases leads the mortgage origination amount of shadow banks to increase by about 1.09 bps.

To further investigate the shadow banks' mortgage origination behaviors, we then examine the impact of MBS purchases on the volume of mortgages originated to different types of borrowers. We begin with the investigation in the impact of MBS purchases on the mortgages originated to conventional borrowers by examining the origination of conventional mortgages. We find that MBS purchases lead traditional banks to originate more mortgages to conventional borrowers. This effect is insignificant on shadow banks, which indicates that the origination of conventional mortgages does not contribute to the increase in the shadow banks' mortgage origination. After controlling the demand side factors by comparing the mortgage amount given to the same county in the same year by different financial institutions, we find that shadow banks originate a larger amount of conventional mortgages than traditional banks at the lender-county level. Quantitatively, a 1% increase in MBS purchases leads the shadow banks' conventional mortgage origination to increase by about 1.59 bps.

We then discuss the impact of QE on the volume of mortgages originated to riskier borrowers. As the Federal Housing Administration (FHA) loan is a mortgage designed for borrowers with lower credit scores, we test the impact of MBS purchases on the mortgages originated to riskier borrowers by investigating the origination of FHA-insured mortgages. We find that MBS purchases lead shadow banks to originate more FHA-insured mortgages and experience a higher growth rate of FHA-insured mortgages in counties with higher shadow banking exposures. Economically, a 1% increase in MBS purchases leads the FHA-insured mortgage origination growth rate of shadow banks to increase by about 11.85 bps in counties where the shadow banking exposures are 50%. This result indicates that the increase in the mortgage origination of shadow banks is driven by the increase in the origination of FHA-insured mortgages instead of conventional mortgages. After controlling the demand side factors by comparing the volume of mortgages given in the same county in the same year by different financial institutions, we find that shadow banks originate a larger volume of FHA-insured

mortgages than traditional banks at the lender-county level. Quantitatively, a 1% increase in MBS purchases will lead the volume of shadow banks' mortgage originations to increase by about 0.80 bps.

Finally, this paper investigates the impact of MBS purchases on mortgage rates provided by shadow banks. We focus on the mortgage products with 175k loan amount, 30-year maturity and 20% down payment to alleviate the concern that the results are driven by other mortgage characteristics. We find that MBS purchases lead shadow banks to require a higher mortgage rate than traditional banks in counties with higher shadow banking exposures. While in counties with lower shadow banking exposures, the difference between the mortgage rates provided by shadow banks and traditional banks is insignificant.

The rest of paper is structured as follows. Section 2 discusses the related literature. Section 3 summarizes the data used in our study. Section 4 describes the impact of MBS purchases on mortgage securitization activities. Section 5 reports the effect of MBS purchases on mortgage origination. Section 6 investigates the influence of MBS purchases on the volume of mortgages originated to different types of borrowers. Section 7 discusses the impact of MBS purchases on mortgage rates. Section 8 concludes.

2. Related literature

This paper ties various strands of literature concerning traditional banks, shadow banks, monetary policy and mortgage securitization. This paper first sheds light on the literature concerning the rising of shadow banking system. Most of research attributes the expansion in shadow banking system to the tightening macroprudential policies, such as capital requirement (Ordonez, 2018; Plantin, 2015; Buchak et al., 2018; Martinez-Miera and Repullo, 2019; Irani et al., 2018), liquidity requirement (Aftab and Varotto, 2019) and leverage requirement (Farhi and Tirole, 2018). Other literature focuses on the tightening monetary policy. It shows that shadow banks attract more yield-sensitive clienteles by offering a higher interest rate (Xiao, 2020) and significantly boost their securitization activities (Nelson, Pinter and Theodoridis,

2016) during the period with tightening monetary policy. Consequently, shadow banks expand their loan originations dramatically which attenuates the effectiveness of the bank lending channel of monetary policy (Chen, Ren and Zhan, 2018; Elliott et al., 2019).

The closet paper to ours is Elliott et al. (2019). They examine the effects of monetary policy on the credit supply of traditional banks and shadow banks in syndicated loan, household auto loan and mortgage loan markets, respectively. They find that shadow banks expand more credit than traditional banks in syndicated loan market after the tightening monetary policy. Moreover, the substitution from traditional bank lending to shadow bank lending is more pronounced for riskier borrowers. In the auto loan market, they demonstrate that the expansion of shadow banks' auto loan origination nearly offset the reduction in traditional banks' auto loan origination. In the mortgage market, after controlling the county-level demand factor, they find that shadow banks originate more mortgages than traditional banks during the period with tightening monetary policy. More specifically, shadow bank lending perfectly substitutes traditional bank lending in the market for jumbo mortgages, while this substitution is limited in the market for conforming mortgages. These results indicate that shadow banks are more likely to perfectly substitute traditional banks in the loan market where lenders are more dependent on hard information.

Similar to Elliott et al. (2019), this paper investigates the impact of monetary policy on shadow banks. The key divergence is that our paper focuses on the expansionary unconventional monetary policy, specifically QE, while Elliott et al. (2019) concentrate on the conventional monetary policy. We find that MBS purchases have a positive and statistically significant effect on shadow banks' mortgage origination. Specifically, the magnitude of the impact on shadow banks is nearly twice as much as that of traditional banks.

Our paper also contributes to a growing number of literature on mortgage securitization. This literature shows a vigorous debt about the impact of the originate-to-distribute model. Some think that the originate-to-distribute model can be beneficial because it promotes the risk sharing and improve the lenders' liquidity risk management (Allen and Carletti, 2006; Greenbaum and Thakor, 1987; Cebenoyan and Strahan, 2004; Loutskina and Strahan, 2009).

While others believe that banks that are more reliant on the originate-to-distribute model have less incentives to screen and monitor their mortgage originations. Consequently, these lenders originate more inferior-quality mortgages (Purnanandam, 2011; Gete and Reher, 2020; Keys et al., 2010; Nadauld and Sherlund, 2012). Meanwhile, asymmetric information between sellers and buyers in the secondary market for mortgages gives rise to the concern of adverse selection and moral hazard. For example, banks are more prone to sell the mortgages whose borrowers have negative private information (Berndt and Gupta, 2009; Benmelech, Dlugosz and Ivashina, 2012) and have less incentives to renegotiate the securitized mortgages that at the risk of foreclosure (Piskorski, Seru and Vig, 2010). Our findings show that, compared with traditional banks, shadow banks are more reliant on the originate-to-distribute model to finance their mortgages during the QE period. As GSEs and Ginnie Mae are the main mortgage purchasers in the market, shadow banks become more dependent on these institutions.

This paper also adds to a new literature on QE. Recent studies of QE have investigated its impact on lending standards (Kurtzman, Luck and Zimmermann, 2018), mortgage rates (Hancock and Passmore, 2011), household consumption (Di Maggio, Kermani and Palmer, 2020) and bank lending behaviors (Rodnyansky and Darmouni, 2017; Chakraborty, Goldstein and MacKinlay, 2020). We contribute to this literature by investigating the influences of QE on shadow banking activity. Our paper shows that shadow banks expand their mortgage originations, especially the mortgages origination to the riskier borrowers, dramatically during the QE period. The closet papers to ours are Rodnyansky and Darmouni (2017) and Chakraborty and Goldstein and MacKinlay (2020).

Rodnyansky and Darmouni (2017) examine the effects of QE on traditional banks depending on the cross-variation in their MBS holdings. They find that banks with a considerable holding of MBS in balance sheets are prone to be stimulated by QE. More preciously, they suggest that banks with relatively larger holdings of MBS originate more loans in QE1 and QE3, while in QE2 this effect is insignificant. Their findings provide the evidence of the importance of the type of assets purchased by the Federal Reserve, because in QE1 and QE3, the Federal Reserve purchased both MBS and Treasury securities, but in QE2 the Federal

Reserve purchased the Treasury securities solely. Thus, the heterogenous effects of each round of QE are driven by the type of the targeted assets.

Chakraborty, Goldstein and MacKinlay (2020) also study the effects of QE on bank lending behaviors. They provide two measures to identify the banks that are more exposed to the MBS purchases. Similar to Rodnyansky and Darmouni (2017), the first measure defines the banks as the more exposed banks if they have the top tercile of MBS to total asset ratios. The second measure refines the first one by viewing the banks that have top tercile of MBS to total asset ratios and nonzero securitization income as the more exposed banks. They show that the banks that are more exposed increase their mortgage originations and reduce the commercial and industrial lendings following the Federal Reserve's MBS purchases. Consequently, the corporations that have a relationship with these banks cut their investments.

This paper also sheds light on the literature on the bank lending channel of monetary policy. So far, this literature mainly focuses on traditional banks and conventional monetary policy. It shows that contractionary monetary policy leads banks to cut their credit supply (Kashyap and Stein, 1994; Bernanke and Blinder, 1988, 1992; Jiménez et al., 2012; Drechsler, Savov and Schnabl, 2017), and this effect is more pronounced in banks with relatively smaller sizes (Kashyap and Stein, 1995), fewer liquid assets (Kashyap and Stein, 2000), higher capital leverage ratios (Kishan and Opiela, 2000) and stand-alone operations (Campello, 2002). It also points out that the Modigliani-Miller theorem for banks is failed in this area (Kashyap and Stein, 1995, 2000). A key contribution of our paper is to show that bank lending channel of monetary policy also works for shadow banks.

Moreover, this paper also contributes to the growing literature on the risk-taking channel of monetary policy. The recent literature shows that the monetary policy influences not only the quantity, but also the quality of banks' credit supply (Adrian and Shin, 2010; Dell'Ariccia, Laeven and Suarez, 2017; Jiménez et al., 2014; Delis, Hasan and Mylonidis, 2017). According to Borio and Zhu (2012), the low interest rate increases the banks' risk-taking through three primary mechanisms. The first is the search-for-yield effect, where lenders pursuit high returns and are willing to take on more risks (Rajan, 2005). The second mechanism is that the low

interest rate increases the value of banks' assets, liquidities and collaterals, which prompts banks to take on more risks (Adrian and Shin, 2010). The third mechanism is concerning the central bank. If central bank commits to maintain the interest rate at a lower level for a long time, banks are motivated to assume greater risks. During the QE period, the federal fund rate reached the zero-lower bound. The theory is still not clear on whether QE increases incentives for shadow banks to take on more risks or not. Our paper demonstrates that shadow banks originate significantly more mortgages to riskier borrowers than traditional banks during the QE period.

3. Data

3.1 Federal Reserve's large-scale asset purchases

In November 2008, the FOMC announced the initial round of large-scale asset purchase program (QE1), purchasing up to $100 billion of agency debt and $500 billion of agency MBS, to enhance the credit supply in the mortgage market. The program started in Jan 2009 and was expanded with an additional $750 billion of agency MBS, $100 billion of agency debt, and $300 billion of Treasury securities in March 2009. The purchase phase was completed in March 2010.

In September 2010, FOMC conformed that the recovery of output and employment was disappointingly slow, and the investment in nonresidential structure was still weak. Though the long-term inflation met the expectations, the underlying inflation was under the downward pressure. The market was, thus, crowded with the concerns of deflation. To promote the pace of recovery and maintain the underlying inflation, the FOMC initiated the second round of large-scale asset purchase program (QE2) in November 2010.

In September 2012, the FOMC suggested that the economic activities were expanding at a moderate rate. However, the Committee concerned that these improvements would be unsustainable without further policy accommodation. Thus, to maintain the recovery pace and underlying inflation, the third round of large-scale asset purchase program (QE3) was

unanticipatedly announced. The program began with a monthly purchase of $40 billion in agency MBS. In December 2013, the Committee reduced the monthly purchase amount of agency MBS and Treasury securities to $35 billion and $40 billion, respectively. After that, the monthly purchase paces of both agency MBS and Treasury securities dropped by $5 billion at each FOMC meeting, until the completion of third round purchase in October 2014.

This paper uses the gross purchase of agency MBS by FRBNY to quantify the intensity of QE. The summary statistics for the annual MBS purchases are presented in Panel 1 of Table 1. Figure 1 shows the quarterly purchase of MBS and Treasury securities by FRBNY.

(Please insert **Figure 1** about here)

3.2 Mortgage origination data

Home Mortgage Disclosure Act (HMDA) requires most financial institutions to report their mortgage lending activities. It provides a comprehensive mortgage-level information such as the lenders' identities, the mortgage characteristics, and the borrowers' general conditions. This paper utilizes the lenders' identities to classify the lenders as traditional banks and shadow banks and the loan types to distinguish FHA-insured mortgages from others. We use the public version of HMDA data in which only the year of the mortgage origination is available. Panel 2 of Table 1 provides the summary statistics for mortgage variables at the county level.

Lender classification: HMDA provides the detailed identities of all loan originators, which is useful to classify them as traditional banks and shadow banks. Following the identification strategy by Buchak et al. (2018), the loan originator is categorized as a traditional bank if it is a depository institution, otherwise, it is a shadow bank. The classification process begins with the primary regulatory agencies of lenders. Financial institutions that regulated by Office of the Controller of the Currency (OCC), National Credit Union Administration (NCUA), Federal Deposit Insurance Corporation (FDIC) and Office of Thrift Supervision (OTS) are classified as traditional banks. Financial institutions supervised by Department of Housing and Urban Development (HUD) are viewed as shadow banks, since majority of them are independent mortgage companies.

The classification of lenders regulated by Federal Reserve System (FRS) and Consumer Financial Protection Bureau (CFPB) is more complex because these two agencies regulate both traditional banks and shadow banks. This paper classifies the lenders regulated by these two agencies as traditional banks if they are depository institutions, affiliates of depository institutions, and mortgage banking subsidiaries of both state member banks and bank holding companies. The lenders are classified as shadow banks if they are independent mortgage banking subsidiaries and private mortgage insurance companies.

3.3 Mortgage rate data

RateWatch contains a detailed monthly information of mortgage products provided by the branches of financial institutions. It consists of the mortgage maturity, interest rate, down payment, points, and origination fee. This paper collects the mortgage rates for products with 175k loan amount, 30-year maturity and 20% down payment. Panel 3 of Table 1 includes the summary statistics for the mortgage rate variable.

Lender classification: The classification of RateWatch lenders is based on the lender's type. Lenders that are banks, credit unions, savings and loan associations, bank holding companies, internet banks, government banks, US branch of foreign banks, loan production offices, operations offices and employee credit unions are classified as traditional banks. Lenders that are brokers, trust companies, mortgage companies, financial consultants and non-depository institutions are viewed as shadow banks.

3.4 County level macroeconomic data

This paper collects the county level variables from a variety of sources. Specifically, we obtain the county level unemployment rate from the U.S. Bureau of Labor Statistics (BLS), the median household income from the U.S. Census Bureau, the median housing price from Zillow, the real GDP, population, per capital personal income from the U.S. Bureau of Economic Analysis (BEA), and subprime credit score population and household debt to income ratio from the FRBNY Consumer Credit Panel/Equifax data. We also derive the county level inflation based

on the GDP and real GDP data from the BEA. Panel 4 of Table 1 presents the summary statistics of county level macroeconomic variables, and Table 2 summarizes all the variable definitions and the sources.

(Please insert **Table 1** about here)

(Please insert **Table 2** about here)

4. Securitization activities

During the 2007-2008 global financial crisis, the private securitization market nearly dried up (Buchak et al., 2018) which makes it harder for shadow banks to finance their activities through the originate-to-distribute model. To enhance the credit supply in the mortgage market, the Federal Reserve authorized the FRBNY to purchase MBS backed by Fannie Mae, Freddie Mac and Ginnie Mae through the open market operations.

In this program, shadow banks are enabled to sell mortgages to the FRBNY after converting them into MBS and making it guaranteed by Fannie Mae, Freddie Mac or Ginnie Mae. Also, they can sell mortgages to Fannie Mae, Freddie Mac and Ginnie Mae directly who will then convert these mortgages into certified MBS before selling to the FRBNY. Since then, the originate-to-distribute model becomes effective.

Unlike shadow banks, traditional banks mainly use deposits to finance their mortgages. Thus, they are less dependent on the originate-to-distribute model than shadow banks and more likely to hold the mortgages until the maturities (Drechsler, Savov and Schnabl, 2017). Therefore, we hypothesize that the Federal Reserve's MBS purchases make shadow banks become more reliant on the originate-to-distribute model.

To investigate this hypothesis, we study the impact of MBS purchases on shadow banks' securitization activities based on the HMDA data. Since the amount of MBS that created by shadow banks is unavailable, we follow the strategy in Gete and Reher (2020) by quantifying the shadow banks' securitization activities as the amount of mortgages sold. We first test how MBS purchases affect the volume of mortgages sold by shadow banks in Section 4.1. Then, we

study the effect of MBS purchases on the reliance of shadow banks on the originate-to-distribute model in Section 4.2.

One concern is that HMDA only record a mortgage as sold if it is sold within the same calendar year of origination, and the record will not be changed even if the mortgage is sold in the next year. According to Echeverry, Santon and Wallace (2016), the average time to securitize a newly originated mortgage is around sixty days in 2007. Consequently, the extent of the financial institution's securitization activities is underestimated. Following Gete and Reher (2020), we alleviate this concern by designing an identification strategy based on a cross-sectional comparison between shadows banks and traditional banks in Section 4.2. Thus, this measurement error does not result in a biased estimation.

Another concern is that the increase in securitization amount is driven by the rising of mortgage originations. Thus, we cannot reach any conclusion concerning the impact of MBS purchases on the reliance of shadow banks on the originate-to-distribute model based on the results in Section 4.1 solely. To address this concern, we follow Gete and Reher (2020) to calculate the financial institution's reliance on the originate-to-distribute model as the ratio of mortgages sold to total mortgage originations, named as securitization rate, in Section 4.2.

4.1 Mortgage securitization growth rate

We first estimate the impact of MBS purchases on the mortgage securitization growth rate, represented by the mortgage sold growth rate, by shadow banks and traditional banks at the county level, respectively. To reduce the noise from the counties where very limited number of mortgages are sold, we restrict our sample to counties with at least 100 mortgages sold in each year. This restriction reduces the number of counties in our sample from 2,541 to 2,186. The specification for county j in year t is

$$
\begin{aligned}
&Mortgage\ Securitization\ Growth\ Rate_{j,t} \\
&\quad = \alpha_j + \theta_t + \gamma MBS\ Purchases_{t-1} + \rho Shadow\ Banking\ Exposure_{j,t-1} \\
&\quad + \beta MBS\ Purchases_{t-1} Shadow\ Banking\ Exposure_{j,t-1} \\
&\quad + \lambda County\ Controls_{j,t-1} + \varepsilon_{j,t}, \qquad (1)
\end{aligned}
$$

where the dependent variable is the growth rate of mortgage amount sold in county j in year t. $MBS\ Purchases_t$ is the natural logarithm of MBS amount purchased by the Federal Reserve in year t. $Shadow\ Banking\ Exposure_{j,t}$ is the share of mortgages originated by shadow banks in county j in year t. We include the county fixed effects (α_i) and the year fixed effects (θ_t) to ensure that the time-invariant county-specific characteristics and the changes in the aggregate conditions do not drive the results.

$County\ Controls_{j,t}$ is a vector of time-varying control variables for counties including household debt-to-income ratio, percentage of population with a subprime credit score, real gross domestic production, inflation, median household income, median housing price, per capital personal income, population and unemployment rate which could affect the financial institutions' mortgage origination behaviors. All standard errors are clustered at the county level.

The key parameter of interest, β, is the interaction of MBS purchases and the county's exposure to shadow banking activity, which measures the heterogenous effects of MBS purchases on the mortgage origination across counties with different shadow banking exposures.

One concern for this specification is that the results can be driven by the county characteristics that generate the systematical differences between counties with higher and lower shadow banking exposures. For example, if a county with higher shadow banking exposure also has higher housing price, β in Equation (1) will contain the influences from both the shadow banking exposure and the housing price. To remove the biases caused by the endogenous determination of shadow banking exposures, following Chakraborty, Goldstein and MacKinlay (2020), this paper estimates the cross-variation in shadow banking exposures that can be explained by counties' characteristics including unemployment rate, per capital personal income, median household income, real GDP, subprime credit score population, household debt

to income ratio, median housing price, population and inflation, and calculates the residuals as the orthogonalized shadow banking exposures.

To further condition away the potential biases stemming from the endogenous determination of shadow banking exposures, we follow the strategy in Rodnyansky and Darmouni (2017) by employing a standard propensity score matching approach. For the purpose of matching, we employ a probit model to estimate the propensity score for each county based on its fundamental characteristics including unemployment rate, per capital personal income, median household income, real GDP, subprime credit score population, household debt to income ratio, median housing price, population and inflation. Then, we match each treated county with an untreated county with replacement through a nearest-neighbor matching procedure.

Following Cleary (1999), we employ the Fisher's permutation test to examine whether the difference in the magnitude of the interested parameters between shadow banks and traditional banks is significant. Specifically, we begin with pooling the observations from shadow banks and traditional banks and obtain a sample with $n_1 + n_2$ observations where n_1 is the number of observations from shadow banks and n_2 is the number of observations from traditional banks. Then, we randomly select n_1 and n_2 observations and assign them to shadow bank group and traditional bank group, respectively. We calculate the new coefficients for each group and record the difference as d_1. This simulation procedure is repeated 1000 times, and we create the nonparametric distribution of d based on its 1000 observations. The empirical *p-value* represents the percentage of simulations where the d-value is greater than the observed d-value. For example, the observed d-value is 0.5 and there are only 30 out of 1000 simulations providing a d-value greater than the observed *d*-value (i.e. the empirical *p-value* is 0.03), we can conclude that the observed d-value is a relatively larger number in the distribution of *d* and the null hypothesis (H_0: $d = 0$) is rejected at the 5% confidence interval. Similarly, the observed d-value is -0.5 and there are 970 out of 1000 simulations providing a d-value greater than -0.5 (i.e. the empirical *p-value* is 0.97), we can conclude that the observed d-value is a relatively

smaller number in the distribution of d and the null hypothesis (H_0: $d = 0$) is rejected at the 5% confidence interval as well.

(Please insert **Table 3** about here)

Table 3 reports the results. Column (1) and (2) provide the estimation results of the impact of MBS purchases on the growth rate of mortgages sold by shadow banks and traditional banks based on the original shadow banking exposures, respectively. We find that both shadow banks and traditional banks experience a significant increase in the amount of mortgages sold after the MBS purchases. This increase is larger in counties with higher exposures to shadow banking activity. The difference between the coefficients of the interaction term in column (1) and (2) is significant (empirical *P-value* is 0.000) indicating that traditional banks experience significant higher mortgage securitization growth rate than shadow banks.

Column (3) and (4) provide the results based on the orthogonalized shadow banking exposures and column (5) and (6) focus on a propensity score matched sample of counties. After controlling the impact of the endogenous determination of shadow banking exposures, we find that the difference between the impact of MBS purchases on mortgage securitization growth rate of shadow banks and traditional banks is narrowed down, as the empirical *p-value* of the Fisher's permutation test between column (5) and column (6) is 0.168 which is greater than 10%. According to column (5) and (6), economically, a 1% increase in MBS purchases leads the growth rate of mortgages sold by shadow banks to increase by about 3.95 bps in counties where the shadow banking exposures are 50%[3].

Overall, we find a positive and significant impact of MBS purchases on the amount of mortgages sold by shadow banks and traditional banks, and the scales of this effect on shadow banks and traditional banks are similar. Also, we find that these effects are larger in counties with higher exposures to shadow banking activity.

[3] The coefficient of MBS purchases is absorbed by the year fixed effects. Thus, when the MBS purchases increase by 1%, $Mortgage\ Securitization\ Growth\ Rate_{j,t}$ increases by $\beta * Ln(1 + 10\%) * Shadow\ Banking\ Exposure_{j,t-1}$.

4.2 Mortgage securitization rate

In Section 4.1, we find that MBS purchases stimulate the mortgage securitization activities of both shadow banks and traditional banks. However, one concern is that the increase in the securitization amount is driven by the rising of mortgage origination, and the reliance of shadow banks and traditional banks on the originate-to-distribute model may remain unchanged. To alleviate this concern, we follow Gete and Reher (2020) to calculate the financial institution's reliance on the originate-to-distribute model as the ratio of mortgages sold to total mortgage originations, named as securitization rate. In particular, we estimate the following model:

$$\begin{aligned} &Securitization\ Rate_{i,t} \\ &\quad = \alpha_i + \theta_t + \gamma MBS\ Purchases_{t-1} + \rho Shadow\ Bank\ Indicator_i \\ &\quad + \beta MBS\ Purchases_{t-1} Shadow\ Bank\ Indicator_i + \varepsilon_{i,t}, \end{aligned} \tag{2}$$

where $Securitization\ Rate_{i,t}$ is the ratio of mortgages sold to total mortgage originations of lender i in year t. We use lender fixed effects (α_i) to remove the influences from the time-invariant lender-specific variation on the results. We employ the year fixed effects θ_t to control the influences from the aggregate conditions. $MBS\ Purchases_t$ is the natural logarithm of the amount of MBS purchased by the Federal Reserve in year t. $Shadow\ Bank\ Indicator_i$ is a dummy variable which takes the value of 1 if the lender is a shadow bank and 0 if it is a traditional bank. The key parameter of interest, β, is the interaction between MBS purchases and shadow bank indicator, which measures the heterogeneous impact of MBS purchases on securitization rates between shadow banks and traditional banks. Standard errors are clustered at the lender level.

(Please insert **Table 4** about here)

Table 4 reports the results. Column (1) finds a positive impact of MBS purchases on the ratio of mortgages sold to Fannie Mae, Freddie Mac or Ginnie Mae to total originations. It shows that the reliance of shadow banks on Fannie Mae, Freddie Mac and Ginnie Mae is increasing with MBS purchases. It also demonstrates that shadow banks are more reliant on

Fannie Mae, Freddie Mac and Ginnie Mae than traditional banks.

Column (2) provides the evidence that MBS purchases by the Federal Reserve has a negative impact on the ratio of mortgages sold to other institutions such as private securitization, traditional banks, and shadow banks. The empirical *p-value* of the Fisher's permutation test is 0.000 indicating that the difference in the coefficient of the interaction term between column (1) and column (2) is significant.

Column (3) finds a positive impact of MBS purchases on the ratio of mortgages sold to all purchasers to total originations. According to column (1) and (3), economically, a 1% increase in MBS purchases by the Federal Reserve leads shadow banks to increase the ratio of mortgages sold to Fannie Mae, Freddie Mac or Ginnie Mae to total originations by about 0.80 bps and the ratio of total mortgages sold to total originations by about 0.50 bps[4].

Overall, we find that shadow banks rely more on the originate-to-distribute model than traditional banks to finance their mortgages, and the Federal Reserve's MBS purchases increase their reliance on this model. As Fannie Mae, Freddie Mac and Ginnie Mae play a dominant role in the originate-to-distribute model during the QE period, shadow banks become more reliant on these institutions.

5. Mortgage origination

The Federal Reserve initiates the MBS purchase programs to stimulate the credit supply in the mortgage market. Through these programs, the Federal Reserve assures the market participants that there would be a reliable buyer in the TBA market under all market conditions, which greatly improve the TBA market functioning and the efficiency of the originate-to-distribute model. As shadow banks are more reliant on the originate-to-distribute model than traditional banks, we hypothesize that the mortgage origination of shadow banks experiences a higher expansionary rate than that of traditional banks during the QE period. In this section, we

[4] The coefficient of MBS purchases is absorbed by the year fixed effects. Thus, when the MBS purchases increase by 1%, $Securitization\ Rate_{i,t}$ of a shadow bank increases by $\beta * Ln(1 + 10\%) * 1$.

investigate this hypothesis at the county level and the lender-county level, respectively.

5.1 County level evidence

We estimate the heterogenous effects of MBS purchases on mortgage origination of shadow banks and traditional banks across counties with different shadow banking exposures through a specification similar to Equation (1). The key difference is that the dependent variable is the growth rate of mortgage origination of shadow banks and traditional banks in county j in year t. The key parameter of interest, β, is the interaction of MBS purchases and the county's exposure to shadow banking activity, which measures the heterogenous effects of MBS purchases on mortgage origination across counties with different shadow banking exposures. The validity of β requires the assumption that the demand for mortgages at the county level is time-invariant to be met. This assumption alleviates the concern that the results are driven by the changes in demand of mortgages instead of the changes in supply of mortgages.

We cannot relax this assumption in Equation (1) through employing the county-by-year fixed effects to control the impact of time-varying county characteristics, especially the shocks in demand for mortgages, on the results. This is because shadow banking exposures are variant across counties and years and MBS purchases vary in years, the incorporation of county-by-year fixed effects will absorb the coefficient of the interaction of shadow banking exposures and MBS purchases. Therefore, we relax this assumption in Equation (3). To reduce the noise from the counties with very limited mortgage originations, we restrict our sample to counties with at least 100 mortgage originations in each year. This restriction reduces the number of counties in our sample from 2,541 to 2,397.

(Please insert **Table 5** about here)

Table 5 reports the results. Column (1) and (2) show the impact of MBS purchases on the mortgage origination growth rate of shadow banks and traditional banks based on the original shadow banking exposures, respectively. We find that both shadow banks and traditional banks experience a significant increase in mortgage origination growth rate after MBS purchases. More specifically, the impact of MBS purchases on shadow banks is nearly twice as much as

that on traditional banks. The empirical *p-value* of the Fisher's permutation test between column (1) and column (2) is 0.000 indicating that the difference in the impact of MBS purchases on shadow banks and traditional banks is statistically significant.

Column (3) and (4) provide the results based on orthogonalized shadow banking exposures and column (5) and (6) concentrate on a propensity score matched sample of counties. Both pairs show a similar result to that in column (1) and (2), and the difference in the coefficient of the interaction term between each pair is significant as well. According to column (5) and (6), economically, a 1% increase in MBS purchases increase the mortgage origination growth rate of shadow banks by about 3.20 bps and that of traditional banks by 1.75 bps in counties where the shadow banking exposures are 50%.

Overall, we find a positive and significant impact of MBS purchases on the mortgage origination growth rate of shadow banks and traditional banks, and the scale of this effect on shadow banks is nearly twice as much as that on traditional banks. Also, we find that this effect is larger in counties with higher exposures to shadow banking activity.

5.2 Lender-county level evidence

The previous section shows that MBS purchases prompt shadow banks to expand their mortgage originations. However, there remains the concern that the results are driven by the mortgage demand instead of the mortgage supply. To alleviate this concern, this section investigates the impact of MBS purchases on the mortgage origination amount of shadow banks at the lender-county level. We estimate the following model:

$$
\begin{aligned}
&Log\left(Mortgage\ Amount_{i,j,t}\right) \\
&\quad = \alpha_i + \theta_{j,t} + \gamma MBS\ Purchases_{t-1} + \rho Shadow\ Bank\ Indicator_i \\
&\quad + \beta MBS\ Purchases_{t-1} Shadow\ Bank\ Indicator_i \\
&\quad + \lambda County\ Controls_{j,t-1} Shadow\ Bank\ Indicator_i \\
&\quad + \tau Lender\ Controls_{i,t-1} MBS\ Purchases_{t-1} + \varepsilon_{i,j,t}, \qquad (3)
\end{aligned}
$$

where $Log(Mortgage\ Amount)_{i,j,t}$ is the natural logarithm of mortgage amount originated by lender i in county j in year t. $MBS\ Purchases_t$ is the natural logarithm of the MBS amount purchased by the Federal Reserve in year t. $Shadow\ Bank\ Indicator_i$ is a dummy variable which equals to 1 if the lender is a shadow bank and 0 if it is a traditional bank. We include the lender fixed effects (α_i) to ensure that the lender-specific time-invariant characteristics do not affect the results. Following the strategy in Khwaja and Mian (2008) and Elliott et al. (2019), we employ the county-by-year fixed effects ($\theta_{j,t}$) to remove the impact of any county-specific time-varying characteristics, especially the mortgage demand, on the results. Thus, the supply and demand factors are disentangled.

$County\ Controls_{j,t}$ is a vector of time-varying control variables for counties including household debt-to-income ratio, percentage of population with a subprime credit score, real gross domestic production, inflation, median household income, per capital personal income, population, and unemployment rate. We include the interaction between shadow bank indicator and county controls to allow for the differential effects of the changes in county characteristics on shadow banks and traditional banks. $Lender\ Controls_{i,t}$ is the securitization rate of lender i in year t. We employ the interaction between lender controls and MBS purchases to allow for the differential impact of MBS purchases on lenders with different dependence on securitization activities.

The key parameter of interest, β, is the interaction between MBS purchases and shadow bank indicator, which measures the difference in the impact of MBS purchases on mortgage origination between shadow banks and traditional banks. We define a county as a treated county if it belongs the upper quantile of the shadow-banking-exposures distribution of the prior year and an untreated county if it belongs the lower quantile of the distribution. To further alleviate the concern that the endogenous determination of shadow banking exposures drives the result, we match each treated county with an untreated county with replacement through a propensity score matching procedure and create a sample of propensity score matched untreated counties.

The Equation (3) is estimated based on the mortgage origination in treated counties,

untreated counties, propensity score matched untreated counties and all counties separately to demonstrate the heterogenous impact of MBS purchases on shadow banks' mortgage origination amount across counties with different shadow banking exposures. All standard errors are clustered at the lender-county level.

(Please insert **Table 6** about here)

Table 6 reports the results. Column (1) and (2) provide the estimation results based on the mortgage originations in treated and untreated counties, respectively. Both columns find a positive and significant effect of MBS purchases on shadow banks' mortgage origination. Moreover, shadow banks originate a larger amount of mortgages than traditional banks at the lender-county level and this effect is increasing with MBS purchases. The empirical *P-value* of the Fisher's permutation test is 0.080, less than 10%, indicating that this impact is also significantly larger in counties with higher shadow banking exposures.

Column (3) shows the estimation results based on a sample of propensity score matched untreated counties. It provides a similar result to that in column (2). However, the empirical *p-value* of the Fisher's permutation test is 0.331, greater than 10%, meaning that the impact of MBS purchases on shadow banks' mortgage origination in treated counties is significantly different than that in untreated counties after conditioning away the effects of the endogenous determination of shadow banking exposures.

Column (4) focuses on the mortgage originations in all counties. It finds a statistically significant impact of MBS purchases on shadow banks' mortgage origination and demonstrates that shadow banks originate larger amounts of mortgages than traditional banks. Quantitatively, a 1% increase in MBS purchases leads the shadow banks' mortgage origination amount to increase by about 1.09 bps[5].

Taken together, these two sections provide the evidence that MBS purchases lead shadow banks to experience a significantly higher mortgage origination growth rate than traditional

[5] The coefficient of MBS purchases is absorbed by the year fixed effects. When the MBS purchases increase by 1%, $Log(Mortgage\ Amount_{i,j,t})$ of a shadow bank increases by $\beta * Ln(1 + 10\%) * 1$. Thus, $Mortgage\ Amount_{i,j,t}$ increases by $(1 + 10\%)^{\beta} - 1$.

banks at the county level. Specifically, the magnitude of the impact of MBS purchases on the mortgage origination growth rate of shadow banks is nearly twice as much as that of traditional banks, and this impact is larger in counties with higher shadow banking exposures. After controlling the demand side factors, we find that shadow banks originate a larger amount of mortgages than traditional banks at the lender-county level.

6. Mortgage originations to different types of borrowers

In Section 5.1 and 5.2, we prove that MBS purchases by the Federal Reserve lead shadow banks to experience a higher mortgage origination growth rate at the county level and originate a larger amount of mortgages at the lender-county level. To further investigate this impact, we examine the effect of MBS purchases on mortgages originated to different types of borrowers. Section 6.1 looks at the impact of MBS purchases on the mortgages originated to conventional borrowers. Section 6.2 examines the impact of MBS purchases on the mortgages originated to riskier borrowers.

6.1 Mortgages originated to conventional borrowers

Conventional mortgage is a mortgage not insured by FHA. It requires the applicant to have a relatively higher credit score and pay a larger down payment. In this section, we investigate the impact of MBS purchases on the mortgages originated to conventional borrowers by studying the origination of conventional mortgages.

6.1.1 County level evidence

We first estimate the impact of MBS purchases on the origination of conventional mortgages at the county level. The specification is similar to Equation (1). The key difference is that the dependent variable is the growth rate of conventional mortgages originated by shadow banks and traditional banks in county j in year t, respectively. The key parameter of interest, β, is the interaction of MBS purchases and the county's exposure to shadow banking activity, which

measures the heterogenous effects of MBS purchases on the conventional mortgage origination across counties with different shadow banking exposures.

Similar to Section 5.1, the validity of β requires the assumption that the demand for conventional mortgages at the county level is time-invariant to be met. This assumption alleviates the concern that the results are driven by the changes in the demand of mortgages instead of the supply of mortgages. We relax this assumption in Section 6.1.2. To reduce the noise from the counties with very limited conventional mortgage originations, we restrict our sample to counties with at least 100 conventional mortgage originations in each year. This restriction reduces the number of counties in our sample from 2,541 to 2,338.

(Please insert **Table 7** about here)

Table 7 reports the results. Column (1) and (2) demonstrate the impact of MBS purchases on the growth rate of conventional mortgages originated by shadow banks and traditional banks based on the original shadow banking exposures, respectively. Column (2) finds that the MBS purchases by the Federal Reserve lead traditional banks to originate significantly more conventional mortgages, and this effect is enlarged in counties with higher shadow banking exposures. However, column (1) shows that this impact is insignificant on shadow banks. This suggests that the impact of MBS purchases on the conventional mortgage origination of shadow banks and traditional banks is asymmetric.

Column (3) and (4) provide the results based on the orthogonalized shadow banking exposures and column (5) and (6) focus on a propensity score matched sample of counties. They both provide a similar result to that in column (1) and (2). According to column (5) and (6), economically, a 1% increase in MBS purchases increases the growth rate of the conventional mortgages originated by traditional banks by about 3.70 bps in counties where the shadow banking exposures are 50%.

In Section 5.1, we show that MBS purchases lead both shadow banks and traditional banks to experience a significant increase in mortgage origination growth rate at the county level. The results in this section supplement the findings in Section 5.1 by demonstrating that the increase

in the county-level mortgage origination growth rate of traditional banks is driven by the increase in the origination of conventional mortgages. On the contrary, the origination of conventional mortgages does not contribute to the increase in the county-level mortgage origination growth rate of shadow banks.

Overall, we find that MBS purchases lead traditional banks to originate more mortgages to conventional borrowers and experience a higher growth rate of conventional mortgage origination in counties with higher shadow banking exposures. This effect is insignificant on shadow banks.

6.1.2 Lender-county level evidence

In this section, we relax the assumption that the demand of conventional mortgages is time-invariant in Section 6.1.1 by estimating a similar specification to Equation (3). The key difference is that the dependent variable is the natural logarithm of the amount of conventional mortgages originated by lender i in county j in year t.

(Please insert **Table 8** about here)

Table 8 reports the results. Column (1) and (2) provide the estimation results based on the conventional mortgage origination in treated and untreated counties, respectively. Both columns find a positive and statistically significant effect of MBS purchases on shadow banks' conventional mortgage origination. Moreover, shadow banks originate a larger amount of conventional mortgages than traditional banks at the lender-county level, and this effect is increasing with MBS purchases. The empirical *P-value* of the Fisher's permutation test is 0.051, less than 10%, suggesting that this effect is also significantly larger in counties with higher shadow banking exposures.

Column (3) shows the results based on a sample of propensity score matched untreated counties and provides a similar result to that in column (2). However, the empirical *P-value* of the Fisher's permutation test increases to 0.360, greater than 10%, indicating that the magnitude of the effect of MBS purchase on the origination of conventional mortgages in treated counties is similar to that in untreated after conditioning away the impact of endogenous determination

of shadow banking exposures.

Column (4) focuses on the mortgage origination in all counties and demonstrates that shadow banks originate a larger amount of mortgages than traditional banks at the lender-county level. According to column (4), quantitatively, a 1% increase in MBS purchases leads an increase of about 1.59 bps in shadow banks' mortgage origination.

In Section 5.2, we show that MBS purchases lead shadow banks to originate larger amounts of mortgages at the lender-county level. The results in this section supplement the findings in Section 5.2 by demonstrating that the increase in the shadow banks' mortgage origination amount is driven by the increase in the origination amount of conventional mortgages.

Taken together, these two sections provide the evidence that, though, MBS purchases do not have a significant effect on conventional mortgage origination growth rate of shadow banks at the county level, they lead shadow banks to originate a larger amount of conventional mortgages at the lender-county level.

6.2 Mortgages originated to riskier borrowers

We next discuss the impact of MBS purchases on mortgages originated to riskier borrowers. FHA-insured mortgage is a loan designed for borrowers with lower credit scores. It is insured by the FHA and originated by the FHA-approved lenders. In this section, we investigate the impact of MBS purchases on the mortgages originated to riskier borrowers by studying the origination of FHA-insured mortgages.

6.2.1 County level evidence

We first estimate the impact of MBS purchases on the origination of FHA-insured mortgages at the county level. The specification is similar to Equation (1). The key difference is that the dependent variable is the growth rate of FHA-insured mortgage originated by shadow banks and traditional banks in county j in year t, respectively. The key parameter of interest, β, is

the interaction of MBS purchases and the county's exposure to shadow banking activity, which measures the heterogenous effects of MBS purchases on the origination of FHA-insured mortgages across counties with various shadow banking exposures. Similar to Section 5.1, the validity of β requires the assumption that the demand for FHA-insured mortgages is time-invariant at the county level to be met. This assumption alleviates the concern that the results are driven by the changes in demand of mortgages instead of in supply of mortgages. We relax this assumption in Section 6.2.2. To reduce the noise from the counties with very limited FHA-insured mortgage originations, we restrict our sample to counties with at least 100 FHA-insured mortgage originations in each year. This restriction reduces the number of counties in our sample from 2,530 to 1,319.

(Please insert **Table 9** about here)

Table 9 reports the results. Column (1) and (2) show the impact of MBS purchases on the growth rate of FHA-insured mortgages originated by shadow banks and traditional banks based on the original shadow banking exposures, respectively. We find a statistically significant impact of MBS purchases on both shadow banks and traditional banks, and this impact is increasing with the counties' shadow banking exposures. More specifically, the magnitude of the impact on shadow banks is nearly twice as much as that on traditional banks. The empirical *p-value* of the Fisher's permutation test between column (1) and column (2) is 0.001 indicating that the difference in the impact of MBS purchases on shadow banks and traditional banks is statistically significant.

Column (3) and (4) provide the results based on the orthogonalized shadow banking exposures and column (5) and (6) focus on a propensity score matched sample of counties. After controlling the impact of the endogenous determination of shadow banking exposures, we find that the magnitude of the impact on both shadow banks and traditional banks are nearly doubled. The difference in the impact of MBS purchases on shadow banks and traditional banks is remained statistically significant. According to column (5) and (6), economically, a 1% increase in MBS purchases increases the FHA-insured mortgage origination growth rate of shadow banks by about 11.85 bps and traditional banks by 6.00 bps in counties where the

shadow banking exposures are 50%.

In Section 5.1, we show that MBS purchases lead both shadow banks and traditional banks to experience a significant increase in mortgage origination growth rate at the county level. The results in this section supplement the findings in Section 5.1 by demonstrating that the increase in the county level mortgage origination growth rate of shadow banks is driven by the increase in the origination of FHA-insured mortgages.

Overall, we find that MBS purchases lead both shadow banks and traditional banks to originate more mortgages to riskier borrowers and experience a higher growth rate in counties with higher shadow banking exposures. The effect on shadow banks is significantly higher than that on traditional banks.

6.2.2 Lender-county level evidence

In this section, we relax the assumption that the demand of FHA-insured mortgages is time-invariant in Section 6.2.1 by estimating a similar specification to Equation (3). The key difference is that the dependent variable is the natural logarithm of the amount of FHA-insured mortgages originated by lender i in county j in year t.

(Please insert **Table 10** about here)

Table 10 reports the results. Column (1) and (2) provide the estimation results based on the origination of FHA-insured mortgages in treated and untreated counties, respectively. Column (1) finds a positive and significant effect of MBS purchases on shadow banks' FHA-insured mortgage origination amount. Moreover, it shows that shadow banks originate a larger amount of FHA-insured mortgages than traditional banks in treated counties, and this effect is increasing with MBS purchases. Column (2) does not find a significant effect.

Column (3) also find an insignificant effect of MBS purchases based on a sample of propensity score matched untreated counties. Column (4) provides a similar result as that in column (1) based on a sample of all counties. Quantitatively, a 1% increase in MBS purchases leads to an increase of about 0.80 bps in shadow banks' FHA-insured mortgage origination amount at the lender-county level.

In Section 5.2, we show that MBS purchases by the Federal Reserve lead shadow banks to originate a larger volume of mortgages at the lender-county level. The results in this section supplement the findings in Section 5.2 by demonstrating that the increase in the shadow banks' mortgage origination amount in treated counties is driven by the increase in the origination of FHA-insured mortgages.

Taken together, the two sections provide the evidence that MBS purchases lead shadow banks to experience a significantly higher growth rate of FHA-insured mortgage origination at the county level, and this effect is increasing with MBS purchases. Moreover, the impact of MBS purchases on the FHA-insured mortgage origination growth rate of traditional banks is insignificant. At the lender-county level, we prove that MBS purchases lead shadow banks to originate a larger amount of FHA-insured mortgages.

7. Mortgage rates

Another potential approach for shadow banks to expand more mortgage originations than traditional banks is providing mortgage products at a relatively cheaper price during the QE period. Buchak et al. (2018) suggest that the mortgage rates provided by shadow banks are significantly higher than that by traditional banks while the difference is within 1 bp. We hypothesize that the difference between the mortgage rates provided by shadow banks and traditional banks of the same mortgage products is narrowed down during the QE period.

To test this hypothesis, we investigate the impact of MBS purchases on the difference in mortgage rates provided by shadow banks and traditional banks. RateWatch provides the interest rates of standardized mortgage products supplied by the branches of financial institutions. To condition away the impact of mortgage characteristics on the results, we focus on the mortgage products with 175k loan amount, 30-year maturity and 20% down payment. We estimate the following model:

$$
\begin{aligned}
&Mortgage\ Rate_{i,j,t} \\
&\quad = \alpha_i + \theta_{j,t} + \gamma MBS\ Purchases_{t-1} + \rho Shadow\ Bank\ Indicator_i \\
&\quad + \beta MBS\ Purchases_{t-1} Shadow\ Bank\ Indicator_i \\
&\quad + \lambda County\ Controls_{j,t-1} Shadow\ Bank\ Indicator_i + \varepsilon_{i,j,t}, \qquad (6)
\end{aligned}
$$

where $Mortgage\ Rate_{i,j,t}$ is the percentage points of mortgage rates provided by lender i in county j in month t. We employ the lender fixed effects (α_i) to remove the impact of the time-invariant lender-specific variation on the results. We include the county-by-month fixed effects to control the influences of the county-specific time-varying characteristics, especially the changes in the mortgage demand, on the results. Therefore, the results will not be driven by the changes in mortgage demand at the county level. $MBS\ Purchases_t$ is the natural logarithm of the amount of MBS purchased by the Federal Reserve in month t. $Shadow\ Bank\ Indicator_i$ is a dummy variable which takes the value of 1 if the lender is a shadow bank and 0 if it is a traditional bank.

$County\ Controls_{i,t}$ is a vector of time-varying control variables for counties including unemployment rate and median housing price which could affect financial institutions' mortgage origination behaviors. We include the interaction between shadow bank indicator and county controls to allow for the differential effects of the changes in county characteristics on traditional banks and shadow banks. All standard errors are clustered at lender-county level.

The key parameter of interest, β, is the interaction between MBS purchases and shadow bank indicator, which measures the difference in the impact of MBS purchases on mortgage rates provided by shadow banks and traditional bank. We define a county as a treated county if it belongs the upper quantile of the shadow-banking-exposures distribution of the prior year and an untreated county if it belongs the lower quantile of the distribution. All standard errors are clustered at the lender-county level.

(Please insert **Table 11** about here)

Table 11 shows the results. Column (1) and (2) provide the estimation results based on the mortgage products in treated and untreated counties, respectively. Column (1) demonstrates that

the Federal Reserve's MBS purchases have a significant and positive impact on the mortgage rates provided by shadow banks in counties with higher shadow banking exposures, while a 1% increase in MBS purchases only leads to an increase of less than 1 bp on mortgage rates provided by shadow banks. It also shows that shadow banks ask for a higher mortgage rate than traditional banks in these counties, while the size of the difference in within 1 bps as well. This result is consistent with the findings in Buchak et al. (2018). On the contrary, column (2) does not find a significant difference between mortgage rates provided by shadow banks and traditional banks in counties with lower shadow banking exposures.

Column (3) and column (4) estimate the results based on a sample of propensity score matched untreated counties and all counties, respectively. Both provide no evidence that the difference between the mortgage rates provided by shadow banks and traditional banks is significant.

8. Conclusion

Over the last decade, there is a growing literature on shadow banks and QE, respectively. However, the literature on the connection between shadow banks and QE is still scant. In this paper, we investigate the impact of QE on shadow banks in the mortgage market via the origination channel.

We find that the Federal Reserve's MBS purchases stimulate shadow banks' securitization activities significantly and make shadow banks become more reliant on Fannie Mae, Freddie Mac and Ginnie Mae to finance their lending activities. Also, we find a positive effect of MBS purchases on shadow banks' mortgage origination. Specifically, the magnitude of the impact of MBS purchases on the mortgage origination growth rate of shadow banks is nearly twice as much as that of traditional banks. After controlling the demand side factors, we find that MBS purchases lead shadow banks to originate a significantly larger volume of mortgages than traditional banks at the lender-county level.

Furthermore, we provide the evidence that the increase in the mortgage origination growth

rate of shadow banks is driven by the increase in the mortgages originated to riskier borrowers instead of conventional borrowers. Finally, we demonstrate that MBS purchases lead shadow banks to require a higher mortgage rate than traditional banks in counties with higher shadow banking exposures. While in counties with lower shadow banking exposures, the difference between the mortgage rates provided by shadow banks and traditional banks is insignificant.

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Figure 1. Quarterly MBS and Treasury securities purchases by FRBNY

This figure shows the quarterly gross purchase of mortgage-backed securities (MBS) and Treasury (TSY) by the Trading Desk at the FRBNY from the first quarter of 2007 to the fourth quarter of 2014. QE1, QE2 and QE3 refer to the first, second, and third round of QE. Data is from the FRBNY.

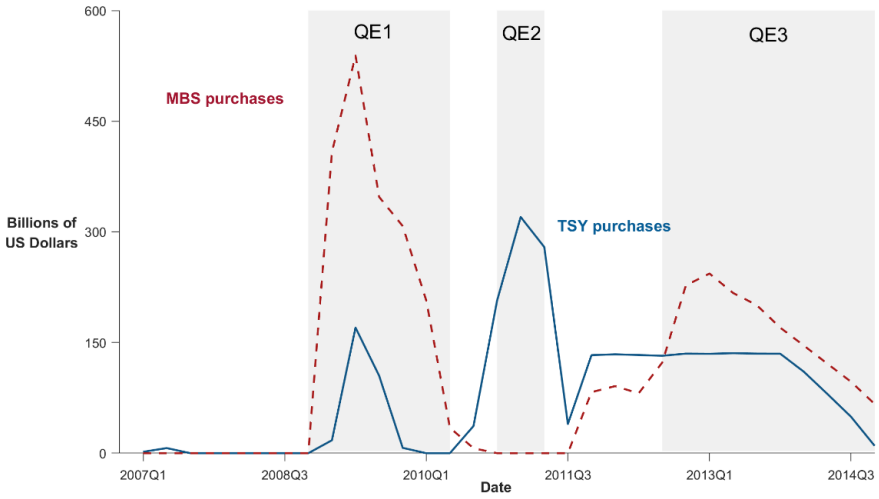

Table 1: Summary statistics

This table presents the summary statistics of data used in the paper. The data period runs from 2009 to 2014. Panel 1 demonstrates the summary statistics for annual MBS purchases by the Federal Reserve. Panel 2 reports the summary statistics for the mortgage variables from HMDA at the county level. Panel 3 shows the summary statistics for mortgage rate data from RateWatch. Panel 4 displays the summary statistics for county level macroeconomic variables collected from BLS, Census Bureau, Zillow and BEA.

	Number of observations	Standard deviation	Mean	Min	Max	Kurtosis	Skewness	10th percentile	90th percentile
Panel 1: Large-scale asset purchase program variable									
Log MBS Purchases	14661	2.40	5.09	0.00	7.38	3.38	-1.30	0.00	7.38
Panel 2: County level mortgage variables									
Log Mortgage Amount	14661	1.80	11.58	5.84	18.51	2.90	0.42	9.43	14.10
Log Mortgage Amount of Banks	14661	1.79	11.29	5.44	18.06	2.87	0.35	9.13	13.77
Log Mortgage Amount of Shadow Banks	14657	1.95	10.04	3.93	17.51	3.05	0.48	7.77	12.81
Log FHA Mortgage Amount	14466	1.90	9.47	3.40	16.17	2.79	0.42	7.25	12.21
Log FHA Mortgage Amount of Banks	14366	1.92	8.73	1.61	15.30	2.72	0.29	6.41	11.44
Log FHA Mortgage Amount of Shadow Banks	14411	1.95	8.72	2.83	15.87	2.89	0.47	6.45	11.53
Panel 3: Mortgage level variable									
Mortgage rate (%)	2512	0.67	4.63	1.75	8.25	3.69	0.25	3.75	5.38
Panel 4: County level macroeconomic variables									
Inflation	14661	0.04	0.02	-0.50	0.36	46.75	-2.49	0.00	0.04
Log Real GDP	14661	1.48	14.18	10.12	20.22	3.46	0.68	12.46	16.23
Log Population	14661	1.30	10.63	6.51	16.12	3.39	0.62	9.13	12.47
Unemployment Rate	14661	0.03	0.08	0.01	0.29	4.56	0.80	0.05	0.12
Log Median Housing Price	14661	0.50	11.66	10.23	14.00	3.52	0.45	11.07	12.30
Log Median Household Income	14661	0.23	10.69	10.01	11.69	3.65	0.52	10.41	10.98
Log Per Capital Personal Income	14661	0.22	10.44	9.59	12.17	5.74	0.88	10.19	10.72
Household Debt to Income Ratio	14661	0.01	0.02	0.00	0.03	1.89	0.23	0.01	0.03
Subprime Credit Score Population	14661	0.09	0.33	0.08	0.68	2.63	0.39	0.22	0.46

Table 2: Variable definitions and sources

Variable	Definition	Source
Monetary policy variable		
MBS purchases	Log of MBS amount purchased by the FRBNY (in millions, U.S. dollar)	FRBNY
Mortgage-level variable		
Mortgage rate	Percentage points of mortgage rate	RateWatch
Institution-level variable		
Mortgage origination amount	Log of mortgage amount (in thousands, U.S. dollar)	HMDA
County-level variables		
Mortgage origination growth rate	Mortgage origination growth rate for shadow banks and traditional banks by county	HMDA
Unemployment rate	Unemployment rate by county	BLS
Median household income	Log of the estimated median household income by county (in U.S. dollars)	Census Bureau
Median housing price	Log of the typical value for homes in the 35th to 65th percentile range by county (in U.S. dollars)	Zillow
Real GDP	Log of the real GDP for all industries by counties (in thousands of chained 2012 U.S. dollars)	BEA
Population	Log of the population by county	BEA
Per capital personal income	Log of the personal income in a county divided by the resident population in that county (in U.S. dollars)	BEA
Inflation	Derived from GDP and real GDP	BEA
Subprime credit score population	Estimated percentage of population with a credit score below 660	FRBNY
Debt to income ratio	Ratio of household debt from FRBNY Consumer Credit Panel/Equifax Data to household income reported by BLS	FRBNY

Table 3: Mortgage securitization growth rate

This table displays the impact of MBS purchases on the growth rate of mortgage amount sold by shadow banks and traditional banks using data from 2009 to 2014, respectively. Column (1) and (2) provide the estimation results based on the original shadow banking exposures. Column (3) and (4) provide the estimation results based on the orthogonalized shadow banking exposures. Column (5) and (6) provide the estimation results based on a propensity score matched sample of counties. *MBS purchases* is the natural logarithm of the lagged annual amount of MBS purchased by the Federal Reserve. *Shadow Banking Exposure* is measured as the share of mortgages given by shadow banks in the county during the prior year. The *Fisher' permutation test* provides the empirical *P-value* to test whether the difference in the coefficient of *MBS Purchases * Shadow Banking Exposure* between shadow banks and traditional banks is statistically significant. All specifications include the year fixed effects, the county fixed effects and the county-level control variables. Standard errors in parentheses are clustered by county. *, **, *** indicate significance at the 10%, 5% and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Variable	Shadow Bank	Traditional Bank	Shadow Bank	Traditional Bank	Shadow Bank	Traditional Bank
MBS Purchases * Shadow Banking Exposure	0.056**	0.149***	0.082***	0.127***	0.079**	0.097***
	(0.022)	(0.015)	(0.023)	(0.018)	(0.037)	(0.024)
Unemployment Rate	1.993***	2.652***	0.463	3.176***	1.030	3.475***
	(0.518)	(0.252)	(0.521)	(0.259)	(1.351)	(0.785)
Per Capital Personal Income	0.175	0.253***	0.239*	0.212***	-0.366	0.337*
	(0.130)	(0.074)	(0.130)	(0.074)	(0.445)	(0.194)
Median Household Income	-0.307***	0.038	-0.795***	0.140**	0.115	0.071
	(0.101)	(0.069)	(0.104)	(0.070)	(0.291)	(0.169)
Real GDP	-0.042	-0.023	-0.025	-0.025	-0.027	0.041
	(0.060)	(0.033)	(0.060)	(0.033)	(0.079)	(0.055)
Subprime Credit Score Population	-2.124***	-0.998***	-3.516***	-0.688**	-2.387**	-1.704**
	(0.490)	(0.284)	(0.502)	(0.287)	(0.951)	(0.729)
Debt to Income Ratio	-9.913***	0.509	-10.547***	0.196	-4.949	0.286
	(2.331)	(1.423)	(2.325)	(1.421)	(3.953)	(3.224)
Median House Price	-0.917***	-0.696***	-1.083***	-0.740***	-1.045***	-0.969***
	(0.089)	(0.062)	(0.090)	(0.062)	(0.134)	(0.101)
Population	0.088	0.154	0.144	0.415***	-0.095	0.208
	(0.276)	(0.160)	(0.272)	(0.155)	(0.553)	(0.291)
Inflation	-0.389***	-0.521***	-0.582***	-0.460***	0.090	-0.220

	(0.102)	(0.064)	(0.103)	(0.065)	(0.172)	(0.151)
Fisher's Permutation Test:						
(Shadow Bank = Traditional Bank)	0.000		0.003		0.168	
County Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Main Effects	Yes	Yes	Yes	Yes	Yes	Yes
Matched Sample	No	No	No	No	Yes	Yes
Orthogonalized Shadow Banking Exposure	No	No	Yes	Yes	No	No
Observations	12,119	12,119	12,119	12,119	5,620	5,620
R-squared	0.490	0.732	0.491	0.730	0.709	0.786

Table 4: Mortgage securitization rate

This table displays the impact of MBS purchases on the securitization rate of shadow banks and traditional banks. The dependent variable in column (1) is the ratio of mortgages sold to either GSEs including Fannie Mae and Freddie Mac or Ginnie Mae to total mortgage originations. The dependent variable in column (2) is the ratio of mortgages sold to neither GSEs nor Ginnie Mae to total mortgage originations. The dependent variable in column (3) is the ratio of mortgages sold to all purchasers to total mortgage originations. *MBS purchases* is the natural logarithm of the lagged annual amount of MBS purchased by the Federal Reserve. *Shadow bank indicator* is a dummy variable which takes the value of one if the lender is a shadow bank and a value of 0 if the lender is a traditional bank. The *Fisher' permutation test* provides the empirical *P-value* to test whether the difference in the coefficient of *MBS Purchases * Shadow Bank Indicator* between column (1) and (2) is statistically significant. Standard errors in parentheses are clustered at the lender level. *, **, *** indicate significance at the 10%, 5% and 1% levels, respectively.

	(1)	(2)	(3)
Variable	Securitization rate		
MBS Purchases * Shadow Bank Indicator	0.008***	-0.003**	0.005***
	(0.001)	(0.001)	(0.001)
Fisher's Permutation Test: (GSEs and Ginnie Mae = Neither GSEs nor Ginnie Mae)	0.000		
Lender Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Main Effects	Yes	Yes	Yes
Observations	42,611	42,611	42,611
R-squared	0.858	0.846	0.868

Table 5: Mortgage origination growth rate

This table displays the impact of MBS purchases on the mortgage origination growth rate of shadow banks and traditional banks using data from 2009 to 2014, respectively. Column (1) and (2) provide the estimation results based on the original shadow banking exposures. Column (3) and (4) provide the estimation results based on the orthogonalized shadow banking exposures. Column (5) and (6) provide the estimation results based on a propensity score matched sample of counties. *MBS purchases* is the natural logarithm of the lagged annual amount of MBS purchased by the Federal Reserve. *Shadow Banking Exposure* is measured as the share of mortgages given by shadow banks in the county during the prior year. The *Fisher' permutation test* provides the empirical *P-value* to test whether the difference in the coefficient of *MBS Purchases * Shadow Banking Exposure* between shadow banks and traditional banks is statistically significant. All specifications include the year fixed effects, the county fixed effects and the county-level control variables. Standard errors in parentheses are clustered by county. *, **, *** indicate significance at the 10%, 5% and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Variable	Shadow Bank	Traditional Bank	Shadow Bank	Traditional Bank	Shadow Bank	Traditional Bank
MBS Purchase * Shadow Banking Exposure	0.076***	0.041***	0.096***	0.052***	0.064**	0.035*
	(0.021)	(0.012)	(0.021)	(0.013)	(0.033)	(0.019)
Unemployment Rate	1.548***	1.996***	0.087	2.427***	-0.581	1.931***
	(0.503)	(0.208)	(0.498)	(0.211)	(0.817)	(0.410)
Per Capital Personal Income	-0.007	0.244***	0.040	0.224***	-0.136	0.498***
	(0.119)	(0.060)	(0.118)	(0.060)	(0.556)	(0.140)
Median Household Income	-0.153	0.067	-0.641***	0.178***	0.128	-0.010
	(0.105)	(0.053)	(0.104)	(0.053)	(0.218)	(0.112)
Real GDP	0.028	-0.028	0.035	-0.029	-0.028	-0.005
	(0.056)	(0.026)	(0.056)	(0.026)	(0.118)	(0.042)
Subprime Credit Score Population	-1.963***	-1.178***	-3.406***	-0.801***	-1.777**	-1.809***
	(0.443)	(0.215)	(0.447)	(0.217)	(0.823)	(0.414)
Debt to Income Ratio	-6.082***	-0.308	-7.114***	-0.151	-4.829	-2.487
	(2.016)	(1.045)	(2.014)	(1.045)	(3.652)	(2.210)
Median House Price	-0.814***	-0.456***	-0.988***	-0.439***	-0.978***	-0.777***
	(0.087)	(0.050)	(0.087)	(0.050)	(0.169)	(0.113)
Population	0.233	-0.473***	0.328	-0.397***	-0.377	-0.149
	(0.264)	(0.138)	(0.260)	(0.136)	(0.593)	(0.227)
Inflation	-0.428***	-0.426***	-0.562***	-0.379***	-0.269**	-0.309**

	(0.099)	(0.050)	(0.099)	(0.050)	(0.134)	(0.124)
Fisher's Permutation Test:						
(Shadow Bank = Traditional Bank)	0.005		0.000		0.074	
County Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Main Effects	Yes	Yes	Yes	Yes	Yes	Yes
Matched Sample	No	No	No	No	Yes	Yes
Orthogonalized Shadow Banking Exposure	No	No	Yes	Yes	No	No
Observations	13,553	13,553	13,553	13,553	6,265	6,265
R-squared	0.454	0.637	0.454	0.637	0.669	0.717

Table 6: Mortgage origination amount

This table displays the impact of MBS purchases on the mortgage origination amount of shadow banks and traditional banks using data from 2009 to 2014. Treated counties (column (1)) and untreated counties (column (2)) are defined as the counties belonging to the top and bottom quantile of the shadow-banking-exposures distribution in the prior year. Column (3) provides the estimation results based on a matched sample of untreated counties. MBS purchases are the natural logarithm of the amount of MBS purchased by the Federal Reserve. Shadow bank indicator is a dummy variable which takes the value of one if the lender is a shadow bank and a value of 0 if it is a traditional bank. The Fisher' permutation test provides the empirical *P-value* to test whether the coefficient of *MBS Purchases * Shadow Bank Indicator* is statistically different across treated counties and untreated counties. Standard errors in parentheses are clustered by lender-county, and *, **, *** indicate significance at the 10%, 5% and 1% levels, respectively.

	(1)	(2)	(3)	(4)
Variable	Treated Counties	Untreated Counties	PSM Untreated Counties	All Counties
MBS Purchases * Shadow Bank Indicator	0.012***	0.009***	0.009***	0.011***
	(0.002)	(0.002)	(0.003)	(0.001)
Securitization Rate * MBS Purchases	-0.008***	-0.004*	-0.011***	-0.007***
	(0.002)	(0.002)	(0.003)	(0.001)
Unemployment Rate * Shadow Bank Indicator	0.318	-0.702**	0.062	0.706***
	(0.253)	(0.302)	(0.344)	(0.153)
Per Capital Personal Income * Shadow Bank Indicator	-0.445***	0.112*	0.084	-0.186***
	(0.054)	(0.058)	(0.059)	(0.030)
Median Household Income * Shadow Bank Indicator	0.282***	-0.164***	-0.063	0.288***
	(0.049)	(0.063)	(0.062)	(0.029)
Real GDP * Shadow Bank Indicator	0.055***	-0.034	0.033	0.026*
	(0.021)	(0.030)	(0.029)	(0.013)
Subprime Credit Score Population * Shadow Bank Indicator	0.250**	0.223*	0.852***	0.978***
	(0.104)	(0.115)	(0.116)	(0.056)
Debt to Income Ratio * Shadow Bank Indicator	0.737	1.023	4.467***	4.443***
	(1.132)	(1.235)	(1.416)	(0.652)
Median Housing Price * Shadow Bank Indicator	0.005	-0.082***	-0.005	0.014
	(0.025)	(0.023)	(0.026)	(0.013)
Inflation * Shadow Bank Indicator	-0.070	-0.512***	-0.128	-0.228***
	(0.098)	(0.145)	(0.168)	(0.057)

Population * Shadow Bank Indicator	0.066***	0.039	0.024	0.107***
	(0.022)	(0.031)	(0.030)	(0.014)
Fisher's Permutation Test				
(Treated Counties = Untreated Counties)		0.080	0.154	
Lender Fixed Effects	Yes	Yes	Yes	Yes
County-by-year Fixed Effects	Yes	Yes	Yes	Yes
Main Effects	Yes	Yes	Yes	Yes
Matched Sample	No	No	Yes	No
Observations	534,015	283,456	204,521	1,612,913
R-squared	0.468	0.387	0.409	0.406

Table 7: Conventional mortgage origination growth rate

This table displays the impact of MBS purchases on the conventional mortgage origination growth rate of shadow banks and traditional banks using data from 2009 to 2014, respectively. Column (1) and (2) provide the estimation results based on the original shadow banking exposures. Column (3) and (4) provide the estimation results based on the orthogonalized shadow banking exposures. Column (5) and (6) provide the estimation results based on a propensity score matched sample of counties. *MBS purchases* is the natural logarithm of the lagged annual amount of MBS purchased by the Federal Reserve. *Shadow Banking Exposure* is measured as the share of mortgages given by shadow banks in the county during the prior year. The *Fisher' permutation test* provides the empirical *P-value* to test whether the difference in the coefficient of *MBS Purchases * Shadow Banking Exposure* between shadow banks and traditional banks is statistically significant. All specifications include the year fixed effects, the county fixed effects and the county-level control variables. Standard errors in parentheses are clustered by county. *, **, *** indicate significance at the 10%, 5% and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Variable	Shadow Bank	Traditional Bank	Shadow Bank	Traditional Bank	Shadow Bank	Traditional Bank
MBS purchase * Shadow Banking Exposure	0.022	0.061***	0.032	0.059***	0.092	0.074***
	(0.039)	(0.013)	(0.037)	(0.015)	(0.061)	(0.023)
Unemployment Rate	2.200***	2.129***	0.378	2.599***	2.317**	2.779***
	(0.813)	(0.246)	(0.813)	(0.250)	(1.169)	(0.554)
Per Capital Personal Income	-0.061	0.238***	0.016	0.211***	-0.455	0.679***
	(0.191)	(0.070)	(0.191)	(0.069)	(0.651)	(0.176)
Median Household Income	-0.380**	0.046	-0.956***	0.167***	-0.071	-0.031
	(0.170)	(0.060)	(0.172)	(0.061)	(0.316)	(0.135)
Real GDP	-0.012	-0.020	0.004	-0.023	-0.032	-0.101
	(0.103)	(0.030)	(0.103)	(0.030)	(0.132)	(0.066)
Subprime Credit Score Population	-1.565**	-0.956***	-3.276***	-0.565**	-0.828	-0.975*
	(0.770)	(0.247)	(0.770)	(0.248)	(1.426)	(0.514)
Debt to Income Ratio	-10.036**	-1.257	-11.393**	-1.111	-0.267	0.610
	(4.506)	(1.225)	(4.482)	(1.225)	(6.362)	(2.382)
Median House Price	-1.168***	-0.511***	-1.346***	-0.504***	-1.520***	-0.785***
	(0.148)	(0.059)	(0.148)	(0.059)	(0.259)	(0.111)
Population	1.707***	0.092	1.689***	0.211	0.471	0.667**
	(0.386)	(0.150)	(0.386)	(0.148)	(0.798)	(0.278)
Inflation	-0.649**	-0.420***	-0.807***	-0.375***	-0.413**	-0.500***

	(0.257)	(0.057)	(0.258)	(0.057)	(0.210)	(0.162)
Fisher's Permutation Test:						
(Shadow Bank = Traditional Bank)	0.026		0.107		0.180	
County Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Main Effects	Yes	Yes	Yes	Yes	Yes	Yes
Propensity Score Matching	No	No	No	No	Yes	Yes
Orthogonalized Shadow Banking Exposure	No	No	Yes	Yes	No	No
Observations	13,068	13,068	13,068	13,068	6,039	6,039
R-squared	0.323	0.596	0.323	0.596	0.657	0.685

Table 8: Conventional mortgage origination amount

This table displays the heterogenous impact of MBS purchases on the conventional mortgage origination amount between shadow banks and traditional banks using data from 2009 to 2014. Treated counties (column (1)) and untreated counties (column (2)) are defined as the counties belonging to the top and bottom quantile of the shadow-banking-exposures distribution in the prior year. Column (3) provides the estimation results based on a matched sample of untreated counties. MBS purchases are the natural logarithm of the amount of MBS purchased by the Federal Reserve. Shadow bank indicator is a dummy variable which takes the value of one if the lender is a shadow bank and a value of 0 if it is a traditional bank. The Fisher' permutation test provides the empirical *P-value* to test whether the coefficient of *MBS Purchases * Shadow Bank Indicator* is statistically different across treated counties and untreated counties. Standard errors in parentheses are clustered by lender-county, and *, **, *** indicate significance at the 10%, 5% and 1% levels, respectively.

	(1)	(2)	(3)	(4)
Variable	Treated Counties	Untreated Counties	PSM Untreated Counties	All Counties
MBS Purchases * Shadow Bank Indicator	0.017***	0.013***	0.016***	0.016***
	(0.002)	(0.003)	(0.003)	(0.001)
Securitization Rate * MBS Purchases	-0.008***	-0.003	-0.009***	-0.006***
	(0.002)	(0.003)	(0.003)	(0.001)
Unemployment Rate * Shadow Bank Indicator	0.278	-1.006***	0.168	0.773***
	(0.284)	(0.364)	(0.405)	(0.177)
Per Capital Personal Income * Shadow Bank Indicator	-0.182***	0.210***	0.144**	0.004
	(0.060)	(0.067)	(0.067)	(0.034)
Median Household Income * Shadow Bank Indicator	0.162***	-0.306***	-0.170**	0.189***
	(0.054)	(0.075)	(0.071)	(0.033)
Real GDP * Shadow Bank Indicator	0.010	-0.065*	0.025	-0.005
	(0.025)	(0.035)	(0.035)	(0.016)
Subprime Credit Score Population * Shadow Bank Indicator	-0.249**	0.251*	0.747***	0.748***
	(0.121)	(0.138)	(0.139)	(0.066)
Debt to Income Ratio * Shadow Bank Indicator	-0.636	2.302	5.765***	4.263***
	(1.295)	(1.454)	(1.688)	(0.760)
Median Housing Price * Shadow Bank Indicator	0.006	-0.035	0.053*	0.042***
	(0.029)	(0.027)	(0.031)	(0.015)
Inflation * Shadow Bank Indicator	-0.122	-0.511***	-0.101	-0.248***

	(0.116)	(0.185)	(0.204)	(0.070)
Population * Shadow Bank Indicator	0.098***	0.042	0.015	0.119***
	(0.026)	(0.037)	(0.036)	(0.016)
Fisher's Permutation Test				
(Treated Counties = Untreated Counties)		0.051	0.360	
Lender Fixed Effects	Yes	Yes	Yes	Yes
County-by-year Fixed Effects	Yes	Yes	Yes	Yes
Main Effects	Yes	Yes	Yes	Yes
Matched Sample	No	No	Yes	No
Observations	446,290	228,045	166,585	1,322,825
R-squared	0.456	0.370	0.396	0.385

Table 9: FHA-insured mortgage origination growth rate

This table displays the impact of MBS purchases on the FHA-insured mortgage origination growth rate of shadow banks and traditional banks using data from 2009 to 2014, respectively. Column (1) and (2) provide the estimation results based on the original shadow banking exposures. Column (3) and (4) provide the estimation results based on the orthogonalized shadow banking exposures. Column (5) and (6) provide the estimation results based on a propensity score matched sample of counties. *MBS purchases* is the natural logarithm of the lagged annual amount of MBS purchased by the Federal Reserve. *Shadow Banking Exposure* is measured as the share of mortgages given by shadow banks in the county during the prior year. The *Fisher' permutation test* provides the empirical *P-value* to test whether the difference in the coefficient of *MBS Purchases* * *Shadow Banking Exposure* between shadow banks and traditional banks is statistically significant. All specifications include the year fixed effects, the county fixed effects and the county-level control variables. Standard errors in parentheses are clustered by county. *, **, *** indicate significance at the 10%, 5% and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Variable	Shadow Bank	Traditional Bank	Shadow Bank	Traditional Bank	Shadow Bank	Traditional Bank
MBS purchase * Shadow Banking Exposure	0.112***	0.049**	0.205***	0.160***	0.237***	0.120**
	(0.031)	(0.021)	(0.036)	(0.029)	(0.063)	(0.056)
Unemployment Rate	0.026	0.855*	-2.635***	0.805*	-0.637	1.737*
	(0.686)	(0.454)	(0.755)	(0.484)	(1.110)	(1.040)
Per Capital Personal Income	0.595**	0.051	0.676**	0.036	0.255	-0.294
	(0.282)	(0.136)	(0.277)	(0.136)	(0.509)	(0.365)
Median Household Income	-0.095	0.140	-0.756***	0.071	-0.631*	0.116
	(0.149)	(0.114)	(0.151)	(0.115)	(0.338)	(0.277)
Real GDP	-0.066	-0.039	0.047	-0.023	-0.043	-0.012
	(0.087)	(0.074)	(0.086)	(0.070)	(0.163)	(0.118)
Subprime Credit Score Population	-4.525***	-1.812**	-6.116***	-1.757**	-4.309***	-1.745
	(0.973)	(0.722)	(0.963)	(0.720)	(1.607)	(1.494)
Debt to Income Ratio	-3.717	4.276	-3.086	4.402	23.948*	20.261**
	(4.458)	(3.197)	(4.370)	(3.098)	(13.053)	(9.132)
Median House Price	-0.832***	-0.447***	-1.067***	-0.482***	-0.864***	-0.504***
	(0.144)	(0.091)	(0.142)	(0.090)	(0.223)	(0.175)
Population	0.018	-1.443***	0.056	-1.341***	0.739	-1.090**
	(0.465)	(0.342)	(0.442)	(0.321)	(0.751)	(0.504)
Inflation	-0.173	-0.070	-0.387**	0.016	0.030	0.093

	(0.188)	(0.129)	(0.187)	(0.129)	(0.342)	(0.207)
Fisher's Permutation Test:						
(Shadow Bank = Traditional Bank)	0.001		0.035		0.000	
County Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Main Effects	Yes	Yes	Yes	Yes	Yes	Yes
Propensity Score Matching	No	No	No	No	Yes	Yes
Orthogonalized Shadow Banking Exposure	No	No	Yes	Yes	No	No
Observations	6,248	6,248	6,248	6,248	2,921	2,921
R-squared	0.539	0.637	0.543	0.642	0.705	0.720

Table 10: FHA-insured mortgage origination amount

This table displays the heterogenous impact of MBS purchases on the FHA-insured mortgage origination amount between shadow banks and traditional banks using data from 2009 to 2014. Treated counties (column (1)) and untreated counties (column (2)) are defined as the counties belonging to the top and bottom quantile of the shadow-banking-exposures distribution in the prior year. Column (3) provides the estimation results based on a matched sample of untreated counties. MBS purchases are the natural logarithm of the amount of MBS purchased by the Federal Reserve. Shadow bank indicator is a dummy variable which takes the value of one if the lender is a shadow bank and a value of 0 if it is a traditional bank. The Fisher' permutation test provides the empirical *P-value* to test whether the coefficient of *MBS Purchases * Shadow Bank Indicator* is statistically different across treated counties and untreated counties. Standard errors in parentheses are clustered by lender-county, and *, **, *** indicate significance at the 10%, 5% and 1% levels, respectively.

	(1)	(2)	(3)	(4)
Variable	Treated Counties	Untreated Counties	PSM Untreated Counties	All Counties
MBS Purchases * Shadow Bank Indicator	0.011***	-0.002	0.001	0.008***
	(0.002)	(0.003)	(0.004)	(0.001)
Securitization Rate * MBS Purchases	0.012***	0.025***	0.020***	0.015***
	(0.004)	(0.005)	(0.007)	(0.002)
Unemployment Rate * Shadow Bank Indicator	-0.259	0.748*	0.279	0.669***
	(0.356)	(0.413)	(0.450)	(0.209)
Per Capital Personal Income * Shadow Bank Indicator	-0.168**	0.300***	0.221***	-0.020
	(0.071)	(0.080)	(0.080)	(0.040)
Median Household Income * Shadow Bank Indicator	-0.102	-0.359***	-0.387***	-0.093**
	(0.063)	(0.084)	(0.082)	(0.038)
Real GDP * Shadow Bank Indicator	-0.071**	-0.087**	-0.107***	-0.061***
	(0.028)	(0.039)	(0.040)	(0.017)
Subprime Credit Score Population * Shadow Bank Indicator	0.024	-0.196	0.266*	0.403***
	(0.134)	(0.156)	(0.157)	(0.072)
Debt to Income Ratio * Shadow Bank Indicator	-7.109***	-1.799	-3.625**	-1.444*
	(1.493)	(1.654)	(1.847)	(0.833)
Median Housing Price * Shadow Bank Indicator	0.109***	0.044	0.205***	0.130***
	(0.032)	(0.031)	(0.037)	(0.017)
Inflation * Shadow Bank Indicator	0.156	-0.397*	-0.034	-0.118

	(0.145)	(0.207)	(0.227)	(0.084)
Population * Shadow Bank Indicator	0.073**	-0.063	-0.006	0.047***
	(0.029)	(0.041)	(0.041)	(0.018)
Fisher's Permutation Test				
(Treated Counties = Untreated Counties)		0.000	0.005	
Lender Fixed Effects	Yes	Yes	Yes	Yes
County-by-year Fixed Effects	Yes	Yes	Yes	Yes
Main Effects	Yes	Yes	Yes	Yes
Matched Sample	No	No	Yes	No
Observations	209,748	86,733	69,527	580,621
R-squared	0.480	0.478	0.490	0.478

Table 11: Mortgage rates

This table displays the impact of lender types on mortgage rates provided by shadow banks and traditional banks. Column (1) and column (2) provide the results in treated counties and untreated counties, respectively. Treated counties are defined as counties belonging to the top and bottom quantile of the shadow-banking-exposures distribution in the prior year while untreated counties are from the bottom quantile of the distribution. Column (3) provides the estimation results based on a matched sample of untreated counties and column (4) is based on the data in all counties. The dependent variable is the percentage points of mortgage rates. MBS purchases are the natural logarithm of the amount of MBS purchased by the Federal Reserve. Shadow bank indicator is a dummy variable which takes the value of one if the lender is a shadow bank and a value of 0 if the lender is a traditional bank. The Fisher' permutation test provides the empirical *P-value* to test whether the coefficient of *MBS Purchases * Shadow Bank Indicator* is statistically different across treated counties and untreated counties. Standard errors in parentheses are clustered by lender-county, and *, **, *** indicate significance at the 10%, 5% and 1% levels, respectively.

	(1)	(2)	(3)	(4)
Variable	Treated Counties	Untreated Counties	PSM Untreated Counties	All Counties
MBS Purchases * Shadow Bank Indicator	0.018***	0.020	-0.009	0.010
	(0.005)	(0.016)	(0.023)	(0.006)
Unemployment Rate * Shadow Bank Indicator	-0.077	3.091*	3.297	1.270
	(1.024)	(1.685)	(4.750)	(1.098)
Median Household Income * Shadow Bank Indicator	-0.015	-0.721	0.694	0.254
	(0.170)	(0.495)	(0.791)	(0.195)
Fisher's Permutation Test				
(Treated Counties = Untreated Counties)		0.244	0.004	
Lender Fixed Effects	Yes	Yes	Yes	Yes
County-by-year Fixed Effects	Yes	Yes	Yes	Yes
Main Effects	Yes	Yes	Yes	Yes
Matched Sample	No	No	Yes	No
Observations	1,152	1,261	991	5,899
R-squared	0.888	0.929	0.889	0.892