

Wix, Carlo; Schüwer, Ulrich

Conference Paper

Monetary Policy and Bank Lending: A Natural Experiment from the US Mortgage Market

Beiträge zur Jahrestagung des Vereins für Socialpolitik 2016: Demographischer Wandel - Session: Forward Guidance and Effectiveness of Monetary Policy, No. A16-V3

Provided in Cooperation with:

Verein für Socialpolitik / German Economic Association

Suggested Citation: Wix, Carlo; Schüwer, Ulrich (2016) : Monetary Policy and Bank Lending: A Natural Experiment from the US Mortgage Market, Beiträge zur Jahrestagung des Vereins für Socialpolitik 2016: Demographischer Wandel - Session: Forward Guidance and Effectiveness of Monetary Policy, No. A16-V3, ZBW - Deutsche Zentralbibliothek für Wirtschaftswissenschaften, Leibniz-Informationszentrum Wirtschaft, Kiel und Hamburg

This Version is available at:

<https://hdl.handle.net/10419/145943>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

Monetary Policy and Bank Lending: A Natural Experiment from the US Mortgage Market

Preliminary draft February 2016

Abstract

This paper explores how credit demand affects the pass-through of monetary policy to bank lending. We employ a novel identification strategy based on exploiting exogenous cross-sectional variation in local mortgage credit demand across U.S. counties following the occurrence of large natural disasters. First, we show that large natural disasters cause increased local credit demand in the short-term and reduced local credit demand in the medium-term, which we interpret as intertemporal substitution. We then test whether the effect of monetary policy on bank lending is different for unaffected counties and counties subject to an exogenously reduced credit demand following a natural disaster. We find that credit growth associated with a one percentage point decrease in the federal funds rate is 9 percentage points higher in counties with reduced credit demand relative to unaffected counties. Hence, our results suggest that monetary policy is more effective when credit demand is low.

JEL Codes: E52, G21, Q54

1 Introduction

Since the beginning of the Great Recession, central banks in both the United States and Europe have conducted an unprecedented expansionary monetary policy. However, despite the lowering of interest rates to near zero and several rounds of quantitative easing, monetary policy has been less successful in stimulating credit expansion and economic activity than anticipated by policy makers (e.g., Taylor, 2014; Goodhart, 2015). This has sparked a debate about the perceived ineffectiveness of monetary policy. The absent expansion in bank lending could be due to restricted credit supply, i.e. banks not willing to lend (e.g., Agarwal et al., 2015; Gropp et al., 2014), or reduced credit demand, i.e. households not wanting to borrow (e.g., Hall, 2011; Mian and Sufi, 2012, 2014). Understanding the pass-through of monetary policy to bank lending is an important question for the appropriate design of monetary policy measures.

In this paper, we explore how credit demand affects the pass-through of monetary policy to bank lending in the U.S. mortgage market. Empirically identifying this effect is challenging due to well-known endogeneity problems. For instance, reductions in the federal funds rate generally occur during recessions and thus as an endogenous policy response to reduced economic activity and bank lending. Thus, drawing conclusions about the link between monetary policy, bank lending and credit demand is difficult based on aggregate time-series data alone.

In our paper, we employ a novel identification strategy to circumvent these endogeneity problems. We exploit the occurrence of large natural disasters as an exogenous shock to local mortgage demand across U.S. counties. In the year immediately after a large natural disaster mortgage credit demand growth increases above normal levels and conversely, three years later, falls significantly below normal levels. This empirical pattern can be interpreted as an intertemporal substitution effect as households bring forward their housing investments after a large natural disaster to fix the property damages caused by the

disaster. We use this exogenous cross-sectional variation across the U.S. to identify the role of credit demand for the pass-through of monetary policy to bank lending.

We find that monetary policy is more effective in stimulating bank lending when credit demand is low. A one percentage point reduction in the federal funds rate is associated with an 8 percent increase in mortgage lending in counties without exogenously altered credit demand, but with a 17 percent increase in counties subject to an exogenous negative credit demand shock. These results are robust to a number of alternative specifications and placebo tests.

We construct a unique dataset at the county-year level combining data from various sources. For lending, we use data on individual mortgage loan applications from the Home Mortgage Disclosure Act (HMDA) dataset, which we aggregate at the county level. We merge this data with county-level data on property damages from natural disasters such as hurricanes and floods, using the Spatial Hazard and Loss Database for the United States (SHELDUS). Our measure for monetary policy is the annual average effective federal funds rate, as provided by the Federal Reserve Bank of St. Louis. We augment the dataset with county-level macroeconomic variables provided the U.S. Bureau of Economic Analysis (BEA), and U.S. macroeconomic variables provided by the World Bank.

Our paper mainly contributes to the empirical literature on monetary policy transmission. There is a vast literature on the bank lending channel of monetary policy transmission, starting with early papers by Bernanke and Blinder (1992) and Bernanke and Gertler (1995). This strand of literature finds that the effect of monetary policy on bank lending is stronger for banks with less liquid balance sheets (Kashyap and Stein, 2000), in state banking markets where financially constrained banks have more market share (Ashcraft, 2006), and for banks with low capital or liquidity (Jiménez, Ongena, Peydró, and Saurina, 2012). While all these papers address how monetary policy transmission depends on banks' credit supply, there is little empirical evidence on how the pass-through of monetary policy to bank lending is affected by households' credit demand. Our paper sheds light on the

role of credit demand in monetary policy pass-through.

Further, our paper adds to a number of recent studies investigating the effect of natural disasters on financial intermediation. Cortés (2014) shows that access to local finance improves growth and employment after the occurrence of natural disasters. Cortés and Strahan (2015) show that banks operating in multiple regional markets allocate credit supply from unaffected to affected areas to meet increased local demand after natural disasters. Most recently, Lambert, Noth, and Schüwer (2015) show that independent banks affected by Hurricane Katrina increased their risk-based capital ratios to mitigate bankruptcy as they do not have access to internal capital markets of a parent bank holding company.

The paper proceeds as follows. Section 2 describes the data used in this study and provides descriptive statistics. Section 3 presents the empirical strategy and the estimation results. Section 4 concludes.

2 Data and Descriptive Statistics

In this section, we describe our dataset and provide descriptive statistics. We combine data from several sources to construct a novel panel dataset at the county-year level that contains information on mortgage lending, property damages from natural disasters, and U.S. county- and country-level macroeconomic information.

Our main sample covers the period 2000 to 2007. We start the sample period in 2000 because the data on bank lending from the Home Mortgage Disclosure Act, which is in principle available since 1994, is less consistent during the 1990s (see, e.g., Bhutta and Canner, 2013). Further, we end the sample period in 2007 to exclude the financial crisis.

2.1 Data

Bank lending. For lending, we use individual loan application data collected under the Home Mortgage Disclosure Act (HMDA). The HMDA of 1975 requires mortgage lenders with home or branch offices in metropolitan statistical areas (MSAs) to publicly disclose their lending activities each year. Whether a depository institution or non-depository institution is covered by the HMDA depends on its size, the extent of its business in an MSA, and whether it is in the business of residential mortgage lending (FFIEC, 2007). HMDA data is available at the loan application level and contains inter alia information on the loan amount, type, purpose, and occupancy of each application. Moreover, the dataset reports the action taken by the bank with regard to each loan application.¹ An important advantage of the HMDA database is its extensive coverage of about 75 - 90 percent of all conventional home mortgage loans in the US (Bhutta and Canner, 2013; Dell’Ariccia et al., 2012). Moreover, mortgage debt makes up around 80% of total debt for US households (Mian and Sufi, 2010) and mortgage credit demand is considered a good proxy for households’ total credit demand. We restrict our analysis to conventional loans for the purpose of home purchase or home improvement. This excludes FHA-insured, VA-guaranteed, and FSA/RHS-guaranteed loans which only make up a minority of all loans, and furthermore excludes loans for the purpose of refinancing and multi-family dwellings both of which constitute different types of loan markets.

We focus on loan applications which were either denied by the lending institution or approved and subsequently resulted in a mortgage origination. Thus, our analysis differentiates between the volume of loan originations as a measure of equilibrium bank lending, and the volume of loan applications (both approved and denied), which we use, following Dell’Ariccia, Igan, and Laeven (2012) as a proxy measure of credit demand. We then aggregate the data at the county-year level and, in accordance with the HMDA reporting

¹See Appendix A.1 for details regarding the HMDA reporting criteria and Table I for information contained in the HMDA dataset.

criteria, only consider counties which are part of an MSA.

Monetary policy. Our main measure for monetary policy is the change in the annual average effective federal funds rate, as provided by the Federal Reserve Bank of St. Louis. This measure of monetary policy has been advocated in the literature by Bernanke and Mihov (1998), Kashyap and Stein (2000) and Ashcraft (2006) amongst others. We define the measure ΔM as the inverted change, as common in the literature (e.g., Kashyap and Stein, 2000). Hence, a higher value reflects a more expansionary monetary policy stance.

Natural disasters. For natural disasters, we use data from the University of South Carolina’s Spatial Hazard and Loss Database for the United States (SHELDUS). The database contains county-month-level data on property damages (in US dollar), crop losses, injuries, and fatalities for every loss causing hazard event since 1960 for 18 different types of natural disasters, such as thunderstorms, hurricanes, floods, wildfires, and tornados. We aggregate the data over all disaster types at the county-year level and obtain a dataset containing the total dollar volume of property damages for each year in each county.

Between 2000 and 2007 SHELDUS contains data on 64,257 natural disasters in the US, most of which are way too small to have any effect on mortgage lending. In this paper, we thus focus on the occurrence of only the largest natural disasters. We construct the indicator variable $DIS_{c,t}$ that takes on the value 1 if a large natural disaster occurred in county c in year t , and 0 otherwise. We define a natural disaster to be large if the property damage caused by natural disasters in a county in a given year scaled by the county’s personal income is in the upper 99 percent quantile over the whole sample, i.e.

$$DIS_{c,t} = \begin{cases} 1 & \text{if } \text{disaster damage}_{c,t} \geq Q_{99}(\text{disaster damage}_{c,t}) \\ 0 & \text{otherwise} \end{cases}$$

where

$$\text{disaster damage}_{c,t} = \frac{\text{US\$ property damage per year and county}}{\text{US\$ total personal income per year and county}}.$$

This leaves us with 93 large natural disasters over the sample period from 2000 to 2007.

County-level and U.S. macro data. We augment our dataset with county-level data on population and personal income provided by the U.S. Bureau of Economic Analysis (BEA)², and with national data on GDP growth, inflation and unemployment provided by the World Bank.³

Following the sample construction described in Subsection 2.1, we obtain a sample containing 1,129 counties from 2000-2007.

2.2 Descriptive Statistics

Table II gives an overview by year of the relevant variables in our dataset. Both the mean volume of mortgage applications and mortgage originations over all counties increased up until 2005, the peak of the housing boom in the US. Over our sample period, the annual average federal funds rate first dropped from 6.9 percent to 1.1 percent in 2003, and then again increased up to 5.0 percent in 2007. Thus, our sample period covers both expansionary and contractionary cycles of monetary policy. Figure illustrates this development.

[Figure 1 about here]

²Source: <http://www.bea.gov/regional/downloadzip.cfm>

³Source: <http://data.worldbank.org>

3 Empirical Strategy and Results

3.1 The Effect of Natural Disasters on Credit Demand

In this section, we establish the effect of large natural disasters on credit demand. Similar to Cortés and Strahan (2015), we regress the log change in loan applications on county and year fixed effects, plus a series of event-time indicator variables defined around large natural disasters:

$$\Delta \log LA_{c,t} = \gamma_c + \gamma_t + \sum_{k=-2}^6 \beta^k DIS_{c,t}^k + \epsilon_{c,t}. \quad (1)$$

The dependent variable $\Delta \log LA_{c,t}$ represent credit demand growth on a yearly basis, where $LA_{c,t}$ is the total dollar volume of all loan applications in county c in year t . The event-time indicators $DIS_{c,t}^k$ run from $k=-2$ (2 years prior to the disaster) to $k=+6$ (6 years after the disaster), where $k=0$ represents the year in which the disaster occurred. We include county fixed effects γ_c and year fixed effects γ_t , such that the coefficients β^k capture abnormal mortgage credit demand growth relative to a county's long run average (absorbed by γ_c) and relative to the time trend across all counties (absorbed by γ_t).

[Figure 2 about here]

Figure 2 shows the estimated β -coefficients from Equation (1) along with the lower and upper bound of the 95% confidence interval. There is no abnormally high or low mortgage credit demand growth in the two years prior to a large disaster, which is consistent with the notion of the disasters being unexpected and exogenous. One year after a large natural disaster, the data shows an increase in mortgage demand growth of about 6 percentage points above normal levels (significant at the 5 percent level). Credit demand increases after natural disasters as households have to repair their or buy entirely new houses due to the destruction caused by large natural disasters. Conversely, three years after a large

natural disaster mortgage credit demand growth decreases about 14 percentage points below normal levels. This pattern indicates an intertemporal shift in the mortgage credit demand of households induced by the occurrence of large natural disasters.

3.2 Monetary Policy Transmission in Times of Low Credit Demand

In this section, we examine how exogenously reduced credit demand three years after a large natural disaster affects the monetary policy transmission mechanism. We follow the methodology of Ashcraft (2006) and Jimenéz et al. (2012) and identify the differential response of bank lending to changes in the federal funds rate based on interactions of monetary policy with our natural disaster dummy, which is a proxy measure for an exogenous credit demand shock. We therefor run the following baseline regression:

$$\Delta \log LO_{c,t} = \alpha + \beta \Delta M_t + \gamma DIS_{c,t-3} + \delta (DIS_{c,t-3} \times \Delta M_t) + \sum_k \theta^k X_t^k + \gamma_c + \epsilon_{c,t}. \quad (2)$$

The dependent variable $\Delta \log LO_{c,t}$ represent credit (origination) growth on a yearly basis, where $LO_{c,t}$ is the total dollar volume of mortgage originations in county c in year t . The variable $DIS_{c,t-3}$ is the same indicator variable as in Equation (1), taking on the value 1 if a large natural disaster has occurred in county c three years prior, and 0 otherwise. Based on our findings in Subsection (3.2), we use $DIS_{c,t-3}$ as a proxy for an exogenous shock to credit demand in county c in year t . Our measure for monetary policy ΔM_t is the change in the inverted annual average effective federal funds rate from year $t - 1$ to year t . In our baseline regression, we also include a set of control variables to account for macroeconomic conditions which might affect both bank lending and monetary policy, namely GDP growth, inflation, and unemployment. This specification has the advantage that we are able to estimate the main effect of monetary policy. As a robustness check, we include year fixed effects which absorb all variables at the country level. We furthermore

include county fixed effects and cluster standard errors at the county level. Our coefficient of main interest, δ , estimates the differential effect of a change in monetary policy on mortgage origination growth between counties which have and have not been subject to an exogenous credit demand shock, as measured by the third year lag of a large natural disaster indicator.

[Table III about here]

Column (1) of Table (III) shows the results for our baseline regression model in Equation (2). The coefficient β captures the main effect of monetary policy. As expected, β is positive and significant, indicating that a reduction in the federal funds rate increases mortgage lending activity (remember that we invert the sign of the federal funds rate such that a higher value reflects a more expansionary monetary policy stance). The coefficient γ captures the effect of exogenously reduced credit demand growth due to the intertemporal substitution effect described in Subsection 3.2 and is, as expected, negative. The coefficient of interest, δ , is positive and significant and can be interpreted in two ways, depending on the order in which one takes the derivatives. First, looking at the derivative $\partial \Delta \log LO_{c,t} / \partial \Delta M_t$, a positive value of δ indicates that expansionary monetary policy is more effective in stimulating mortgage lending when credit demand is low. In our sample, a one percentage point reduction in the federal funds rate is associated with a 8 percent increase in mortgage activity during normal times, but associated with a 17 percent increase in counties which are subject to a negative credit demand shock. Second, looking at the derivative $\partial \Delta \log LO_{c,t} / \partial DIS_{c,t-3}$, a positive value of δ indicates that monetary policy is effective in mitigating the consequences of a negative credit demand shock. While mortgage activity in our sample contracts by 22 percent three years after a large natural disaster without monetary policy intervention, a one percentage point reduction in the federal funds rate would reduce this contraction to 12 percent, and a 2 percentage point reduction in the federal funds rate would completely revoke the negative effect of a large natural disaster on mortgage activity.

This latter interpretation of the coefficient δ is of particular relevance with regard to recent debate on the perceived ineffectiveness of monetary policy. Some commentators have interpreted the absent increase in bank lending since the financial crisis as proof that monetary policy has been “comparatively ineffective and toothless” (Goodhart, 2015). The problem with drawing conclusions based on aggregate time series data is the lack of a counterfactual how bank lending would have evolved in the absence of an expansionary monetary policy. Our novel identification strategy based on exploiting exogenous regional variation in credit demand allows us to overcome this limitation and investigate how bank lending would have evolved with and without expansionary monetary policy. Interpreting our findings in the light of the recent debate, we conclude that monetary policy has not necessarily been as ineffective as perceived by many policy makers. We argue that without the current expansionary monetary policy, the drop in lending activity would have been even steeper than what has been observed.

Column (2) of Table III provides a robustness check where we include year fixed effects which absorb all variables varying at the national level. While this specification does not allow us to estimate the main effect of monetary policy, the coefficients of the disaster dummy, $D_{c,t-3}$, as well as the coefficient of the interaction term, $D_{c,t-3}M_t$, is very similar to our baseline specification, confirming the validity of our results.

3.3 Robustness

3.3.1 Placebo Tests

Our identification of the differential response of bank lending to monetary policy hinges on the intertemporal substitution of credit demand established in Subsection 3.2. We find that mortgage demand growth first increases in the year following a large natural

disaster and then falls below normal levels three years later. Is there really anything special about monetary policy transmission in year 3 after a large natural disaster? To answer this question, we conduct a placebo test in which we replace the indicator variable $DIS_{c,t-3}$ in Equation (2) with $DIS_{c,t-2}$ and $DIS_{c,t-4}$ respectively. If the intertemporal substitution pattern shown in Figure ?? really matters, then we would expect to see no significant values for the coefficients γ and δ in the placebo regressions. Table IV shows the estimation results for this placebo test. The coefficient β , measuring the main effect of monetary policy, is again positive and significant and of equal magnitude as in our baseline specification. On the other hand, the coefficient of interest δ is insignificant in both placebo specifications, indicating no differential effect of monetary policy on bank lending in the year 2 and the year 4 after a large natural disaster. The coefficient β is insignificant in year 4, and significant, but of way lower magnitude in year 2. This confirms the validity of the intertemporal substitution pattern established in Subsection 3.2 and thus the validity of our identification strategy.

4 Conclusions

In this paper, we investigate how the pass-through of monetary policy to bank lending is affected by households' credit demand. We propose a novel identification strategy based on exploiting exogenous cross-sectional variation in local mortgage credit demand conditions due to the occurrence of large natural disasters. Large natural disasters induce an intertemporal substitution pattern with regard to mortgage credit demand as households bring forward their housing investments to fix the damages caused by disasters. We find that a one percentage point reduction in the federal funds rate is associated with an 8 percent increase in mortgage lending in counties without exogenously altered credit demand, but with a 17 percent increase in counties subject to an exogenous negative credit demand shock. Thus, our findings suggest that monetary policy is more effective in stimulating bank lending when credit demand is low.

Our results can also be interpreted in the light of the recent debate on the perceived ineffectiveness of monetary policy during the Great Recession. The assertion that monetary policy has failed to stimulate credit growth suffers from a lack of knowledge about the counterfactual evolution of bank lending if monetary policy had been less expansionary. Our identification strategy allows us to compare credit growth in times of exogenously reduced credit demand with and without monetary stimulus. Our results that monetary policy is effective in cushioning the negative effects of reduced credit demand on bank lending suggest the interpretation that credit activity during the financial crisis would have contracted significantly stronger if monetary policy had been less expansionary.

References

- Agarwal, Sumit, Souphala Chomsisengphet, Neale Mahoney, and Johannes Stroebe, 2015, Do banks pass through credit expansions? The marginal profitability of consumer lending during the great recession, *Mimeo* 1, 1–50.
- Ashcraft, Adam B., 2006, New evidence on the lending channel, *Journal of Money, Credit, and Banking* 38, 751–775.
- Bernanke, Ben S., and Alan S. Blinder, 1992, The federal funds rate and the channels of monetary transmission, *The* 82, 901–921.
- Bernanke, Ben S., and Mark Gertler, 1995, Inside the black box: The credit channel of monetary policy transmission, *Journal of Economic Perspectives* 9, 27–48.
- Bernanke, Ben S., and Ilian Mihov, 1998, Measuring monetary policy, *Quarterly Journal of Economics* 113, 869–902.
- Bhutta, Neil, and Glenn B. Canner, 2013, Mortgage market conditions and borrower outcomes: Evidence from the 2012 HMDA data and matched HMDA-credit record data, *Federal Reserve Bulletin* 99, 1–58.
- Cortés, K. R., and Philip E. Strahan, 2015, Tracing out capital flows: How financially integrated banks respond to natural disasters, *Federal Res* 12, 1–25.
- Cortés, Kristle R., 2014, Rebuilding after disaster strikes: How local lenders aid in the recovery, *Federal Reserve Bank of Cleveland Working Paper* 28, 1–31.
- Dell’Ariccia, Giovanni, Deniz Igan, and Luc Laeven, 2012, Credit booms and lending standards: Evidence from the subprime mortgage market, *Journal of Money, Credit and Banking* 44, 367–384.
- FFIEC, 2007, A guide to HMDA reporting - getting it right!, *Federal Financial Institutions Examination Council* 1–29, <https://www.ffiec.gov/hmda/guide.htm>.

- Goodhart, Charles, 2015, Why monetary policy has been comparatively ineffective?, *The Manchester School* 83, 20–29.
- Gropp, Reint, John Krainer, and Elizabeth Laderman, 2014, Did consumers want less debt? Consumer credit demand versus supply in the wake of the 2008-2009 financial crisis, *SAFE Working Paper Series* 42, 1–44.
- Hall, Robert E., 2011, The long slump, *American Economic Review*, 101, 431–469.
- Jiménez, Gabriel, Steven Ongena, Jose-Luis Peydró, and Jesus Saurina, 2012, Credit supply and monetary policy: Identifying the bank balance-sheet channel with loan applications, *American Economic Review* 102, 2301–2326.
- Kashyap, A. K., and Jeremy C. Stein, 2000, What do a million observations on banks say about the transmission of monetary policy?, *American Economic Review* 90, 407–428.
- Lambert, Claudia, Felix Noth, and Ulrich Schüwer, 2015, How do banks react to catastrophic events? Evidence from Hurricane Katrina, *SAFE Working Paper Series* 94, 1–47.
- Mian, Atif, and Amir Sufi, 2014, *House of debt: How they (and you) caused the Great Recession, and how we can prevent it from happening again* (University of Chicago Press).
- Mian, Atif R., and Amir Sufi, 2010, Household leverage and the recession of 2007 to 2009, *NBER Working Paper* 1586, 1–31.
- Mian, Atif R., and Amir Sufi, 2012, What explains high unemployment - the aggregate demand channel, *NBER Working Paper* 17830, 1–35.
- Taylor, John B., 2014, The role of policy in the great recession and the weak recovery, *The American Economic Review* 104, 61–66.

A Background information

A.1 HMDA Reporting Criteria

The Home Mortgage Disclosure Act (HMDA) of 1975 requires most financial institutions in the US to publicly disclose their mortgage lending activities at the individual loan application level to their regulators. Whether a depository institution or non-depository institution is covered depends on its size, the extent of its business in an MSA, and whether it is in the business of residential mortgage lending (FFIEC, 2007).

Reporting criteria for depository institutions (as of 2007):

- a. The institution is a bank, credit union, or savings association.
- b. On the preceding December 31, the total assets of the institution exceed the coverage threshold.⁴
- c. On the preceding December 31, the institution had a home or branch office in an MSA.
- d. In the preceding calendar year, the institution originated at least one home purchase loan or refinancing of a home purchase loan secured by a first lien on a one-to-four-family dwelling.
- e. The institution is federally insured or regulated; the mortgage loan was insured, guaranteed, or supplemented by a federal agency; or the loan was intended for sale to Fannie Mae or Freddie Mac.

Reporting criteria for non-depository institutions (as of 2007):

- a. The lender is a for-profit institution (other than a bank, savings association, or credit union).
- b. In the preceding calendar year, the institution's home purchase loan originations (including refinancings of home purchase loans) did equal or exceed 10 percent of its total loan originations, measured in dollars, or equal \$25 million or more.
- c. The institution either: (1) had a home or branch office in an MSA on the preceding December 31, or (2) received applications for, originated, or purchased five or more home purchase loans, home improvement loans, or refinancings on property located in an MSA in the preceding calendar year.
- d. The institution either: (1) had assets (when combined with the assets of any parent corporation) exceeding the coverage threshold on the preceding December 31, or (2) originated 100 or more home purchase loans (including refinancings of home purchase loans) in the preceding calendar year.

⁴This asset coverage threshold may change from year to year. For depository institutions it amounted to \$30 million in 2000 and to \$37 million in 2007. For non-depository institutions the threshold remained at \$10 million between 2000 and 2007.

B Figures

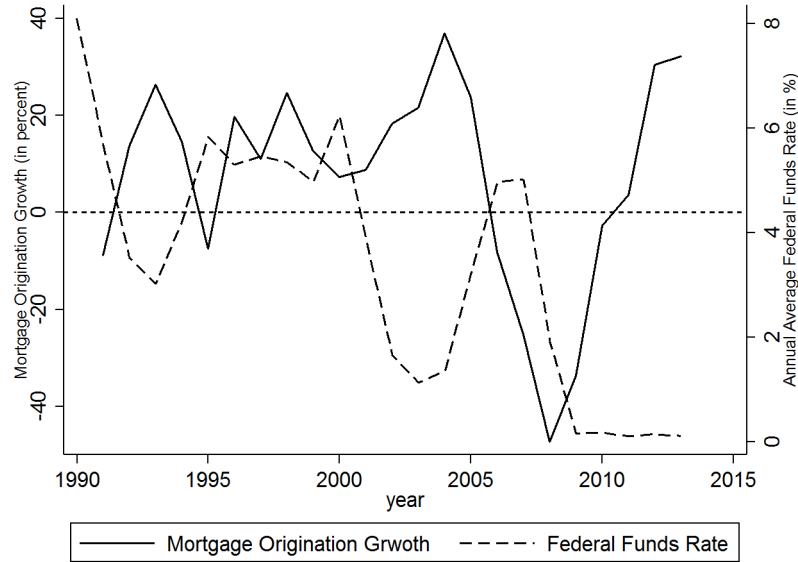


Figure 1: Mortgage Originations Growth and Monetary Policy. Figure 1 is based on a sample of 1,129 counties which are part of metropolitan statistical areas (MSAs). The figure shows the evolution of growth in the total national volume of mortgage originations versus the annual average federal funds rate as a measure of monetary policy.

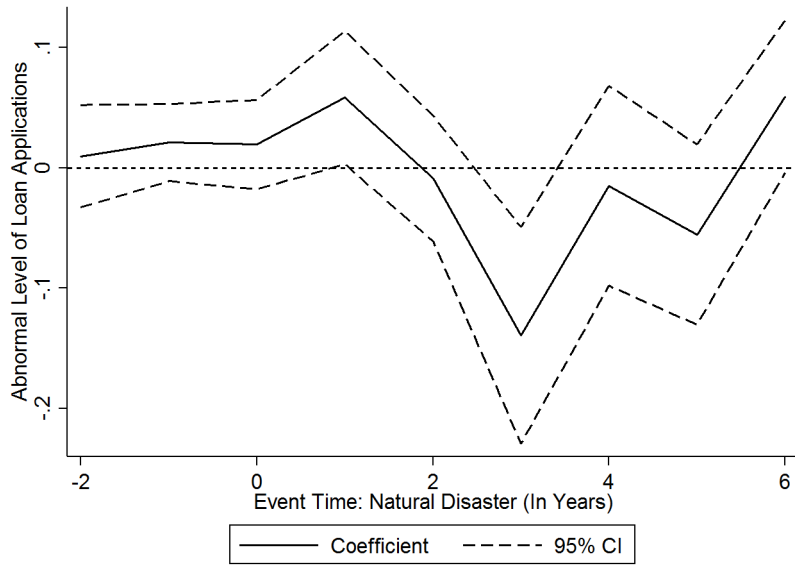


Figure 2: Abnormal Credit Demand Growth around Large Natural Disasters.

Figure 2 reports the estimated β -coefficients from Equation (1) along with the lower and upper bound of the 95% confidence interval. These coefficients are estimators for abnormal mortgage credit demand growth around large natural disasters relative to a county's long run average (absorbed by county fixed effects γ_c) and relative to the time trend across all counties (absorbed by time fixed effects γ_t)

C Tables

Table I
HMDA Dataset Variables

HMDA data is available at the loan application level and contains inter alia information on the loan amount, type, occupancy, and purpose of each application. Moreover, the dataset reports the action taken by the bank with regard to each loan application. Table I gives an overview of the variables contained in the HMDA dataset relevant for our analysis.

Variable	Specification
<i>Loan characteristics</i>	
Loan Amount	Numerical (dollar amount)
Loan Type	1) Conventional, 2) Federal Housing Administration-insured, 3) Veterans Administration-guaranteed, 4) FSA/RHS-guaranteed, 5) (Farm Service Agency or Rural Housing Service)
Purpose of Loan	1) Home purchase, 2) Home improvement, 3) Refinancing
Owner-Occupancy	1) Owner-occupied as a principal dwelling, 2) Not owner-occupied, 3) Not applicable
Action Taken	1) Loan originated, 2) Application approved but not accepted, 3) Application denied by financial institution, 4) Application withdrawn by applicant, 5) File closed for incompleteness, 6) Loan purchased by your institution, 7) Preapproval request denied by financial institution, 8) Preapproval request approved but not accepted
<i>Geographical variables</i>	
State	Two-Digit State Code
MSA	Four-Digit MSA Number
County	Three-Digit County Code
Census Tract	Six-Digit Census Tract

Table II
Descriptive Statistics

Table II shows for each year in our sample the number of counties, the mean volume of mortgage applications over all counties, the mean volume of mortgage originations over all counties, the annual average federal funds rate, and the number of large natural disasters

Year	Number of Counties	Mortgage Applications (in \$mn.)	Mortgage Originations (in \$mn.)	Federal Funds Rate (in%)	Number of Large Disasters
2000	1,129	532.2	437.7	6.2	4
2001	1,129	559.0	476.3	3.9	10
2002	1,129	645.2	563.3	1.7	1
2003	1,129	797.9	685.4	1.1	3
2004	1,129	1133.3	937.6	1.4	18
2005	1,129	1440.3	1160.7	3.2	49
2006	1,129	1383.5	1065.0	5.0	5
2007	1,129	1062.8	796.4	5.0	3

Table III
Monetary Policy Pass-Through to Bank Lending

Table III shows the estimation results for our baseline regression in Equation (2). In the dependent variable, $LO_{c,t}$ is the total dollar volume of mortgage loan originations in county c in year t . Our measure for monetary policy ΔM_t is the change in the annual average federal funds rate. $D_{c,t-3}$ is an indicator variable which takes on the value 1 if a large natural disaster happened in county c in year $t - 3$, and 0 if not. Column (1) includes a battery of country-level macroeconomic control variables and no year fixed effects, while Column (2) provides a robustness check including year fixed effects. *, ** and *** indicate statistical significance at the 10%, 5% and 1% level respectively. Standard errors are clustered at the county-level.

	(1) $\Delta \log LO_{c,t}$	(2) $\Delta \log LO_{c,t}$
ΔM_t	0.08*** (0.00)	
$D_{c,t-3}$	-0.22*** (0.07)	-0.20*** (0.06)
$(D_{c,t-3} \times \Delta M_t)$	0.09** (0.04)	0.08** (0.04)
US GDP Growth	0.10*** (0.00)	
US Inflation	0.24*** (0.01)	
US Unemployment	0.23*** (0.01)	
County FE	YES	YES
Year FE	NO	YES
Constant	-2.02*** (0.06)	0.02*** (0.00)
Observations	9024	9024
Adjusted R^2	0.25	0.29

Clustered standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table IV
Placebo Tests

Table IV provides a placebo test with regard to our baseline specification. Instead of including $D_{c,t-3}$, we include $D_{c,t-2}$ and $D_{c,t-4}$ which take on the value 1 if a large natural disaster happened in county c in year $t - 2$ $t - 4$ respectively, and 0 if not. $LO_{c,t}$ is the total dollar volume of mortgage loan originations in county c in year t . Our measure for monetary policy ΔM_t is the change in the annual average federal funds rate. *, ** and *** indicate statistical significance at the 10%, 5% and 1% level respectively. Standard errors are clustered at the county-level.

	(1) $\Delta \log LO_{c,t}$	(2) $\Delta \log LO_{c,t}$
ΔM_t	0.08*** (0.00)	0.08*** (0.00)
$D_{c,t-2}$	-0.05** (0.02)	
$(D_{c,t-2} \times \Delta M_t)$	0.03 (0.02)	
$D_{c,t-4}$		0.04 (0.05)
$(D_{c,t-4} \times \Delta M_t)$		0.03 (0.02)
US GDP Growth	0.10*** (0.00)	0.10*** (0.00)
US Inflation	0.24*** (0.01)	0.24*** (0.01)
US Unemployment	0.23*** (0.01)	0.23*** (0.01)
County FE	YES	YES
Year FE	NO	NO
Constant	-2.00*** (0.06)	0.02*** (0.00)
Observations	9024	9024
Adjusted R^2	0.24	0.29

Clustered standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$