Heterogeneous Effects of Housing Credit Policy*

Myroslav Pidkuyko†

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Abstract

We study the heterogeneous impact of expansionary credit policies by combining exogenous policy changes in US federal housing agencies mortgage holdings with household-level data from the Consumer Expenditure Survey and the Survey of Consumer Finances. Following an increase in agency purchases, households with mortgage increase their spending, while outright homeowners and renters do not adjust their expenditure at all. Among the mortgagors we document heterogeneous responses to an activity in secondary mortgage markets across the income, mortgage length distribution, and debt level.

JEL classification: E44, R38, G28, N22, E52

Keywords: Mortgage Debt, Government-Sponsored Enterprises, Credit Policy

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†Department of Economics, University of Manchester, M13 9PL, United Kingdom. Email: myroslav.pidkuyko@manchester.ac.uk. Web: www.myroslavpidkuyko.com

1 Introduction

Who benefits from governmental intervention in the mortgage markets? In this paper, we investigate whether credit policy changes have an impact on households' spending and we study how differences in households' balance sheets may affect the propagation of such policies. In particular, we focus on exogenous governmental intervention in the mortgage markets through various federal housing agencies, and mortgage assets purchases of these agencies. If credit market interventions were neutral (Meltzer, 1974; Greenspan, 2005; Lehnert, Passmore, and Sherlund, 2008) an increase in agency purchases should have little impact on private consumption. Instead, we find that expansionary credit policy leads to an increase in private consumption. We also find that the effect is heterogeneous depending on the households' portfolio composition and debt level.

We use the household's housing tenure status (whether they rent their home, own their home with a mortgage, or own their house without the mortgage) to predict their asset and debt position. We show that following an increase in agency purchases, households with mortgage increase their spending substantially, followed by a smaller increase for renters, while there is no substantial increase of expenditure for outright homeowners. Moreover, the expansionary policy increases the expenditure inequality among the mortgagors. This result is consistent with mortgagors behaving as a wealthy hand to mouth type of consumers (Cloyne, Ferreira, and Surico, 2017). Mortgagors have low liquidity despite holding a sizable illiquid asset (house) and consume any extra dollar of income.

To understand this heterogeneity in response between and within the groups, we further group households based on several characteristics; in particular, we are interested in which characteristic of mortgagors might explain the aforementioned heterogeneity in response to credit policy as well as the increase in inequality. We find that households with mortgage react differently to credit policy shock based on their income level, the length of their mortgage and the level of their debt.

The results we find are important for several reasons. Firstly, as the mortgagor group is the largest share of the population, our findings may shed a light on the ag-

gregate effects of exogenous housing credit policy and the transmission mechanism it operates through. Secondly, quantitative effects of housing credit policy and conventional monetary policy shocks share similar transmission mechanisms on an aggregate macroeconomic level (see Fieldhouse, Mertens, and Ravn, 2017). This paper shows that the same is true on a more dis-aggregated household level. Indeed, our results are consistent with Cloyne, Ferreira, and Surico (2017), that show that following a temporary cut in an interest rate, households with a mortgage debt significantly increase their expenditure, renters increase their expenditure a bit, while homeowners do not adjust their spending at all.

We also look deeper into the interplay between credit and monetary policy we look at the effect of the credit policy on expenditure inequality. A temporary cut in interest rates decreases both the expenditure and income inequality (Coibion, Gorodnichenko, Kueng, and Silvia, 2017); the same is not true for the credit policy. We show that following a news shock to agency purchasing activity, the expenditure inequality increases slightly for all households. Moreover, the increase in inequality within the mortgagors is significant and is equal to almost half percentage point.

One issue is worth noting before proceeding. For the most part, credit policy changes are a reaction to business cycle conditions (the most recent QE3 being the prime example). In order to analyze the response of consumption to any of these policy changes, it is, therefore, important to isolate the non-cyclically motivated policy changes that are free of any confounding influences of the business cycle (such as long-term objectives of increasing the homeownership). We combine the exogenous non-cyclically motivated events from Fieldhouse and Mertens (2017) with mortgage purchases of two largest federal housing agencies (Fannie Mae and Freddie Mac), where we use the former as an instrumental variable in regressions of households' consumption on measures of agency purchase activity. We then estimate the impulse response of households' consumption to news shock about future agency purchasing activity using Jordà's (2005) local projection method.

Related Literature. This paper relates to four strands of literature. Firstly, we analyze the US federal government interventions into the mortgage markets. For the most

part the literature focused on governments' intervention in terms of tax policies. Recent studies include Chambers, Garriga, and Schlagenhauf (2009); Hilber and Turner (2014); Floetotto, Kirker, and Stroebel (2016); Sommer and Sullivan (2017), among others. Fieldhouse, Mertens, and Ravn (2017) is the most recent study that instead analyzes the interventions to the federal housing agencies, rather than any tax policies. In this paper, we use exogenously identified policy interventions from Fieldhouse et al. (2017); unlike Fieldhouse et al. (2017), however, we analyze the transmission mechanisms through which the policy operates using the US household survey data.

Secondly, this paper is related to literature that analyzes the interaction between federal housing agencies and other markets. The most recent studies include Gonzalez-Rivera (2001); Naranjo and Toevs (2002); Lehnert, Passmore, and Sherlund (2008); Hancock and Passmore (2011, 2014) as well as Fieldhouse et al. (2017). We focus specifically on the effect of mortgage purchases of governmental housing agencies on consumption of different types of households using a novel identification strategy.

Thirdly, our paper is related to the literature on the role of household balance sheet channels in the transmission of monetary and fiscal policy shocks. These include Iacoviello (2005); Eggertsson and Krugman (2012); Luetticke (2015); Greenwald (2016); Hedlund, Karahan, Mitman, and Ozkan (2016); Cloyne, Ferreira, and Surico (2017); Kaplan, Moll, and Violante (2017); Auclert (2017); Bilbiie (2017), to name a few. Like in Cloyne, Ferreira, and Surico (2017), we use the households' housing tenure status to proxy their asset and debt position.

Finally, this paper is related to literature that analyzes the effects of monetary policy shocks on inequality. Coibion, Gorodnichenko, Kueng, and Silvia (2017) uses US household level data to study the effect of conventional monetary policy on income and consumption inequality. We follow Coibion et al. (2017) methodology to construct the measure of expenditure inequality between all types of households as well as within each housing tenure group. Unlike Coibion et al. (2017) we focus on the effect of credit policy shocks on expenditure inequality.

Structure of the Paper. The rest of the paper is structured as follows. Section 2 sets out the empirical model. Section 3 presents the impulse response analysis. Section 4

concludes.

2 Empirical Framework

2.1 Institutional Background and Identification of Exogenous Policy Changes

US mortgage markets is the largest capital market in the world and is the dominant source of credit for American households. It finances key component of household wealth and aggregate spending - housing. By the 3rd quarter of 2017, the total mortgage debt in the US was about $8.7 trillion. In comparison, auto, credit card and student debt combined was about $2.3 trillion.

The US mortgage market is also quite unique. The US federal government is heavily involved in the mortgage market (especially in terms of residential mortgage purchases) though various agencies: Government-Sponsored Enterprises (GSEs) and Government Agencies. We focus on the involvement of the government through the GSEs. In particular, we focus on two largest GSEs: Fannie Mae, funded in 1938 and publicly traded since 1968, and Freddie Mac, funded in 1970. GSEs were chartered by Congress to support secondary mortgage markets and are subject to favorable tax and regulatory treatment. These agencies acquire mortgages through advance commitments to buy loans from mortgage lenders which are delivered once the loans are originated in the primary market; they are not allowed to do any direct lending. Over time, the agencies played and increasingly active role in the residential mortgage markets. As Figure 1 indicates, in 2004 Fannie Mae and Freddie Mac held almost 20% of all mortgage debt.

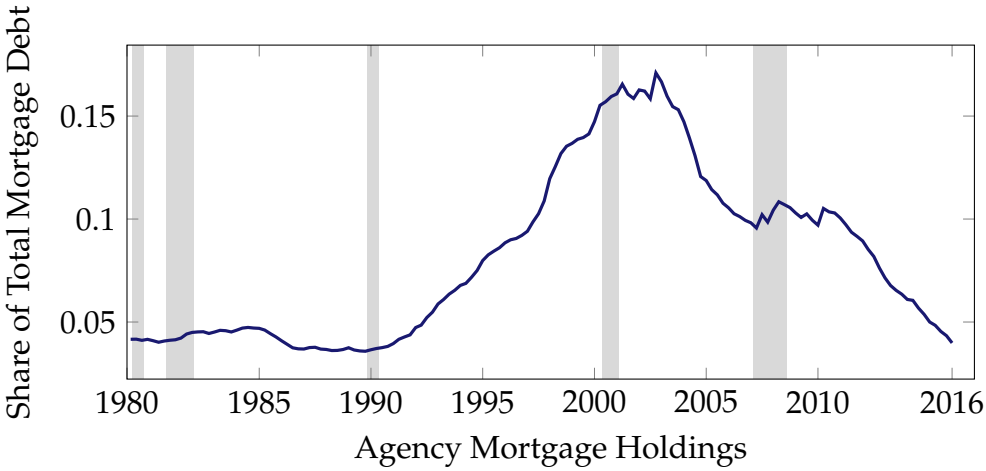

FIGURE 1: Agency mortgage holdings as a percent of total mortgage originations. Data is between 1980 and 2016. Grey areas represent NBER recessions.

In the empirical section of this paper we focus on the portfolio purchases of the housing agencies, shown in Figure 2, and how it affects expenditure of households with different debt position. Unfortunately, simply correlating measures of agency activity with households' expenditure ignores potential endogeneity problems. On one hand, Fannie Mae and Freddie Mac respond to market conditions, and thus act pro-cyclically. On the other hand, Fannie Mae and Freddie Mac have a public mission to provide stability on the mortgage markets, and thus act counter-cyclically. Ignoring these potential problems makes the causal inference invalid.

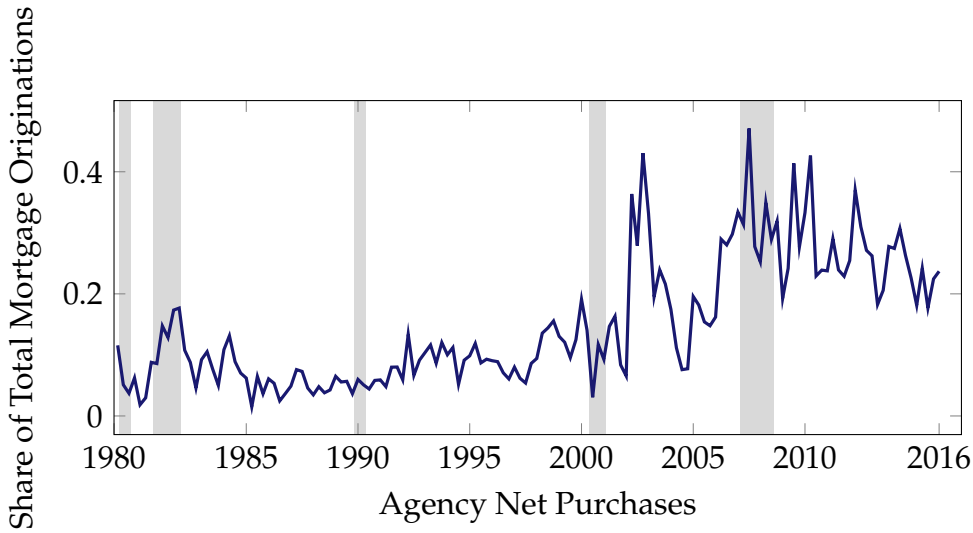

FIGURE 2: FNMA & FHLMC net purchase for portfolio investment. Data is between 1980 and 2016. Grey areas represent NBER recessions.

To account for the endogeneity in agency market activity we use narrative identification approach and use major regulatory policy events as an instrument for agency purchase activity. Fieldhouse and Mertens (2017) document significant policy changes that are expected to affect agency portfolios and isolate those events (which they call non-cyclical events) that are free of confounding influences in the spirit of Romer and Romer (2004) and Ramey (2011). We quantify these changes as a percentage of the average annualized level of originations in the preceding year. As most of the policy interventions after 2006 were related to 2007/2008 financial crisis and were mostly cyclically motivated, we limit the analysis to pre-crisis sample.

2.2 Impulse Response Specification

To evaluate the effect of agency purchase activity on households' income and consumption we conduct an impulse response analysis of shock to agency mortgage purchase. We use a local projections instrumental variable approach where we use the narrative instrument identified in the previous section for identification.

We start with assessing whether the narrative policy changes do lead to significant changes in net agency purchases. Our first-stage regression specification is of the form

$$\frac{\sum_{j=0}^{h} p_{t+j}}{X_t} = \tilde{a}_h + \tilde{c}_h \frac{\tilde{m}_t}{X_t} + \tilde{d}_h(L) Z_{t-1} + \tilde{u}_{t+h}, \tag{2.1}$$

where p_t is the agency's net purchase, X_t trend in real mortgage originations, $\tilde{m}_t$ is non-cyclically motivated narrative measure in real dollars, and Z_t is a set of controls (defined below). $\tilde{d}_h(L)$ denotes the polynomial of order 4. Figure 3 shows the robust F-statistics on the excluded instrument in each of the first-stage regressions (2.1) for horizons $h = 1$ (one quarter) to $h = 20$ (five years).

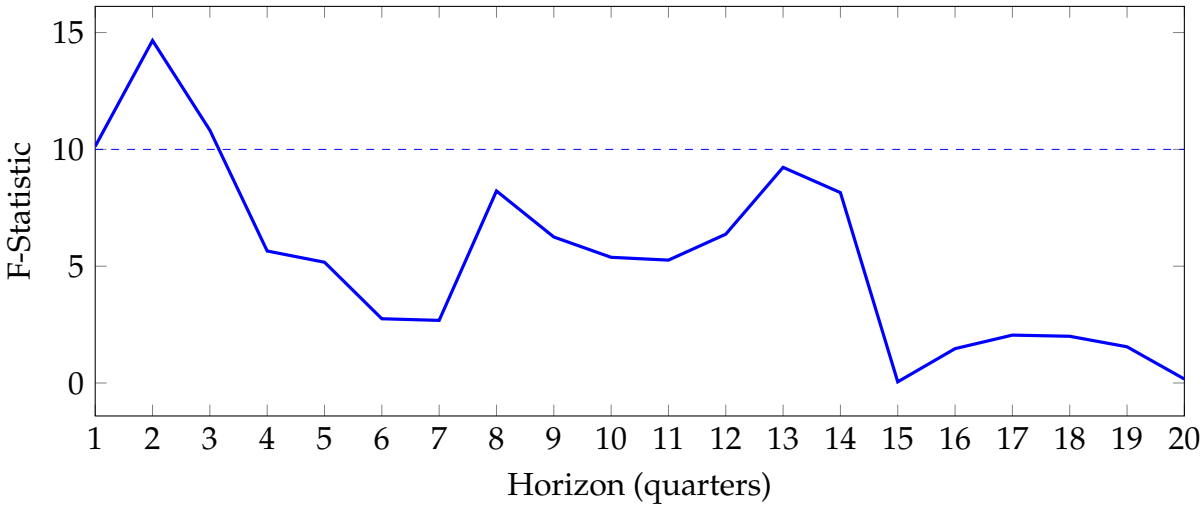

FIGURE 3: **First Stage Robust F-statistic.** Figure displays robust F-statistics on the excluded instrument of the first-stage regressions of cumulative agency net purchases.

The results indicate that the narrative measure is a strong instrument for agency purchasing activity for horizons between 1 and 3 quarters after the policy events, with robust F-test statistics exceeding 10. The F-statistics are low for longer horizons. Given these results we restrict the analysis to horizons between 1 and 3 quarters. Specifically, we focus on the agency purchase activity 2 quarters after the shock, as the robust F-statistic is the highest and equal to 15.

We now proceed to identifying the effect of agency purchase activity on households' consumption and income. Our goal is to identify the response to shocks to expectations of future agency purchasing activity. For a given outcome variable y_t, we estimate the response at horizon h using

$$\frac{y_{t+h} - y_{t-1}}{y_{t-1}} = a_h + b_h \left(\frac{4}{2} \times \frac{\sum_{j=0}^{2} p_{t+j}}{X_t} \right) + d_h(L) Z_{t-1} + u_{t+h}, \tag{2.2}$$

The right hand side variable of interest measures annualized agency commitments made over an 2 quarter period expressed as a ratio of long-run trend in annualized originations X_t. We choose an 2 quarter horizon to measure expected future purchases because at this horizon the robust F-statistic associated with the narrative instrument in the first-stage regression is the largest. Therefore, our first-stage is (2.1) with $\sum_{j=0}^{2} p_{t+j}/X_t$ as the dependent variable.

The regression in (2.2) estimates the quarter $h \geq 0$ response to a time 0 news shock to agency purchases. Expected agency purchases are proxied by agency net purchases made over the next half a year. To address endogeneity, we use the indicator of non-cyclical policy events, deflated by the core PCE price index and scaled by trend originations X_t , as the instrument. The IV estimates of b_h in (2.2) can be interpreted as the response associated with a percent increase in the agency net purchase that becomes anticipated h periods before.

The control variables Z_t include the lagged growth rates of the core PCE price index, a nominal house price index, and total mortgage debt, the log level of real mortgage originations, housing starts, and lags of several interest rate variables: the 3-month T-bill rate, the 10-year Treasury rate, the conventional mortgage interest rate, and the BAA-AAA corporate bond spread. They also include lags of agency net purchases and commitments as a ratio of X_t as well as the unemployment rate and the growth rate of real personal income. See Appendix A.1 for a detailed description of the data sources and definitions.

3 The Effect of Agency Purchases on Expenditure and Income

In this section we document the response of households' expenditure and income to news shock to agency purchases, proxied by agency net purchases made over next half a year.

3.1 Response of Aggregate Expenditure and Income

We first analyze the response of expenditure and income for all the households using rich income and expenditure data contained in the CEX survey. We define expenditure as an expenditure on non-durable goods and services, that includes food, alcohol, tobacco, fuel, light and power, clothing and footwear, personal goods and services, fares, leisure services, household services, non-durable household goods, motoring expenditures and leisure goods. Our measure of households' income is sum of labor- and non-labor household income net of taxes paid. See Appendix A.2 for a detailed de-

scription and sample retrictions. Figure 4 plots the response of income (left panel) and expenditure (right panel) together with 95% confidence bounds to an additional 1% increase in net purchase by the agencies, anticipated 2 quarters in advance, under the specification in (2.2) using non-cyclically motivated narrative measure as an instrument. The households' per-capita income increases significantly following an increase in agency portfolio activity, reaching its peak of about 0.01 basis points a year after the shock. Expenditure increases as well, by higher amount than income, reaching its peak of about 0.05 basis points, and the increase is significant between 4 and 8 quarters.

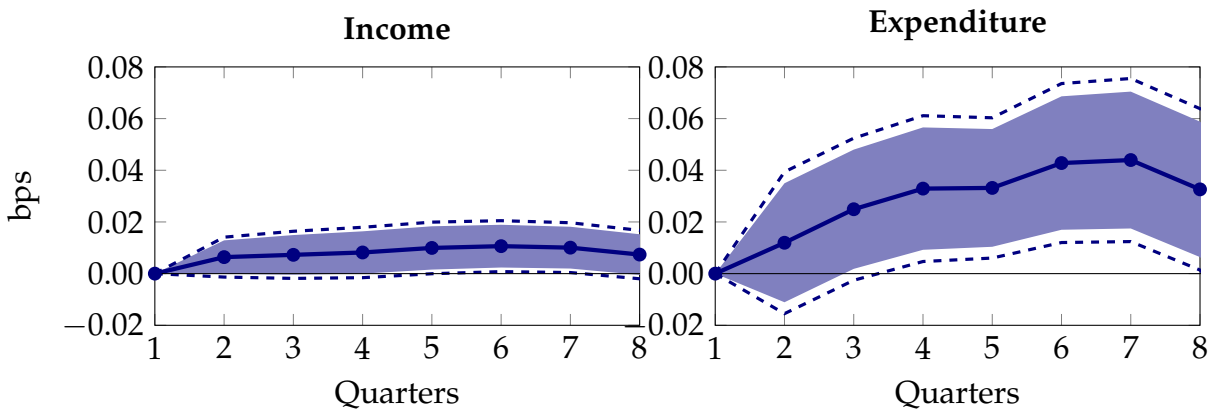

FIGURE 4: Impulse response of income (left panel) and expenditure (right panel) to a 1% increase in net purchase by FNMA & FHLMC, anticipated 2 quarters before. Blue areas and broken lines represent 90% and 95% confidence intervals, respectively.

3.2 Pseudo-Cohort Analysis

In the previous section we documented the aggregate response of households' income and expenditure to news shock to agency purchases. As documented by Fieldhouse, Mertens, and Ravn (2017), an increase in mortgage purchases by the agencies boosts mortgage lending and lowers mortgage rates. It is, therefore, important to distinguish between those households who own the house with a mortgage and those without. Agency purchases also influence house prices and expand homeownership, therefore the effect on those households who own the house and those who do not might be different. The CEX survey, on top of containing rich income and expenditure data, contains information on housing tenure status. We utilize this information and group the households into three categories based on their tenure status in the spirit of Cloyne,

Ferreira, and Surico (2017). The categories are *renters*, *mortgagors* and *outright owners*. Unfortunately, given the rotating panel nature of the CEX survey it is not possible to follow individual households for more than four quarters over which they are observed. We, therefore, employ a grouping estimator to aggregate individual observations into pseudo-cohorts by housing tenure as in Browning, Deaton, and Irish (1985).

For households with mortgage debt, the length of the mortgage debt that remains to be repaid is in important factor in determining their expenditures. For example, people with longer mortgage remaining might benefit more from the cut in mortgage rates, as their lifetime value of debt is now lower. The CEX survey, unfortunately, does not contain rich information on mortgage length and structure. The SCF survey, on the other hand, contains information on mortgage origination, value and length remaining. As SCF survey is a triennial survey, we again use synthetic panel techniques to group individual households into groups. To follow more or less homogeneous group over time and to merge the mortgage information contained in SCF with income and expenditure information in CEX, we define groups by the year of birth of the household head, or cohorts, similarly to Attanasio, Kovacs, and Molnar (2017). We define cohorts over five year bands, using 1989 as a benchmark, as reported in Table 1. We then calculate the average length of mortgage remaining for each cohort for each wave in SCF survey and merge it with the CEX survey on a cohort basis.

Cohort	Year of Birth	Age in 1989
1	1965 - 1974	15 - 24
2	1955 - 1964	25 - 34
3	1945 - 1954	35 - 44
4	1935 - 1944	45 - 54
5	1925 - 1934	55 - 64

TABLE 1: Cohort Definition

We divide households into two groups, based on length of mortgage remaining - those with mortgage remaining below 18 years, which we call a group with *short mortgage*, and those above, which we call a group with *long mortgage*. We choose these categories to maximize the number of households in each group.

Mortgage refinancing decision is another important factor in determining their ex-

penditure. For example, those that decide to refinance their existing mortgage for the one with the lower rate can benefit from smaller mortgage payments and allocate extra cash to expenditure. On the other hand, the costs associated with refinancing might be too high for the household to decide to refinance existing mortgage, reaching almost 3% of the of the household's initial mortgage balance (see Hurst and Stafford (2004)). CEX survey includes information on mortgage refinancing decision starting from 1994. We extrapolate the information between 1980 and 1993 using the k-nearest neighbor algorithm, to classify the households into those who *refinance* and those who *don't refinance* using a set of household characteristics (see Appendix for details).

Similarly, we group the households by their decision to borrow against their house using a home equity line of credit (HELOC). While households that decide to use HELOC can enjoy extra cash, they also face another debt on top of their existing mortgage debt. Similarly to the refinancing decision described above, we extrapolate the household's decision to take out HELOC to the whole sample using k-nearest neighbor algorithm. We group households into two groups: those that *take HELOC* and those that *do not take HELOC*.

Finally, we also group households based on their pre-tax income. We define two groups - *poor* households, that are in the bottom 50% of the income distribution, and *rich* households, that are in the top 50% of the income distribution.

3.2.1 Grouping Households by Housing Tenure

We start with looking at the response of income and expenditure of households based on their housing tenure status. We define three types of households - renters, mortgagors and outright owners (or simply owners). As in Section 3.1 we look at the response of expenditure to a 1% increase in net purchase by the agencies, anticipated 2 quarters in advance, under the specification in (2.2) using non-cyclically motivated narrative measure as an instrument. Figure 5 plots the coefficients b_h from equation (2.2) over the horizon $h = 1$ (one quarter) to $h = 8$ (two years) along with 90% and 95% confidence intervals. We see from the figure, that after a news shock to agency net purchases the only group that significantly increases their expenditure are the mortgagors, for horizon between three and seven quarters, while the change in expenditure

for renters and owners is insignificant for all horizons.

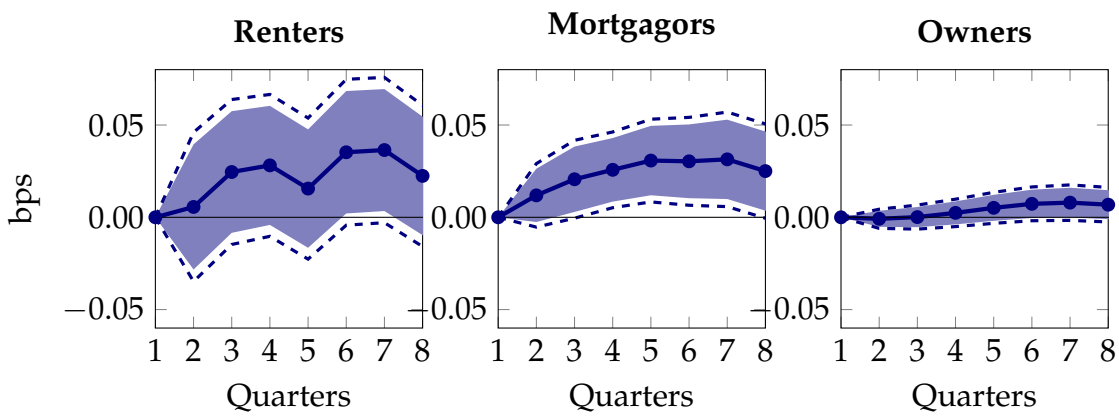

FIGURE 5: Impulse response of expenditure (bottom panel) to an additional to a 1% increase in net purchase by FNMA & FHLMC, anticipated 2 quarters before. Blue areas and broken lines represent 90% and 95% confidence intervals, respectively.

As we documented in Section 3.1, the news shock to agency net purchases increases the income of the households. It might be, that the heterogeneous response we observe in expenditure is due to heterogeneous response in income. To understand whether this mechanism is at play, we look at the response of income a 1% increase in net purchase by the agencies, anticipated 2 quarters in advance, under the same specification as before. Figure 6 plots the coefficients b_h from equation (2.2) over the horizon $h = 1$ (one quarter) to $h = 8$ (two years) along with 90% and 95% confidence intervals. We see that, following a shock, income increases significantly for renters only, with some (however insignificant) increase for owners, while the income of mortgagors does not react at all. Moreover, we document that quantitatively mortgagors respond the least in terms of increase income, yet they are the only group that increase their expenditure following an increase in income.

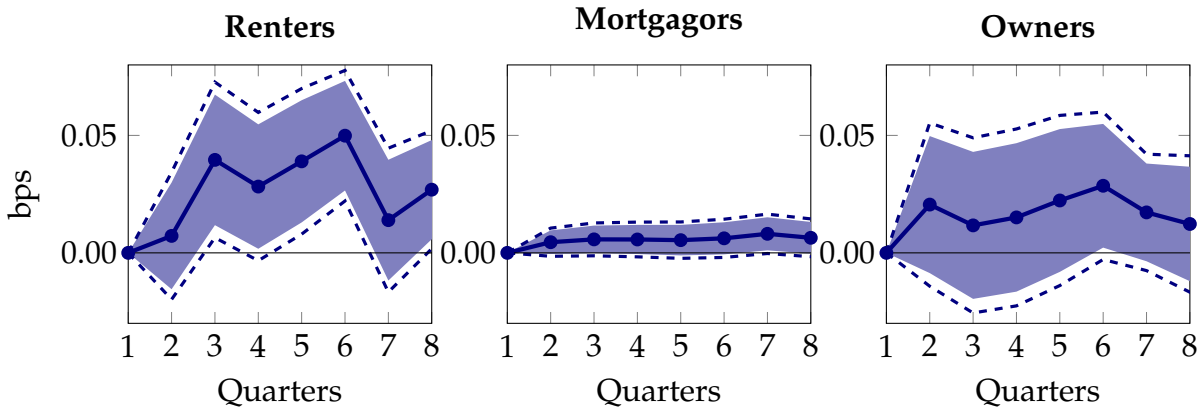

FIGURE 6: Impulse response of income to an additional to a 1% increase in net purchase by FNMA & FHLMC, anticipated 2 quarters before. Blue areas and broken lines represent 90% and 95% confidence intervals, respectively.

3.2.2 Response of Expenditure Inequality

We documented the evidence that following a news shock to agency purchase activities there is a heterogeneous response between housing tenure groups. We now look at what happens with expenditure within each of the groups. For that we construct Gini coefficient of level of expenditure on non-durable goods and services in the spirit of Coibion, Gorodnichenko, Kueng, and Silvia (2017). Our measure of inequality is raw, not controlling for any household characteristics like the number of household members, age, education, etc. The only control characteristic that we take is the housing tenure status.

Figure 7 plots the response of Gini coefficient (measured between 0 and 100) to a 1% increase in net purchase by agencies, anticipated 2 quarters before. Top left panel plots the response of Gini coefficient to a news shock for all the households in the data. We can see the positive and significant increase (at 90% significance level) in expenditure inequality one quarter after the shock by about quarter of percentage point. Expenditure inequality within renters group (top right panel) does not respond significantly. We can neither see a significant increase in expenditure inequality within the homeowners group (bottom right panel). With regards to expenditure inequality within the mortgagor group (bottom left panel), there is a positive and significant (both at 90% and 95% significance level) increase of inequality by almost half percentage point. This suggests that overall increase in expenditure inequality is mostly driven by in-

crease within the mortgagors. In the next section we will analyze what characteristics of households (depending on their income level and their housing tenure status) and of mortgagors in particular (depending on the length of their mortgage) drives the heterogeneous response of expenditure and expenditure inequality between the three groups of households.

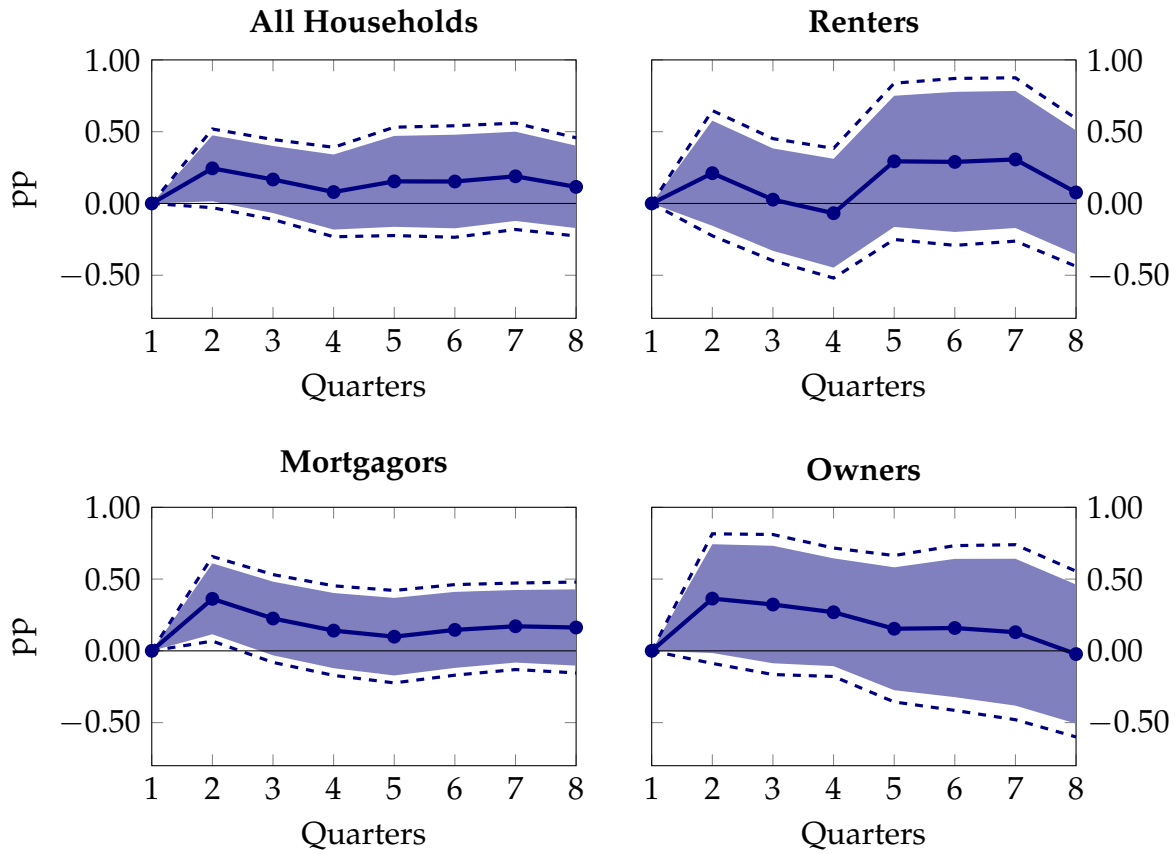

FIGURE 7: Impulse response of expenditure Gini to a 1% increase in net purchase by FNMA & FHLMC, anticipated 2 quarters before. Blue areas and broken lines represent 90% and 95% confidence intervals, respectively.

3.2.3 Response of Expenditure Along the Income Distribution

The increase of expenditure inequality following a news shock to agency purchases implies that households with different characteristics will have different response of expenditure to the same shock. In this section we analyze households based on level of their income. We use the definition of income from before and divide the households into two categories: *poor* households that are in the bottom 50% of income distribution, and *rich* households, that are in the top 50% of income distribution. As before, we also

divide households by housing tenure status. This way we have six different groups of households: renters, mortgagors and homeowners, each of whom are either poor or rich.

We start the analysis of renters. Before, we observed that renters do not increase their expenditure following a shock, and neither there is an increase in the expenditure inequality within renters. This could imply that there should be no increase in expenditures for neither poor nor rich renters. Indeed, as Figure 8 indicates, neither of the income groups of renters increase their expenditure following a shock and quantitatively the response is similar.

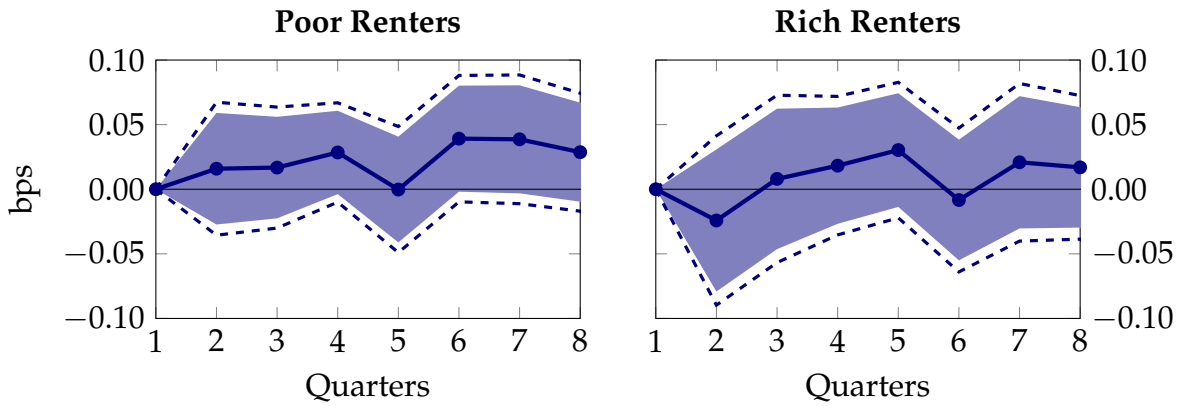

FIGURE 8: Impulse response of expenditure to an additional to a 1% increase in net purchase by FNMA & FHLMC, anticipated 2 quarters before. Blue areas and broken lines represent 90% and 95% confidence intervals, respectively.

The mortgagors, however, show a different result. As Figure 9 indicates, the increase in expenditure among rich mortgagors (right panel) is higher, following a shock, and is significant between 5 and 7 quarters (with a 90% confidence), while the response of the poor mortgagors is quantitatively lower, and is only significant after quarter 6 (with a 90% confidence). This indicates that there is indeed a heterogeneous within the mortgagors group that is consistent with an increase in expenditure inequality within the mortgagors group.

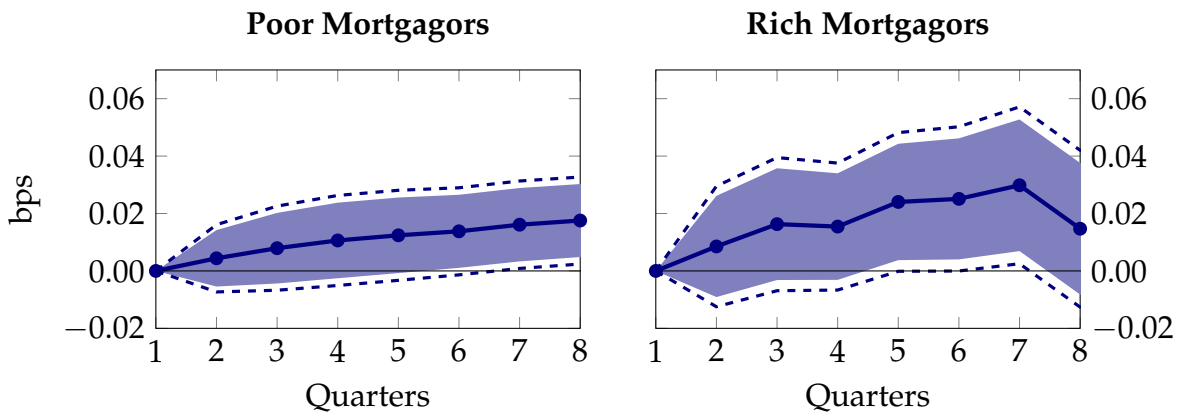

FIGURE 9: Impulse response of expenditure to an additional to a 1% increase in net purchase by FNMA & FHLMC, anticipated 2 quarters before. Blue areas and broken lines represent 90% and 95% confidence intervals, respectively.

The response for owners is similar to that of renters. As Figure 10 indicates, there is no significant change in expenditure for neither poor nor rich homeowners. Indeed, the results go inline with the positive (though insignificant) increase in inequality between homeowners, as the poor homeowners increase their expenditure by less (again, the results are more indicative and not significant).

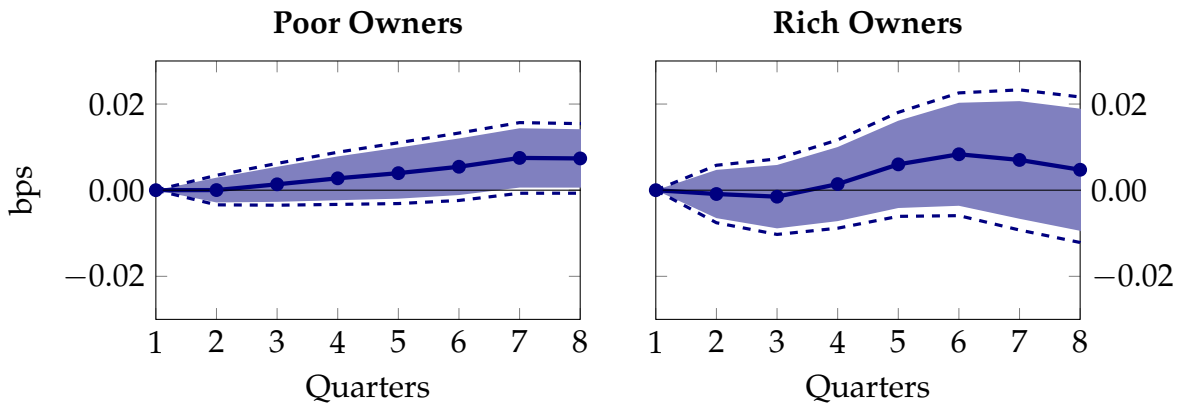

FIGURE 10: Impulse response of expenditure to an additional to a 1% increase in net purchase by FNMA & FHLMC, anticipated 2 quarters before. Blue areas and broken lines represent 90% and 95% confidence intervals, respectively.

In next section we focus specifically on the mortgagors group to further understand the increase in expenditure inequality for that group.

3.2.4 Response of Expenditure Along the Mortgage Length Distribution

While the increase in expenditure inequality within mortgagors group could be partially explained by the heterogeneous increase in expenditure for different income categories, the results are not significant enough to make that claim. For that reason we define two groups of mortgagors based on their mortgage length remaining. We group the mortgagors into those with a *short* mortgage - where the remaining mortgage debt matures in less than 18 years - and with a *long* mortgage - where the remaining mortgage debt matures 18 or more years. The idea behind this classification is quite straightforward: following an expansion in agency portfolio activity, both the short term, the long term, and the mortgage rates fall (see Fieldhouse, Mertens, and Ravn, 2017); mortgagors with a long mortgage might anticipate a long-term effects of reduction in value of their mortgage, and thus benefit more. Indeed, we can confirm this intuition by looking at Figure 11. As figure indicates, following a shock, mortgagors with short mortgage (left panel) increase their expenditure slightly (reaching a peak of about 0.01 basis points), whereas the mortgagors with long mortgage exhibit a strong and significant increase between 3 and 6 quarters following a shock (reaching a peak of about 0.05 basis points).

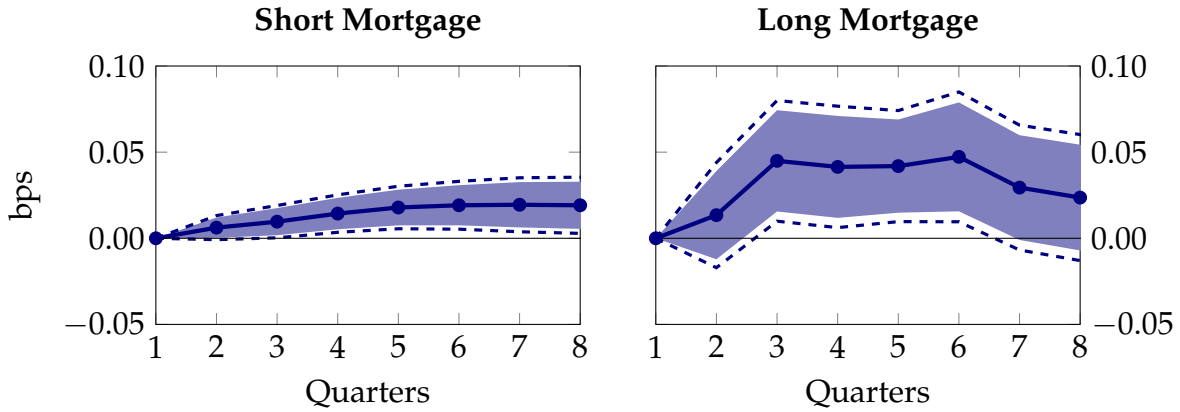

FIGURE 11: Impulse response of expenditure to an additional to a 1% increase in net purchase by FNMA & FHLMC, anticipated 2 quarters before. Blue areas and broken lines represent 90% and 95% confidence intervals, respectively.

To summarize the results we found so far, we show that following a news shock to agency purchase activity, households with the mortgage debt increase their consumption, while households without debt do not increase their expenditure at all. We also

find that a news shock increases the expenditure inequality among the mortgagors. We show that heterogeneous response could be partially explained by the difference in mortgage length remaining, while the difference along income distribution is small and not enough to justify increase in expenditure Gini.

3.2.5 Response of Expenditure Based on Refinancing Decision

We know look at the other channel that might explain the increase in expenditure inequality within the mortgagors groups - the decision of households to refinance the mortgage. We group households into those that decide to refinance and those that do not. We find that refinancing decision does no matter for the households. Indeed, as Figure 12 indicates, both households that decide to refinance (left panel) and those that do not (right panel) increase their expenditure by almost the same amount, reaching a peak of almost 0.05 basis points a year following a shock.

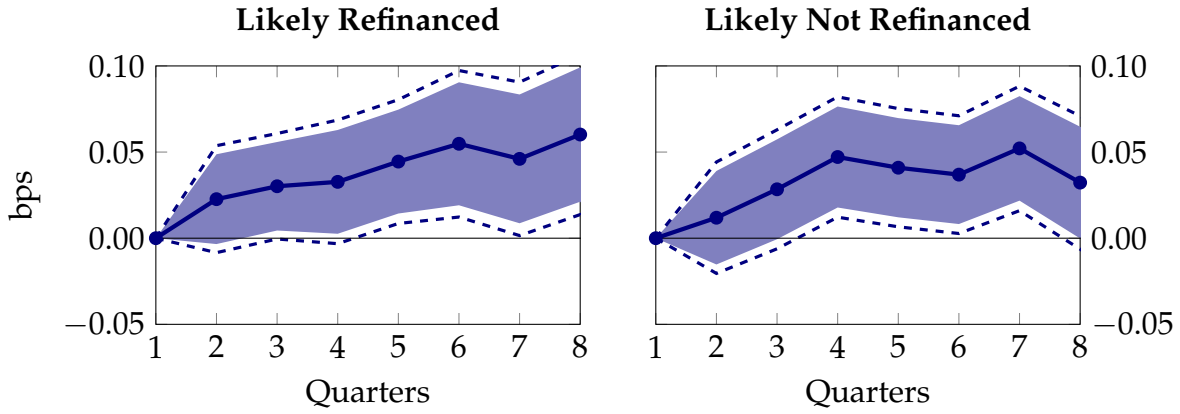

FIGURE 12: Impulse response of expenditure to an additional to a 1% increase in net purchase by FNMA & FHLMC, anticipated 2 quarters before. Blue areas and broken lines represent 90% and 95% confidence intervals, respectively.

3.2.6 Response of Expenditure and HELOC

Finally, we analyze whether a households' decision to take out a home equity line of credit matters. Figure 13 plots the response of expenditure of households that do take out HELOC (left panel) and those that do not (right panel). Following a shock, those households that do not take out an extra debt increase their expenditure significantly, again reaching a peak of about 0.05 basis points a year after, while for those that do take out HELOC the increase is insignificant.

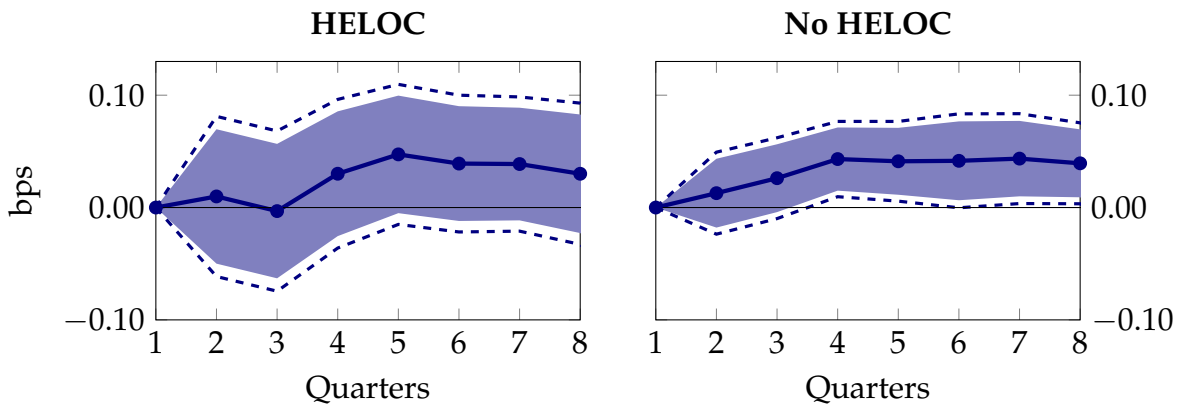

FIGURE 13: Impulse response of expenditure to an additional to a 1% increase in net purchase by FNMA & FHLMC, anticipated 2 quarters before. Blue areas and broken lines represent 90% and 95% confidence intervals, respectively.

The results in this section show the causal effect of news shock to agency mortgage purchases. To understand which channel is exactly responsible for increase in expenditure for mortgagors only, and heterogeneous increase along the mortgage length distribution, next section develops heterogeneous agent life-cycle model with uninsurable risk and aggregate mortgage market shocks. Through the lens of this model we explain the empirical evidence we found in the previous sections and analyze which channels contribute to the results indicated.

4 Conclusions

We study the heterogeneous impact of expansionary credit policies by combining exogenous policy changes in US federal housing agencies mortgage holdings with household level data from the Consumer Expenditure Survey and the Survey of Consumer Finances. We group households into pseudo-cohorts based on their housing tenure status: renters, mortgagors and homeowners. We show that following an increase in agency purchases, households with mortgage increase their spending, while outright homeowners and renters do not adjust their expenditure at all. The general equilibrium effect of increase in income can partially explain the reaction of mortgagors, that behave as wealthy hand-to-mouth consumers. We also show that a news shock to agency mortgage purchases increases expenditure inequality within mortgagors. To analyze this finding we further divide mortgagors along several characteristics - in-

come, mortgage length, mortgage refinancing, and home equity loan. We show that the difference in income alone is too small to explain the difference in response of expenditure among the household with mortgage debt, while the difference in mortgage length results in heterogeneous response of expenditure. We also show that there is no difference in response depending on refinancing decision. There is, however, a difference in response of expenditure to a shock depending whether households took out a home equity loan. We argue that households with longer mortgage anticipate long-term effects of reduction in debt (e.g. via refinancing and lower mortgage rates), while those that did not take out a home equity loan have less debt remaining and thus can increase their expenditure following expansionary credit policy. We also show that overall behavior of mortgagors is consistent with a wealthy hand-to-mouth behavior.

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A Data

A.1 Agency and Market Data

Residential mortgage debt is the sum of home mortgages and multifamily residential mortgages from the Federal Reserve's Financial Accounts of the United States. *Nominal GDP* is from the National Income and Product Accounts. *Agency mortgage holdings* is the sum of the retained mortgage portfolios of Fannie Mae and Freddie Mac. Between 1980 and 2003, the data on retained mortgage portfolio is available from various issues of Federal Reserve Bulletin. After 2003 the data is from monthly volume summaries combined with annual OFHEO/FHFA reports. *Residential mortgage originations* before 1997 is from monthly releases of the Survey of Mortgage Lending Activity from the HUD. After 1997 the data on originations is available from Datastream (series USMORTORA). *Net portfolio purchases* is the sum of corresponding series for Fannie Mae and Freddie Mac. Individual series before 2003 are available from various issues of Federal Reserve Bulletin. After 2003 the data is from Fannie Mae's and Freddie Mac's monthly volume summaries. *Conventional mortgage rate* is the 30-year fixed-rate conventional conforming mortgage rate, available at Freddie Mac mortgage market survey. *Housing starts* is obtained from FRED database at the Federal Reserve Bank of St. Louis (series HOUST). *House prices* is measured by the Freddie Mac house price index (FMHPI) available on Freddie Mac's website. *Nominal price level* is obtained from FRED database at the Federal Reserve Bank of St. Louis (series PCEPILFE). *Personal income* is obtained from FRED database at the Federal Reserve Bank of St. Louis (series PI). *Unemployment rate* is obtained from FRED database at the Federal Reserve Bank of St. Louis (series UNR). *Short- and long-term interest rates* are 3-month and 10-year Treasury rates, obtained from FRED database at the Federal Reserve Bank of St. Louis (series TB3MS and GS10). *BAA and AAA corporate bond rates* are the Moody's seasoned BAA and AAA yields, obtained from FRED database at the Federal Reserve Bank of St. Louis (series BAA and AAA).

A.2 CEX Data

We use the interview section of the Consumer Expenditure Survey (CEX) between 1980 and 2007. Data between 1980 and 1995 is obtained from ICPSR through UK Data Service. Post-1995 data is publicly available at the Bureau of Labor Statistics (BLS) website. We define *non-durable goods and services* as food, alcohol, tobacco, fuel, light and power, clothing and footwear, personal goods and services, fares, leisure services, household services, non-durable household goods, motoring expenditure and leisure goods. We adjust the food at home between 1982 and 1987 following Aguiar and Bils (2015). We define households' income as a amount of income before tax in the past 12 months. After 2005, BLS started imputing missing income observations. Before 2004 we impute missing income observations as in Coibion, Gorodnichenko, Kueng, and Silvia (2017).

We exclude households that are in either top 1% or bottom 1% of either the non-durable expenditure or income level. We also exclude the households who report zero food expenditure. Finally, we exclude households who's household head is below 25 and over 74 years old. We also keep the households that do not change the housing tenure status between the interviews.

A.3 SCF Data

We obtain the Survey of Consumer Finances from the Board of Governors of the Federal Reserve System website. We use nine surveys between 1983 and 2007. We apply the same data restrictions as for the Consumer Expenditure Survey. We collect information on households' date of birth, the housing tenure status and the length of mortgage remaining. We then construct five birth cohorts (see Table 1) and match the information on average mortgage length remaining with the CEX data.