

**HOUSEHOLDS' BALANCE SHEETS  
AND THE EFFECT OF FISCAL POLICY**

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# HOUSEHOLDS' BALANCE SHEETS AND THE EFFECT OF FISCAL POLICY <sup>(\*)</sup>

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## **Abstract**

Using households' balance sheet composition in the Panel Survey of Income Dynamics, we identify six household types. Since 1999, there has been a decline in the share of patient households and an increase in the share of impatient households with negative wealth. Using a six-agent New Keynesian model with search and matching frictions, we explore how changes in households' shares affect the transmission of government spending shocks. We show that the relative share of households in the left tail of the wealth distribution plays a key role in the aggregate marginal propensity to consume, the magnitude of fiscal multipliers, and the distributional consequences of government spending shocks. While the output and consumption multipliers are positively correlated with the share of households with negative wealth, the size of the employment multiplier is negatively correlated. Moreover, our calibrated model delivers jobless fiscal expansions.

**Keywords:** panel survey of income dynamics, household balance sheet, fiscal policy, six-agent New Keynesian model, search and matching.

**JEL classification:** E21, E62.

## Resumen

En este trabajo identificamos seis tipos de hogares en Estados Unidos en función de la composición de su balance financiero en el Panel Survey of Income Dynamics. Desde 1999 se observa una acusada disminución en la proporción de hogares ahorradores y un aumento en la proporción de hogares endeudados, en particular aquellos que presentan una riqueza neta negativa. Utilizando como marco teórico un modelo neokeynesiano con estos seis tipos de hogares, así como con imperfecciones en los mercados de crédito y de trabajo, exploramos cómo los cambios en la distribución de los hogares en función de su balance afectan la transmisión de los *shocks* del gasto público al consumo agregado, al empleo y al PIB. Encontramos que la proporción de hogares en la cola izquierda de la distribución de la riqueza desempeña un papel clave en la propensión marginal agregada al consumo, la magnitud de los multiplicadores fiscales y las consecuencias distributivas de los *shocks* del gasto público. Si bien el valor de los multiplicadores de producción y consumo está correlacionado positivamente con la proporción de hogares con riqueza negativa, el tamaño del multiplicador de empleo decrece con la proporción de este tipo de consumidores.

**Palabras clave:** Panel Survey of Income Dynamics, balance financiero de los hogares, política fiscal, modelo neokeynesiano, fricciones de búsqueda y emparejamiento.

**Códigos JEL:** E21, E62.

# 1 Introduction

The 2008 financial turmoil hit households' financial position hard: Credit froze, and the prices of financial and real assets plummeted. In the aftermath of the Great Recession, there was a widespread consensus on the use of discretionary fiscal policy as a tool to mitigate the adverse effects of the crisis.<sup>1</sup> In this paper, we aim to isolate the role of households' balance sheets in the transmission of government spending shocks. To do so, we first identify, using data from the Panel Survey of Income Dynamics (PSID)<sup>2</sup>, six types of households as a function of their balance sheet composition and show that their relative shares have changed significantly in the United States since the Great Recession. Second, using the empirical weights for the PSID cross-sections since 1999, we calibrate a six-agent New Keynesian model with search and matching frictions and show that the aggregate fiscal multipliers for output, consumption, and employment are sensitive to the distribution of households' shares.

Recent literature on household heterogeneity and the transmission of fiscal shocks has highlighted the following empirical facts: *(i)* individual consumption responses to a government spending shock are negatively correlated with a household's net worth and positively correlated with her indebtedness level; *(ii)* the responses of aggregate consumption and output to government spending shocks are higher in periods of high aggregate indebtedness level or financial distress with high levels of debt and financial distress; and *(iii)* there is a strong positive correlation between wealth inequality and the magnitude of fiscal multipliers. We argue that these empirical regularities can be tied together through some degree of financial heterogeneity in the household sector and changes in the distribution of households over time.

Our identification strategy using the PSID is based on first classifying households using their ratio of non-housing net worth to income as patient (Ricardian) or impatient. We, then, further disaggregate impatient households by looking at the assets and liabilities sides of their balance sheets. On the asset side, we focus only on real estate holdings classifying households as a function of homeownership. On the liabilities side, we consider mortgage debt holdings for homeowners and uncollateralized debt holdings – credit card debt, student loans, etc – for non-homeowners. Among homeowners, we consider three types of households: homeowners without a mortgage, homeowners with high leverage, and homeowners with low leverage. Non-homeowners can be indebted or debt free. Indebted non-homeowners are households without real estate but with uncollateralized debt holdings, that is, impatient households with negative wealth holdings. We document that the shares of these six types of households in the PSID were quite stable until 2007, when the share of patient households

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<sup>1</sup>The U.S. Congress passed the Economic Stimulus Act of 2008, the American Recovery and Reinvestment Act of 2009, and several smaller stimulus measures that became law in 2009 and 2010. Overall, the fiscal stimulus was about 7 percent of GDP.

<sup>2</sup>Panel Study of Income Dynamics, public use dataset. Produced and distributed by the Institute for Social Research, University of Michigan, Ann Arbor, MI (2017)



began to steadily decline and the share of impatient households with negative wealth started to increase.

We explore the role played by the observed changes in the distribution of households in the transmission mechanism of government spending shocks by calibrating a six-agent New Keynesian model with the empirical weights estimated in the PSID for each of the waves from 1999 to 2013. Our model features savers and spenders, differences in portfolio compositions, and differences in the capacity to extract collateral from real estate holdings or from expected income. In order to isolate balance sheet heterogeneity, we assume search and matching frictions in the labor market so that all households perceive the same labor income regardless of their characteristics.

We conclude that the effects of fiscal policy shocks on individual consumption are very sensitive to the structure of the household's balance sheet of the household. As expected, while the response of patient households' consumption to an expansionary government spending shock is negative, the responses of all impatient households are positive. Moreover, individual consumption responses are a decreasing function of the level of household wealth. We find that, among impatient households, the response of consumption is stronger for indebted households. We also find that the individual consumption response is an increasing function of the indebtedness level. Consequently, as the distribution of household shares in the PSID has changed over time, the model-implied aggregate marginal propensity to consume and the output multiplier have changed significantly. For example, the model-implied output multiplier is about 55 percent larger in 2013 than in 1999, mostly because of the increase in the share of households with negative wealth. The sharp consumption response of these constrained households reduces the marginal utility of further consumption, putting additional upward pressure on wages. In the model, then firms become more reluctant to incur the cost of posting new vacancies, relying on adjustments in the intensive margin to meet the boost in demand. Consequently, in the model, the increase in the output multiplier since 1999 is paired with a decline in the employment multiplier. Finally, in our model, the size of the fiscal effect is also positively correlated with wealth inequality. In particular, we find a strong correlation between the model-implied Gini coefficient for wealth and the output fiscal multiplier. Therefore, our calibrated model is able to account for the empirical facts described earlier.

We finally explore the normative issue of the welfare effect of government spending shocks. We find that the welfare cost varies substantially across households types. While an increase in government spending implies a welfare loss for patient households and impatient consumers with housing, the welfare of the remaining impatient households increases. Thus, the effect on aggregate welfare of changes in government spending depends critically on the distribution of wealth and credit among the population. We find that the share of households in the left tail of the net wealth distribution has a disproportionate effect on the aggregate marginal propensity to consume, the value of the fiscal multiplier and the distributional consequences of fiscal shocks.



The rest of the paper is organized as follows. Section 2 overviews the related literature. Section 3 describes the data set and the criteria used to identify the types of households according to their balance sheet positions. Section 4 introduces the theoretical model. Section 5 discusses our calibration strategy. Section 6 explores the transmission mechanism of government spending shocks in the model and its evolution for each of the PSID waves. Section 7 analyzes the relationship between fiscal multipliers and wealth inequality and also explores the welfare effects of fiscal shocks. Section 8 concludes.

## 2 Literature review

This paper is related to the literature on the effects of fiscal policy in an economy with financial frictions. Some papers such as Agarwal et al. (2007), using U.S. data, and Agarwal and Quian (2014), using Singapore data, show that, after a government transfer, spending increases the most for consumers who were most likely to be financially constrained. In our model, financial rigidities take the form of housing collateral, as in Kiyotaki and Moore (1997); Iacoviello (2005); and Liu et al. (2013).<sup>3</sup>

This paper is also related to the literature analyzing the effect of heterogeneous behavior and distributional dynamics in the aggregate effects of economic shocks. Carroll et al. (2014) and Carroll et al. (2017) set up a model with heterogeneity in the rate of time preference to show that matching the wealth distribution is key to obtaining a realistic distribution of the marginal propensity to consume. In Kaplan and Violante (2014) and Kaplan et al. (2014) households can store wealth in liquid or illiquid assets and hand-to-mouth behavior emerges endogenously, both in poor households and wealthy households with illiquid assets. They show that hand-to-mouth households, both wealthy and poor, have significantly stronger responses to transitory income shocks than non-hand-to-mouth households. For Krueger et al. (2016), household heterogeneity in terms of earnings, wealth, and the time discount factor is essential to understanding the amplification effect of aggregate productivity shocks. The amplification channel is only present when there is a large fraction of households in the left tail of the distribution.

Recently, this literature has focused on the role of household heterogeneity in the transmission of fiscal policy. Brinca et al. (2016) develop a life-cycle model with heterogeneous agents and incomplete markets. Households are heterogeneous with respect to asset holdings, productivity, and rate of time preference. They find that the fiscal multiplier is highly sensitive to the fraction of the population facing binding credit constraints and to the average wealth level in the economy. Antunes and Ercolani (2016) use a general equilibrium,

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<sup>3</sup>Fernández-Villaverde (2010) explores the transmission of fiscal shocks in a model with financial frictions in the form of an endogenous premium on loans, and Canzoneri et al. (2016) consider financial frictions in the form of a bank intermediation cost.

flexible-price model with household heterogeneity in terms of wealth and endogenous household borrowing against uncollateralized assets to study the effects of fiscal-driven expansions of public debt on output, credit, and welfare. For example, the dynamics of the household borrowing limit generated by these policies increases the utility of borrowers and wealth-poor agents, while it reduces that of the wealth-rich group. The model by Oh and Reis (2012) includes borrowing constraints and price rigidities to show the importance of using targeted public transfers to redistribute wealth across agents in order to increase aggregate consumption, employment, and output. McKay and Reis (2016) augment this framework to study the effects of automatic stabilizers in the United States. Their model considers two groups of households divided according to their degree of impatience and allows for shocks to skills and labor status for the impatient households, generating a changing distribution of wealth and marginal propensities to consume over the cycle.

In our model, the responses of asset prices and debt to the government spending shocks are key in the characterization of the transmission mechanism of fiscal policy. The link between house price movements and household consumption has been widely studied in the literature (see, for example, Campbell and Cocco, 2007; Attanasio, Blow, Hamilton, and Leicester, 2009; and Angrisani, Hurd, and Rohwedder, 2015). Recently, researchers have studied the role of household debt in the transmission of fiscal policy. Parker et al. (2013) find that, after a tax rebate, homeowners spend more than renters. Surico and Trezzi (2015) find that the response to a change in property taxes is more pronounced for homeowners with mortgage debt and Cloyne and Surico (2017) show that homeownership per se is not the driver of the different consumption response to a tax change but mortgage indebtedness. Acconcia et al. (2015) show that government transfers have an effect on consumption only for indebted homeowners with low liquidity-to-wealth ratio. Misra and Surico (2014) also find that households with both a high level of mortgage debt and a high level of income have the largest propensity to consume after a tax rebate.

Moreover, the aggregate effects of fiscal shocks are higher in environments characterized by heightened financial stress. Based on a panel of OECD countries, Klein (2017a) concludes that fiscal consolidation leads to severe contractions when implemented in high private debt states. Demyanyk et al. (2016) document that relative fiscal multipliers are higher in U.S. geographies with higher consumer indebtedness. Bernardini and Peersman (2016) find the aggregate government spending multiplier in the United States over the past century to be higher in periods of private debt overhang. Using data on U.S. states, Bernardini et al. (2017) estimate fiscal multipliers ranging from 0 and more than 4 in the period surrounding the Great Recession, depending on the state of the business cycle, household indebtedness, and the interaction between the two.

Along the lines of Brinca et al. (2016) and Carroll et al. (2017), our model predicts a positive correlation between the fiscal multiplier and wealth inequality. Agnello and Sousa (2014) find that spending-driven fiscal adjustments deteriorate income distribution, whereas in Klein and Winkler (2017), austerity leads to a strong and persistent increase in income

inequality only in periods of private debt overhang. DeGiorgi and Gambetti (2012) find that after a government spending shock consumption increases at the bottom of the consumption distribution but falls at the top, implying a reduction of consumption inequality. Also, Anderson et al. (2016) conclude that government spending policy shocks tend to decrease consumption for the wealthiest individuals and increase it for the poorest.

### 3 Identifying household types in the data

In this section, we describe our identification strategy for households as a function of their individual characteristics along three dimensions: attitude towards savings, homeownership, and access to credit. We consider data for the 1999-2013 period from the Panel Study of Income Dynamics (PSID), which surveys a representative sample of U.S. households and individuals every odd year.

We first classify households as patient or impatient by comparing their non-housing wealth and their income. We focus on non-housing wealth because investment in real estate may be considered compatible with a high discount of the future by impatient households to the extent that housing provides current utility services. Non-housing wealth corresponds to the PSID variable “wealth” net of the equity value of the main home.<sup>4</sup> Our definition of income includes salaries and other compensation plus private and government transfers.<sup>5</sup>

Table 1 summarizes our identification strategy of household types. As described in the first column of Table 1, we use a threshold strategy to classify households as patient or impatient: a household is classified as patient (impatient) if her non-housing wealth is above (below) a certain percentage  $a$  of her income. In this paper, we also incorporate into the analysis households with negative wealth, who are classified as impatient households. Once a household qualifies as patient, we do not impose any additional restrictions on her balance sheet.

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<sup>4</sup>Non-housing wealth balances include the net value of farm or business assets; the value of checking accounts, savings accounts, money market funds, certificates of deposits, savings bonds, Treasury bills, and other IRAs; the value of debts other than mortgages (credit cards, student loans, medical and legal bills, personal loans); the net value of real estate other than main home; the value of private annuities or IRAs; the value of shares of stock in publicly held corporations; mutual or investment trusts; the value of other investments in trusts or estates, bond funds, life insurance policies, and special collections; and the net value of vehicle or other assets “on wheels”.

<sup>5</sup>Income incorporates salary; dividends; rent payments received; worker compensation; trust fund income; financial support from relatives; financial support from non-relatives; child support received; alimony received; supplemental security income; temporary assistance for needy families (state program) and other welfare; pensions/annuity; lump sum payments (inheritances, itemized deductions); and financial support given to others.

Table 1: HOUSEHOLD CLASSIFICATION: OUR PROPOSAL

	Threshold	Homeowner	Liabilities	Leverage
Patient: R	$W \geq a * I$	Unrestricted	Unrestricted	Unrestricted
Impatient: HH	$0 < W < a * I$	Yes	No	No
Impatient: BL	$0 < W < a * I$	Yes	Mortgage debt	Low
Impatient: BH	$0 < W < a * I$	Yes	Mortgage debt	High
Impatient: HNH	$0 < W < a * I$	No	No	No
Impatient: EK	$W \leq 0$	No	Non-mortgage debt	Unrestricted

Columns 2 to 4 in Table 1 summarize the classification criteria for balance sheet composition used for impatient households. We define five types of impatient households depending on whether they have assets, liabilities, or both in their balance sheet. In our identification strategy, we restrict the asset side of the balance sheet to one type of asset, real estate, while we consider two types of liabilities: mortgages (collateral-based debt) and non-collateral debt. In the PSID, non-collateral debt includes credit cards, student loans, medical and legal bills, and personal loans.

Among impatient households with real estate holdings, we distinguish three types of households: *(i)* households who own houses but do not borrow against them, labeled as *HH*; *(ii)* households whose loan-to-value ratios exceed the median loan-to-value ratio in the sample, labeled as *BH*; and *(iii)* households with a low loan-to-value ratio, labeled as *BL*. We consider two types of impatient households without assets: *(i)* households who, along the lines of traditional hand-to-mouth consumers of Galí et al. (2007), do not hold any assets or liabilities, labeled as *HNH*; and *(ii)* households who borrow against their future labor income, as in Eggertsson and Krugman (2012), thus holding a negative wealth, labeled as *EK*.

We explore several values for the threshold  $a \in (0, 1)$ . In Table 2, we report the empirical shares for the 1999 wave for  $a = \{0.25, 0.50, 0.75\}$ . The shares for households using the different cutoffs are within the values considered reasonable for calibration purposes. For clarity, in the remainder of the paper, we perform the analysis with the  $a = 0.50$  threshold, although we analyze the robustness of our results for the other cutoff values in Section 6.

Table 2: PSID SAMPLE WEIGHTS (IN %) FOR YEAR 1999

	$a = 0.25$	$a = 0.50$	$a = 0.75$
Patient: R	58	43	35
Impatient: HH	3	5	6
Impatient: BL	3	6	9
Impatient: BH	7	11	13
Impatient: HNH	13	19	21
Impatient: EK	16	16	16

Next, we characterize the distribution of non-housing wealth (in real terms) for the 1999 PSID wave. Table 3 reports the percentiles of the wealth distribution for each household category. By construction, indebted impatient households without assets – households with negative wealth, *EK*, – are classified as the least wealthy for all wealth quantiles. But, more importantly, for all wealth quantiles, patient households can be classified as the wealthiest households, which aligns well with our classification of these households as savers or patient. Moreover, Table 3 also provides evidence on the dispersion of the wealth distribution for each type of household. The most disperse wealth distribution corresponds to patient households.

Table 3: NON-HOUSING (REAL) WEALTH PERCENTILES FOR YEAR 1999

Household	p10	p25	p50	p75	p90
Patient: R	13,210	27,685	65,652	166,108	402,615
Impatient: HH	791	1,582	4,271	8,701	16,532
Impatient: BL	1,622	4,350	10,599	18,351	29,267
Impatient: BH	1,661	3,639	8,543	14,633	24,521
Impatient: HNH	406	1,186	3,164	7,119	11,865
Impatient: EK	-15,978	-5,932	-949	0	0

*Note:* The values represent the cutoff values for real non-housing wealth.

Table 4 reports the shares of each type of household that belong to the interquartile ranges of the overall wealth distribution in our sample for 1999. While most of the Ricardian households are concentrated in the interquartile ranges above the median wealth in the sample, all impatient households with negative wealth, *EK*, are concentrated in the lower 25 percent tail of the wealth distribution for households. The bulk of the other impatient households is concentrated around the median of the wealth distributions. Most of the impatient households with positive wealth fall into the interquartile ranges around the median of the wealth distribution.

Table 4: DISTRIBUTION OF HOUSEHOLDS ACROSS REAL NON-HOUSING WEALTH PERCENTILES FOR EACH HOUSEHOLD TYPE: 1999

Percentile	p0- <b>p10</b>	p10 - <b>p25</b>	p25 - <b>p50</b>	p50 - <b>p75</b>	p75 - <b>p90</b>	p90 - p100
Patient: R	0	1	5	32	36	25
Impatient: HH	0	10	66	23	1	0
Impatient: BL	0	4	40	54	2	0
Impatient: BH	0	4	48	46	2	0
Impatient: HNH	0	15	68	16	0	0
Impatient: EK	44	56	0	0	0	0

*Note:* Percentiles are bolded to represent the bracket containing that percentile; that is, p10 - **p25** indicates that  $p25 \geq wealth > p10$ .

Again, if we consider the overall wealth distribution of the households in our sample, we can run the identification strategy defined in Table 1 for each interquartile range. Table 5

shows that the lowest 10 percentiles of the overall wealth distribution are populated only by indebted impatient households without assets and that the highest 25 percentiles are mostly populated by patient households. However, the interquartile ranges around the median – 25 to 50 and 50 to 75 – highlight the diversity of household types in the middle of the wealth distribution.

Table 5: DISTRIBUTION OF HOUSEHOLDS WITHIN REAL NON-HOUSING WEALTH PERCENTILES FOR YEAR 1999

Percentile	p0- <b>p10</b>	p10 - <b>p25</b>	p25 - <b>p50</b>	p50 - <b>p75</b>	p75 - <b>p90</b>	p90 - p100
Patient: R	0	3	9	52	97	99
Impatient: HH	0	4	13	4	0	0
Impatient: BL	0	2	10	13	1	0
Impatient: BH	0	4	20	19	1	0
Impatient: HNH	0	21	49	11	0	0
Impatient: EK	100	71	0	0	0	0

*Note:* Percentiles are bolded to represent the bracket containing that percentile; that is, p10 - **p25** indicates that  $p25 \geq wealth > p10$ .

Having offered a picture of the wealth distribution, we turn to the income distribution, which is summarized by the quantiles in Table 6. In this case, the picture is slightly different: Patient households do not have the highest level of income. For example, the median income of a patient household is 12 percent lower than the median income of impatient homeowners with mortgage debt.

Comparing Table 3 and Table 6, we conclude that, at the median, a patient household has a non-housing wealth that is 65 percent larger than her income, while the wealth-to-income ratio for impatient households is below 1. Moreover, Table 7 shows the share of patient households for all income interquartiles of the overall income distribution in the sample, even for the lowest ones, is significant. For example, almost 30 percent of households in the 0 to 10 percentile bracket are classified as patient. Thus, we argue that the threshold strategy we propose here allows us to separate households as a function of their attitude toward savings, not as a function of the liquidity constraints they may face. This is why we label patient households as Ricardian – we assume they behave following Ricardian equivalence.

Table 6: (REAL) INCOME PERCENTILES FOR YEAR 1999

Household	p10	p25	p50	p75	p90
Patient: R	9,522	22,103	39,550	66,316	102,434
Impatient: HH	7,155	14,238	25,628	38,954	55,369
Impatient: BL	18,292	29,449	44,699	66,588	96,897
Impatient: BH	19,799	31,656	44,580	63,343	87,405
Impatient: HNH	7,910	13,842	22,955	34,408	49,042
Impatient: EK	3,250	7,248	15,029	26,819	38,509

Table 7: DISTRIBUTION OF HOUSEHOLDS WITHIN REAL INCOME PERCENTILES FOR YEAR 1999

Percentile	p0- <b>p10</b>	p10 - <b>p25</b>	p25 - <b>p50</b>	p50 - <b>p75</b>	p75 - <b>p90</b>	p90 - p100
Patient: R	32	31	35	44	55	71
Impatient: HH	6	7	6	6	3	2
Impatient: BL	1	3	5	8	11	9
Impatient: BH	1	3	8	17	19	13
Impatient: HNH	18	28	28	17	8	3
Impatient: EK	43	27	18	8	3	2

*Note:* Percentiles are bolded to represent the bracket containing that percentile; that is, p10 - **p25** indicates that  $p25 \geq RealIncome > p10$ .

We revise the evolution of non-housing wealth for each household category over time in Figure 1. The two distributions that change the most are the one for Ricardians, which shifts more density to its right tail, and the one for impatient households with no assets and no liabilities, which gets a fatter left tail. These results point toward an increase in wealth inequality, which is evident when computing the Gini coefficient: it increases from 0.851 in 1999 to 0.874 in 2013, as reported in Table A.1 in Appendix A.

Table 8 reports the empirical weights for each type of household in each PSID wave from 1999 to 2013. Our identification strategy leads, on average, to a 40 percent share of patient households and, hence, a 60 percent share of impatient households. The share of impatient households without assets is larger than the share of impatient households with assets, on average, 40 percent and 20 percent, respectively. Over time, the distribution of shares is quite stable until 2007, when there are bigger shifts across categories. The largest changes in the relative share in the population are for patient households and indebted impatient households without assets, *EK*. The share of patient households declines from 43 percent in 1999 to 37 percent in 2013, while the share of indebted impatient households without assets increases from 16 percent to 24 percent.<sup>6</sup>

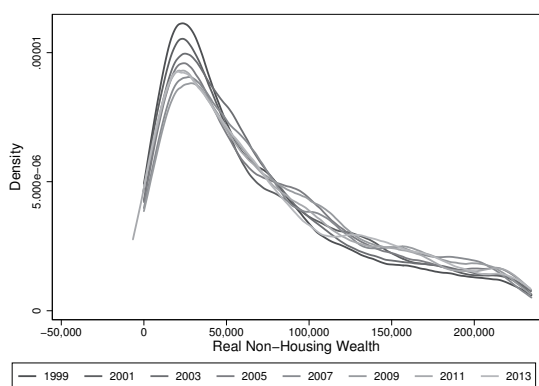
Table 8: PSID SAMPLE WEIGHTS (IN %)

	1999	2001	2003	2005	2007	2009	2011	2013
Patient: R	43	43	43	42	42	38	38	37
Impatient: HH	5	4	5	4	4	3	4	4
Impatient: BL	6	7	7	7	6	7	6	5
Impatient: BH	11	12	11	11	10	10	9	9
Impatient: HNH	19	18	18	19	19	19	20	20
Impatient: EK	16	16	16	17	19	22	23	24
Total Impatient	57	57	57	58	58	62	62	63

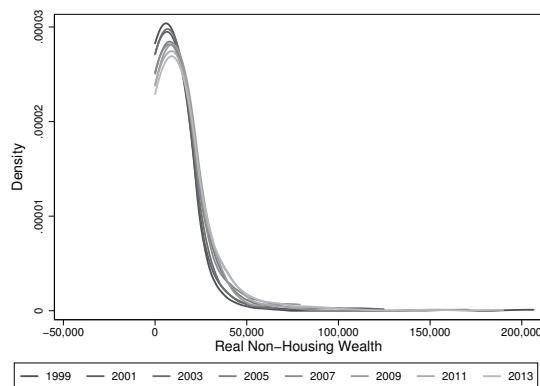
<sup>6</sup>Appendix C overviews the classification suggested by Kaplan et al. (2014) of households as Ricardians, wealthy hand-to-mouth, and poor hand-to-mouth.



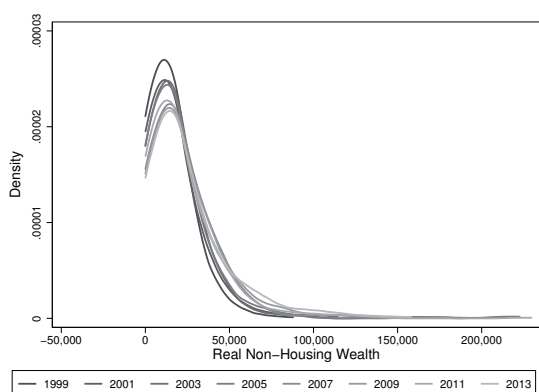
Figure 1: REAL NON-HOUSING WEALTH BY HOUSEHOLD TYPE



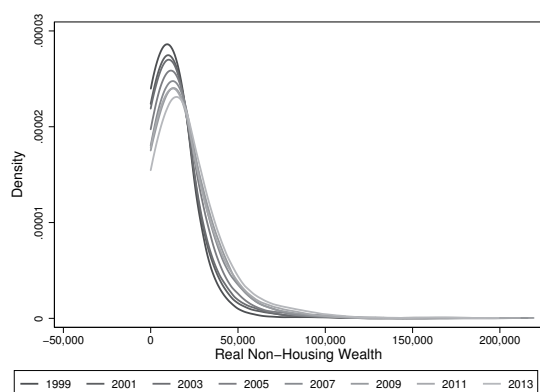
(a) Ricardian households



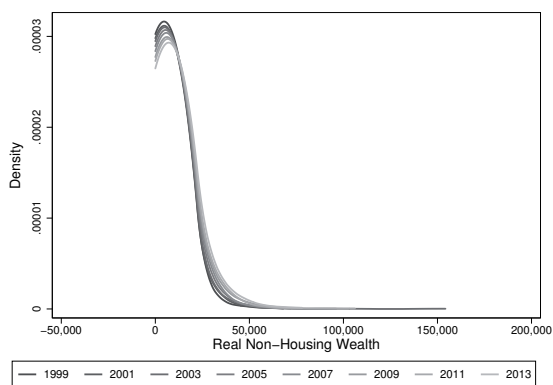
(b) Impatient homeowners without liabilities



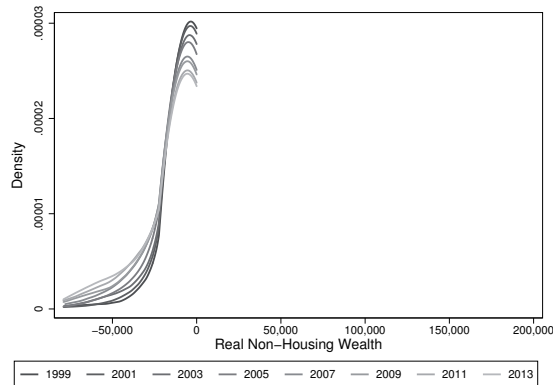
(c) Impatient homeowners with low leverage



(d) Impatient homeowners with high leverage



(e) Impatient non-homeowners without liabilities



(f) Impatient non-homeowners with negative wealth

## 4 The model

We consider a standard New Keynesian model with balance sheet heterogeneity in the household sector and search and matching frictions. Andrés et al. (2015) argue that the response of the intensive and extensive margins of labor to fiscal shocks is key to explaining the size of the output multiplier in the presence of financial heterogeneity. We assume that there is perfect risk sharing among household members and that all workers are equally productive and delegate the negotiation of wages and hours with firms to a union. Thus, in equilibrium, all households earn the same labor income. Abstracting from labor income heterogeneity and from the potential interactions between employment status and household balance sheet composition are strong assumptions. But, in this way, we can isolate the role of diversity in households' balance-sheet composition in the transmission of government spending shocks.

### 4.1 Households

The economy is populated by  $N$  households who differ in their degree of impatience, the conditions of access to credit, and homeownership status. Let  $N^i$  denote the mass of  $i^{th}$  type households and  $\tau^i = \frac{N^i}{N}$  be the weight of the  $i^{th}$  type households in the total population.

Ricardian households,  $R$ , are the standard financially unconstrained patient households in macro models. Ricardian households are net savers/lenders that own assets other than their main home (physical capital, deposits, public debt, etc.) and do not have liabilities. In our economy, Ricardian households coexist with financially constrained individuals who are more impatient than them. Some, but not all, impatient households are net borrowers. We assume that borrowers face a binding borrowing constraint due to some underlying friction in the credit market.

While some impatient households are homeowners, others do not have housing. Among impatient homeowners, we distinguish three types of households according to the quality of the collateral services provided by their real estate: (i) households who own houses but do not have access to credit –  $HH$  households; (ii) households who can borrow against a high proportion of the expected value of their real estate holdings –  $BH$  households; and (iii) households who can borrow against a low proportion of the expected value of their home –  $BL$  households. Impatient homeowners with access to credit resemble borrowers à la Kiyotaki and Moore (1997) and Iacoviello (2005).

We consider two types of impatient households without housing holdings: (i) traditional hand-to-mouth consumers à la Galí et al. (2007) who have zero net worth –  $HNH$  households; and (ii) households who borrow against their current and expected future labor income, as in Eggertsson and Krugman (2012) –  $EK$  households – and, hence, have negative wealth.

The specification of preferences is common across household types although parameterizations are type-specific. Households' life time utility function is defined over consumption,  $c_t^i$ ; housing holdings,  $x_t^i$ ; and leisure of her employed and unemployed members.  $l_{1t}$  are hours

worked per employee, and  $l_2$  are hours spent job seeking by the unemployed members of the household. Hours worked are determined through the bargaining process between the union and firms, while the hours devoted to job seeking are determined exogenously,

$$\mathbb{E}_t \sum_{t=0}^{\infty} \beta_i^t \left[ \ln c_t^i + \phi_x^i \ln x_t^i + \phi_1 n_{t-1}^i \frac{[1 - l_{1t}]^{1-\eta}}{1 - \eta} + \phi_2 (1 - n_{t-1}^i) \frac{[1 - l_2]^{1-\eta}}{1 - \eta} \right], \quad (1)$$

where  $\beta_i$  is the type-specific discount rate. In particular, we assume that all impatient households share the same discount factor,  $\beta_I$ , and that the discount rate for Ricardians households,  $\beta_R$  is larger than that for impatient households. As shown in Iacoviello (2005), in the absence of uncertainty, the assumption  $\beta_R > \beta_I$  ensures that the borrowing constraints for impatient households are binding. We assume that homeowners share the same parameter governing preferences over housing,  $\phi_x^R = \phi_x^{HH} = \phi_x^{BH} = \phi_x^{BL} = \phi_x$ , and this parameter is set to zero for households without real estate holdings. The remaining preference parameters are the Frisch elasticity of labor supply,  $\eta$ ; the valuation of leisure by employed members of the household,  $\phi_1$ ; and the valuation of leisure by the unemployed members,  $\phi_2$ .

Another common feature of the optimization problem of households is the law of motion for employment,  $n_t^i$ , in the constraint set, which is given by

$$n_t^i = (1 - \sigma) n_{t-1}^i + \rho_t^w (1 - n_{t-1}^i), \quad (2)$$

Under our model assumptions,  $n_t^i = n_t$  for all households and jobs are destroyed each period at the exogenous rate  $\sigma$ . New employment opportunities come at the rate  $\rho_t^w$ , which is the probability that an unemployed worker finds a job. This probability is taken as exogenous by individual workers, but it is endogenously determined at the aggregate level according to the matching function,

$$\rho_t^w (1 - n_{t-1}) = \chi_1 v_t^{\chi_2} [(1 - n_{t-1}) l_2]^{1-\chi_2}, \quad (3)$$

where  $v_t$  stands for the number of active vacancies during period  $t$ , and  $\chi_1$  and  $\chi_2$  are the parameters of the Cobb-Douglas matching function.

Finally, let  $\Omega_t^i$  be the value function for household  $i$ . Let us derive here the marginal value of employment for a worker,  $\lambda_{ht}^i$ , which plays a key role in the bargaining process discussed in the following. Essentially,  $\lambda_{ht}^i$  measures the marginal contribution of a newly created job to the household's utility

$$\lambda_{ht}^i \equiv \frac{\partial \Omega_t^i}{\partial n_{t-1}^i} = \lambda_{1t}^i w_t l_{1t} + \left( \phi_1 \frac{[1 - l_{1t}]^{1-\eta}}{1 - \eta} - \phi_2 \frac{[1 - l_2]^{1-\eta}}{1 - \eta} \right) + [1 - \sigma - \rho_t^w] \beta^i \mathbb{E}_t \lambda_{ht+1}^i, \quad (4)$$

where  $\lambda_{1t}^i$  is the household's marginal utility of consumption. The first term on the right hand side captures the value of the cash flow generated by the new job at time  $t$ , evaluated in consumption terms. The second term represents the net utility from the newly created job.

The third term represents the “capital value” of an additional employed worker, conditional on her keeping the employment status in the future.

Given our assumptions, the labor market decisions, both for the extensive and the intensive margins, are identical for all households and, hence, they receive the same labor income. Thus, in our model, heterogeneity in consumption can only be driven by differences in balance sheet composition. In the remainder of this subsection, we describe the constraint set for each type of household.

**Ricardian households:** Patient households are the only savers in the economy. They lend  $d_t^R$  to the private sector and  $d_t^P$  to the public sector through short-term nominal contracts. We assume that the nominal returns on public and private loans are equal to the policy rate,  $r_t^n$ . Patient households are also the owners of physical capital,  $k_t^R$ . They undertake productive investment,  $j_t^R$ , which is subject to adjustment costs. Patient households accrue any extraordinary profits of firms in the form of dividends,  $f_t^R$ .

Patient consumers choose paths for consumption,  $c_t^R$ ; housing holdings,  $x_t^R$ ; leisure,  $1-l_{1t}$ ; private lending,  $d_t^R$ ; public lending,  $d_t^P$ ; and investment,  $j_t^R$  to optimize their lifetime utility subject to the budget constraint, the capital accumulation equation, and the law of motion for employment. The budget constraint for patient households is given by

$$c_t^R + j_t^R \left[ 1 + \frac{\phi}{2} \left( \frac{j_t^R}{k_{t-1}^R} \right) \right] + q_t [x_t^R - x_{t-1}^R] + d_t^R + d_t^P = w_t n_{t-1} l_{1t} + r_t k_{t-1}^R + (1 + r_{t-1}^n) \frac{d_{t-1}^P + d_{t-1}^R}{1 + \pi_t} + f_t^R + trh_t, \quad (5)$$

where  $w_t n_{t-1} l_{1t}$  is the labor income earned by the fraction of employed workers,  $q_t$  stands for the real price of housing,  $[x_t^R - x_{t-1}^R]$  is housing investment, and  $trh_t$  stands for lump sum transfers (taxes) from (to) the government. We assume that debt contracts are in nominal terms and there is a fixed amount of real estate in the economy.

The capital accumulation equation is

$$k_t^R = (1 - \delta) k_{t-1}^R + j_t^R. \quad (6)$$

**Impatient homeowners:** Impatient homeowners use all of their disposable income to consume and invest in housing. In addition to the law of motion of employment, their constraint set contains a budget constraint and, if they are indebted, a borrowing constraint. The budget constraint of impatient homeowners without liabilities,  $HH$ , is given by

$$c_t^{HH} + q_t (x_t^{HH} - x_{t-1}^{HH}) = w_t n_{t-1} l_{1t}, \quad (7)$$

while the borrowing constraint for indebted impatient homeowners,  $i = \{BH, BL\}$ , is

$$c_t^i + q_t (x_t^i - x_{t-1}^i) + (1 + r_{t-1}^n) \frac{b_{t-1}^i}{1 + \pi_t} = w_t n_{t-1} l_{1t} + b_t^i. \quad (8)$$

Indebted impatient homeowners can borrow against the expected future value of their housing holdings up to a fraction  $m^i$

$$b_t^i \leq m^i \mathbb{E}_t \left[ \frac{q_{t+1} (1 + \pi_{t+1}) x_t^i}{1 + r_t^n} \right], \quad (9)$$

with  $m^i$  being larger for indebted impatient homeowners with high leverage than for those with low leverage – that is,  $m^{BH} > m^{BL}$ .

**Impatient non-homeowners:** Impatient non-homeowners do not have housing. We ignore the question of whether that is due to a lack of access to the market or preferences, but we just assume that their valuation of homeownership is zero by imposing  $\phi_x^j = 0$  in the utility function. Impatient households without assets or liabilities,  $HH$ , are the traditional hand-to-mouth consumers and their constraint set is characterized by the following budget constraint:

$$c_t^{HH} = w_t n_{t-1} l_{1t}. \quad (10)$$

We assume that indebted households without collateralizable assets,  $EK$ , borrow against a weighted sum of their current and future labor income. In particular, their borrowing constraint is given by

$$b_t^{EK} \leq m^{EK} \left( 0.1 w_t n_t l_t + \mathbb{E}_t \left[ \sum_{j=1}^3 0.3 \frac{(1 + \pi_{t+j}) w_{t+j} n_{t+j} l_{1,t+j}}{1 + r_t^n} \right] \right) \quad (11)$$

and their budget constraint by

$$c_t^{EK} + (1 + r_{t-1}^n) \frac{b_{t-1}^{EK}}{1 + \pi_t} = w_t n_{t-1} l_{1t} + b_t^{EK}. \quad (12)$$

## 4.2 Firms

Production in our model economy is organized in three different levels. Firms in the competitive wholesale sector use labor and capital to produce a homogeneous good, which is bought by monopolistically competitive intermediate firms. These intermediate firms transform the homogenous good into firm-specific varieties that are bought by retail firms. The competitive retail sector is populated by firms producing homogeneous final goods,  $y_t$ , by combining a continuum of intermediate goods.

**Retailers:** The retail sector is populated by infinitely lived and perfectly competitive firms producing final goods,  $y_t$ , by combining a continuum of intermediate goods,  $y_t^l, l \in [0, 1]$ ,

according to a Dixit-Stiglitz aggregator. The profit maximization problem for retailers is given by

$$\text{Max}_{y_t^l} \left\{ P_t y_t - \int_0^1 P_t^l y_t^l d_l \right\},$$

subject to

$$y_t = \left[ \int_0^1 (y_t^l)^{(1-1/\theta)} d_l \right]^{\frac{\theta}{\theta-1}}. \quad (13)$$

**Intermediate goods producers:** There is a continuum of infinitely lived producers of intermediate goods, indexed by  $l \in [0, 1]$ , operating under monopolistic competition. They buy the wholesale good at price  $P_t^w$  and transform it into a firm-specific variety  $y_t^l$  that is sold to the retail firm at price  $P_t^l$ .

Intermediate goods producers face a pricing problem in a sticky price framework à la Calvo (1983). At any given period, an intermediate producer is allowed to reoptimize her price with probability  $(1 - \omega)$ . Those firms that do not reoptimize their prices set them using a partial indexation rule:  $P_t^l = (1 + \pi_{t-1})^\varsigma P_{t-1}^l$ . The fraction of firms that set their prices optimally choose the price  $P_t^*$  that maximizes the present value of expected profits.

**Wholesale producers:** There is a continuum of infinitely lived wholesale producers, indexed by  $j \in [0, 1]$ , operating under perfect competition. Firms in the wholesale sector are the actual producers in the model economy. Production is conducted combining labor and capital using a Cobb-Douglas technology. Factor demands are obtained by solving the profit maximization problem faced by each wholesale producer

$$\min_{k_t, v_t} E_t \sum_{t=0}^{\infty} \beta_R^t \frac{\lambda_{1t+1}^R}{\lambda_{1t}^R} (y_t - r_t k_{t-1} - w_t n_{t-1} l_{1t} - \kappa_v v_t), \quad (14)$$

subject to

$$y_t = A k_{t-1}^{1-\alpha} (n_{t-1} l_{1t})^\alpha, \quad (15)$$

$$n_t = (1 - \sigma) n_{t-1} + \rho_t^f v_t. \quad (16)$$

Future profits are discounted using the stochastic discount factor of patient households because they are the owners of the firms. We assume that all workers are perfect substitutes in production irrespective of their balance sheet position. The probability of filling a vacancy at any given period  $t$ ,  $\rho_t^f$  is exogenous from the perspective of the firm but, at the aggregate level, this probability is endogenously determined by the following condition:

$$\rho_t^w (1 - n_{t-1}) \rho_t^f v_t = \chi_1 v_t^{\chi_2} [(1 - n_{t-1}) l_2]^{1-\chi_2}. \quad (17)$$

The solution to the previous optimization problem delivers the following first order conditions with respect to capital and vacancies:

$$r_t = (1 - \alpha) \frac{y_t}{k_{t-1}} \quad (18)$$

$$\frac{\kappa_v}{\rho_t^f} = \beta_R \mathbb{E}_t \left[ \frac{\lambda_{t+1}^R}{\lambda_{1t}^R} \frac{\partial V_{t+1}}{\partial n_t} \right], \quad (19)$$

where  $V_t$  stands for the value function of the wholesale producer. Equation (19) reflects that firms choose the number of vacancies so that the marginal posting cost per vacancy,  $\kappa_v$ , is equal to the expected present value of holding the vacancy, where  $\frac{\partial V_{t+1}}{\partial n_t}$ . The marginal value of an additional match for the firm,  $\lambda_{ft}$ , is

$$\lambda_{ft} = \alpha \frac{y_t}{n_{t-1}} - w_t l_{1t} + (1 - \sigma) \beta_R \mathbb{E}_t \left[ \frac{\lambda_{1t+1}^R}{\lambda_{1t}^R} \frac{\partial V_{t+1}}{\partial n_t} \right]. \quad (20)$$

The marginal contribution of a new job to profits is equal to the marginal product net of the wage bill, plus the capital value of the new job, adjusted by the probability of the match continuing in the future.

Given that capital is pre determined, wholesale producers respond to unanticipated shocks by adjusting labor input. In addition, to optimally choosing vacancy postings in response to the shock, wholesale producers decide on the intensive margin of labor by engaging in a negotiation with the trade union described in the following.

### 4.3 Trade in the Labor Market: The Labor Contract

Following Andrés et al. (2013), we assume that although households types may differ in their reservation wages, they delegate wage and hours bargaining to a trade union. The trade union maximizes the aggregate marginal value of employment for workers

$$\lambda_{ht} = \sum_{i \in I} \tau^i \frac{\lambda_{ht}^i}{\lambda_{1t}^i}, \quad (21)$$

where  $\frac{\lambda_{ht}^i}{\lambda_{1t}^i}$  represents the premium, in terms of consumption, of employment over unemployment for household type  $i$ . The premiums are weighted according to the shares in the population for each type of household. Delegating the bargaining process to a union implies that all households receive the same wage, work the same number of hours, and face the same unemployment rate.

The Nash bargaining problem maximizes the weighted product of the surpluses of the union and the representative wholesale firm

$$\max_{w_t, l_{1t}} \left[ \sum_{i \in I} \tau^i \frac{\lambda_{ht}^i}{\lambda_{1t}^i} \right]^{\lambda^w} (\lambda_{ft})^{1-\lambda^w} = (\lambda_{ht})^{\lambda^w} (\lambda_{ft})^{1-\lambda^w}, \quad (22)$$



where  $\lambda^w \in [0, 1]$  represents the union's bargaining power.

The solution to the Nash bargaining problem gives the optimal hours worked

$$\alpha \frac{y_t}{n_{t-1} l_{1t}} = \phi_1 (1 - l_{1t})^{-\eta} \sum_{i \in I} \frac{\tau^i}{\lambda_{1t}^i}, \quad (23)$$

and the optimal real wage

$$\begin{aligned} w_t l_{1t} = & \lambda^w \left[ \alpha \frac{y_t}{n_{t-1}} + \frac{\kappa_v v_t}{1 - n_{t-1}} \right] \\ & + (1 - \lambda^w) \left[ \phi_2 \frac{(1 - l_2)^{1-\eta}}{1 - \eta} - \phi_1 \frac{(1 - l_{1t})^{1-\eta}}{1 - \eta} \right] \sum_{i \in I} \frac{\tau^i}{\lambda_{1t}^i} \\ & + (1 - \lambda^w) (1 - \sigma - \rho_t^w) \sum_{\tilde{i} \in \tilde{I}} \tau_t^i \mathbb{E}_t \left[ \frac{\lambda_{ht+1}^{\tilde{i}}}{\lambda_{1t+1}^{\tilde{i}}} \left( \beta^R \frac{\lambda_{1t+1}^R}{\lambda_{1t}^R} - \beta^{\tilde{i}} \frac{\lambda_{1t+1}^{\tilde{i}}}{\lambda_{1t}^{\tilde{i}}} \right) \right], \quad (24) \end{aligned}$$

where  $i \in I$  refers to all types of households and  $i \in \tilde{I}$  refers to the impatient consumers. The wage prevailing in the search equilibrium is a weighted average of the highest feasible wage, which is given by the marginal product of labor plus hiring costs, and the outside option for the union members. This outside option has two components. The first is the weighted sum of the lowest acceptable wage for each type of household, which is given by the difference in the utility of leisure between employment and unemployment. The second is a weighted sum for impatient households of an inequality term in utility. Impatient households cannot smooth consumption intertemporally because they are constrained. However, when a match occurs, impatient households know that such a match continues with probability  $(1 - \sigma)$  in the future, yielding labor income that can be used for consumption. Hence, impatient households use the labor negotiations to improve their lifetime utility by narrowing the gap in utility with respect to intertemporal optimizing households. If the share of households with the wider gap in utility increases, then the resulting optimal wage in the bargaining process will be higher.

#### 4.4 Policy Instruments and Resources Constraint

The monetary authority follows a Taylor-type interest rate rule,

$$1 + r_t^n = (1 + r_{t-1}^n)^{r_R} [(1 + \pi_t)^{1+r_\pi} (1 + \bar{r}^n)]^{1-r_R}, \quad (25)$$

where  $\bar{r}^n$  is the steady-state level of the interest rate. The parameter  $r_R$  captures the level of interest rate inertia and  $r_\pi$  represents the weight given to inflation in the policy rule.

Revenues and expenditures are made consistent by the government intertemporal budget constraint,

$$d_t^P = g_t + tr h_t + \frac{1 + r_{t-1}^n}{1 + \pi_t} d_{t-1}^P. \quad (26)$$

To ensure stationarity of the debt-to-GDP ratio, we impose the following fiscal policy reaction function:

$$trh_t = trh_{t-1} - \psi_1 \left[ \frac{d_t^P}{gdp_t} - \frac{\overline{d^P}}{gdp} \right] - \psi_2 \left[ \frac{d_t^P}{gdp_t} - \frac{d_{t-1}^P}{gdp_{t-1}} \right], \quad (27)$$

where  $\psi_1 > 0$  captures the speed of adjustment from the current debt-to-GDP ratio toward the debt-to-GDP target ratio,  $\left(\frac{\overline{d^P}}{gdp}\right)$ . The value of  $\psi_2 > 0$  is chosen to ensure a smooth adjustment of current debt toward its steady-state level.

Finally, the aggregate resource constraint guarantees that the sum of demand components plus the cost of posting vacancies equals aggregate output,

$$y_t = A_t k_{t-1}^{1-\alpha} (n_{t-1} l_{1t})^\alpha = c_t + j_t \left( 1 + \frac{\phi}{2} \left[ \frac{j_t}{k_{t-1}} \right] \right) + g_t + \kappa_v v_t. \quad (28)$$

where

$$c_t = \sum_{i \in I} \tau^i c_t^i. \quad (29)$$

## 5 Calibration

We first describe the calibration of the household-specific parameters, which is summarized in Table 9. The first column reports the household weights,  $\tau^i$ , which are set to the PSID weights for 1999 in our baseline calibration. The second column shows the calibration of the intertemporal discount factor. Following Iacoviello (2005), the intertemporal discount factor for patient households,  $\beta_R$ , is equal to 0.99, and for impatient households,  $\beta_I$ , it is equal to 0.95. The third column reports the preference parameter on housing,  $\phi_x$ , which, by assumption, is identical for all homeowners and zero for non-homeowners. The value of this parameter, as well as the total stock of housing,  $X$ , depends on the value of the private-debt-to-output ratio at the steady state,  $\overline{d^R}/\overline{y}$ . As in Iacoviello (2005), the private-debt-to-output ratio,  $\overline{d^R}/\overline{y}$ , is chosen so that the total stock of housing over annual output is 140 percent. Given these assumptions, the preference parameter on housing,  $\phi_x$ , is set to 0.12. The last column in Table 9 reports the values for the leverage parameters,  $m^i$ : Low-leveraged homeowners,  $BL$ , can borrow up to 73.5 percent of the expected value of their real estate holdings; high-leveraged homeowners,  $BH$ , can leverage up to 98.5 percent; and impatient households with negative wealth,  $EK$ , can borrow against 50 percent of the weighted sum of their current and future labor income.

Table 9: CALIBRATED PARAMETERS: HOUSEHOLD SECTOR

<i>Type</i>	$\tau^i$	$\beta$	$\phi_x^i$	$m^i$
<i>R</i>	0.43	0.99	0.12	--
<i>HH</i>	0.05	0.95	0.12	--
<i>BL</i>	0.06	0.95	0.12	0.735
<i>BH</i>	0.11	0.95	0.12	0.985
<i>HNH</i>	0.19	0.95	0	--
<i>EK</i>	0.16	0.95	0	0.50

Table 10: CALIBRATED PARAMETERS

Parameter	Value	Source
Technology:		
Output elasticity to labor, $\alpha$	0.7	Choi and Ríos-Rull (2009)
Depreciation rate of capital, $\delta$	0.025	Inside plausible literature range
Elasticity of final goods, $\theta$	6	Inside plausible literature range
Frictions:		
Calvo parameter, $\omega$	0.75	Inside plausible literature range
Investment adjustment costs, $\phi$	5.5	QUEST II
Inflation indexation, $\varsigma$	0.4	Kolasa et al. (2012)
Policy:		
Fiscal reaction parameter, $\psi_1$	0.01	Andrés et al. (2016)
Fiscal reaction parameter, $\psi_2$	0.2	Andrés et al. (2016)
Steady state gov.-debt-to-output, $\bar{d}^p/\bar{y}$	0.73	Sample average 1999-2013
Steady state spending to output ratio, $\bar{g}/\bar{y}$	0.17	Sample average
Interest rate smoothing, $r_R$	0.73	Iacoviello (2005)
Interest rate reaction to inflation, $1 + r_\pi$	1.30	Iacoviello (2005)
Preferences:		
Labor elasticity, $\eta$	2	Andolfatto (1996)
Time spent job searching by unemployed, $l_2$	1/6	Andolfatto (1996) and Chéron and Langot (2004)
Time spent working, $\bar{l}_1$	1/3	Andolfatto (1996) and Chéron and Langot (2004)
Leisure preference (empl.), $\phi_1$	1.59	Steady-state equations
Leisure preference (unempl.), $\phi_2$	1.04	Steady-state equations
Labor market:		
Workers' bargaining power, $\lambda^w$	0.4	Inside plausible literature range
Scale parameter matching, $\chi_1$	1.56	Steady-state equations
Matching elasticity, $\chi_2$	0.6	Monacelli et al. (2010)
Cost of vacancy posting, $\kappa_v$	0.04	Choi and Ríos-Rull (2009)
Transition rate, $\sigma$	0.15	Andolfatto (1996) and Chéron and Langot (2004)
Vacancy filling probability, $\bar{\rho}^f$	0.9	Andolfatto (1996) and Chéron and Langot (2004)
LR employment ratio, $\bar{n}$	0.75	Choi and Ríos-Rull (2009)

Table 10 shows the calibration for the remaining parameters. We overview here the parameters linked to the monetary and fiscal policy rules, to preferences, and to search and matching frictions in the labor market.

The specification of the fiscal reaction function and its calibration following Andrés et al. (2016) guarantees a monetary equilibrium for a loose enough fiscal rule. The steady state value of transfers is such that the resulting the resulting public debt to output ratio is equal to 73%, which is the sample average in the years under analysis, 1999 to 2013. Similarly, the steady state value of the spending to output ratio is equal to its sample average, 17%. Taylor's rule parameters,  $r_R = 0.73$  and  $1 + r_\pi = 1.30$  are taken from Iacoviello (2005).

Regarding preference parameters, we assume that the labor supply elasticity,  $\eta$ , is equal to 2 so that the average individual labor supply elasticity, given by  $(\eta^{-1} [1/\bar{l}_1 - 1])$ , is equal to 1, as in Andolfatto (1996). Following Andolfatto (1996) and Chéron and Langot (2004), we set the fraction of time spent working,  $\bar{l}_1$ , equal to 1/3 and the fraction of time households spend searching,  $l_2$ , equal to 1/6. Values for  $\phi_1$  and  $\phi_2$  are obtained in conjunction with the marginal value of employment using a system of steady state equations.

Finally, we discuss the calibration of the parameters linked to the labor market. Worker's bargaining power,  $\lambda^w$ , is assumed to be equal to 0.4, which is also within the range of standard values in the literature<sup>7</sup>. We also assume that the equilibrium unemployment rate is socially efficient (see Hosios, 1990), which implies that  $\lambda^w = 1 - \chi_2$ , and then we set the elasticity of matching to vacancies  $\chi_2 = 0.6$ , which is close to the 0.5 value in Monacelli et al. (2010). The scale parameter of the matching function,  $\chi_1$ , can be computed using the identity between matching flows and unemployment flows, evaluated at the steady state.<sup>8</sup> We calibrate the ratio of recruiting expenditures to output,  $\kappa_v \bar{v}/\bar{y}$ , to represent 0.5 percentage points of output as in Chéron and Langot (2004) and Choi and Ríos-Rull (2009), and very close to the value of 0.44 implied by the calibration of Monacelli et al. (2010). From this ratio, we can obtain the cost of vacancy posting  $\kappa_v$ , which is then equal to 0.04. Following Andolfatto (1996) and Chéron and Langot (2004), we set the exogenous transition rate from employment to unemployment,  $\sigma$ , equal to 0.15 and the probability of a vacant position becoming a productive job,  $\bar{p}^f$ , equal to 0.9. The long-run employment rate,  $\bar{n}$ , is set to 0.75, as in Choi and Ríos-Rull (2009).

<sup>7</sup>For example, this value falls between the one in Christiano et al. (2011) and Mortensen and Nagypal (2007)

<sup>8</sup>Matching flows at the steady state are equal to  $\chi_1 \bar{v}^{\chi_2} [(1 - \bar{n}) l_2]^{1 - \chi_2}$  and the unemployment flows are equal to  $\sigma \bar{n}$ .

## 6 The transmission mechanism of government spending shocks

In this section, we study the transmission of government spending shocks in the model economy calibrated with the empirical weights of 1999. The size of the government spending shock is equal to 1 percent of output, and the shock is assumed to fall exponentially according to the function  $g_t = \rho_g g_{t-1}$  with  $\rho_g = 0.75$ . We first analyze the responses of the representative member of each type of household; second, we discuss the aggregate effects of fiscal shocks and their sensitivity to changes in the distribution of households.

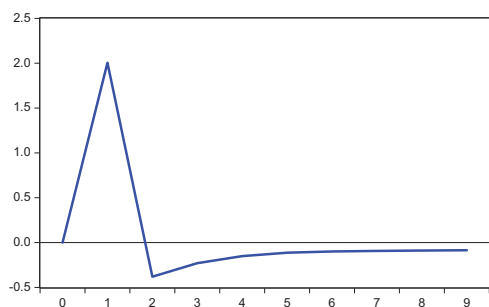
### 6.1 Individual Responses

Households' responses to a government spending shock are determined by the income effect, the wealth effect, and the credit effect. Given our assumptions regarding labor market frictions, the income effect is identical for all households in the model economy irrespective of their balance sheet characteristics. However, the wealth and credit effects are type-specific.

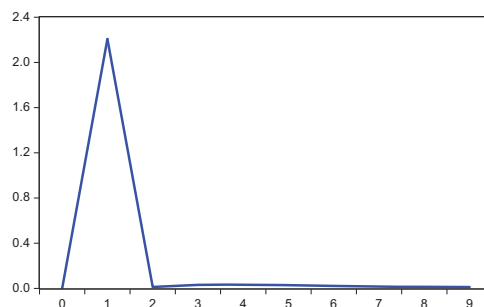
After an expansionary fiscal shock, given that capital is predetermined in our model economy, wholesale producers meet the additional product demand by increasing their labor demand. Wholesale producers can adjust both the intensive and extensive margin of labor input. While hours are optimally chosen each period, a newly filled vacancy is a potentially long-lasting relationship with the worker, as separations are not endogenous. As shown in Figure 2, in response to an expansionary government spending shock, wholesale firms mostly rely on adjusting the intensive margin on impact, only creating some employment in the subsequent periods. The relative magnitude of the responses of hours and employment are quite different: While the peak of hours is at around a 2 percent increase, the peak of employment is at around a 0.15 percent increase. The bargaining between the wholesale producers and the union results in an increase of wages on impact. The positive strong responses of hours and wages on impact, in addition to the very moderate increase in employment, translate into an increase of labor income for households. Therefore, the income effect of the government spending shock is positive and identical for all households.

Although the wealth effect is type-specific, there are some common features. For example, given the deflationary pressures on housing prices triggered by the government spending shock, as shown in Figure 3, wealth of homeowners in the model economy declines on impact. The inflationary pressures in overall prices reduce the real burden of debt for indebted impatient households. Fisher effects depress the real return on lending activities for patient households, which implies an even larger negative wealth effect. Therefore, while the wealth effect is clearly negative for patient households, the sign of the wealth effect for impatient homeowners is ambiguous, depending on their balance sheet composition and the calibration of the model.

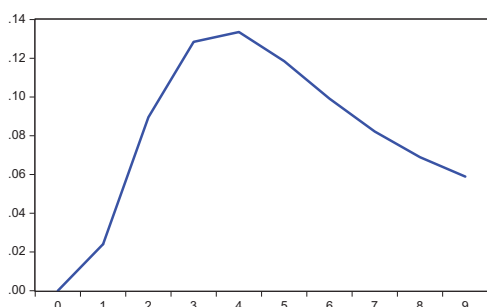
Figure 2: INCOME EFFECT: RESPONSE TO A GOVERNMENT SPENDING SHOCK (IN DEVIATIONS FROM STEADY STATE)



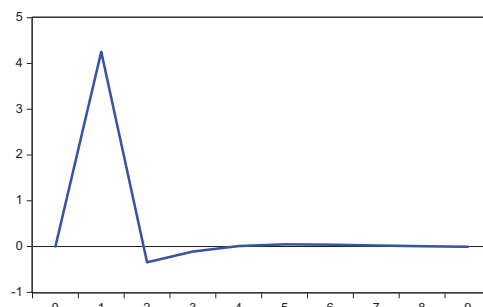
(a) Wage



(b) Hours



(c) Employment

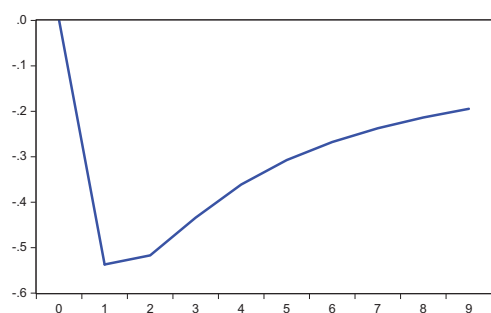


(d) Income

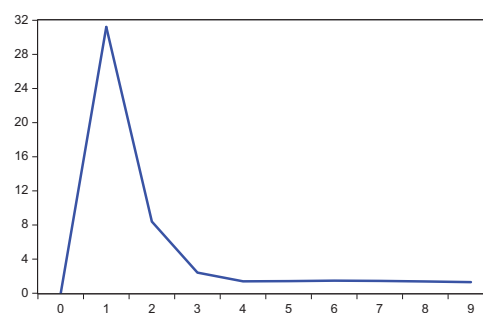
Overall, the available resources for consumption for patient households are scarcer after an expansionary government spending shock because, as shown in Figure 4(c), the fiscal shock triggers an expansion of both public and private debt that, in our model, must be financed by patient households. As shown in Figure 4(b), the negative wealth effect translates into a negative response of investment in both housing (red line) and physical capital (blue line) for patient households. Therefore, as reported in Figure 4(a), the negative wealth and credit effects more than dominate the positive income effect resulting in a negative response of consumption (red line) by patient households on impact that exceeds that of wealth (blue line).

Figure 5 reports the impulse response functions for impatient homeowners. The wealth effect for impatient homeowners without liabilities is unambiguously negative, given the devaluation of the housing holdings, and the credit effect is zero. As shown in Figure 5(a), the income effect dominates the wealth effect for impatient homeowners, as the response of consumption (red line) is positive on impact and the demand for housing increases on impact, as reported in Figure 5(b). Impatient homeowners use the investment in real estate to do some intertemporal smoothing.

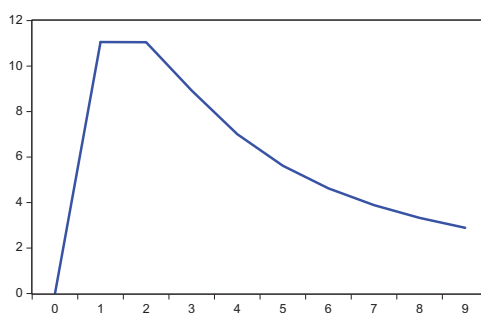
Figure 3: WEALTH EFFECT: RESPONSE TO A GOVERNMENT SPENDING SHOCK (IN DEVIATIONS FROM STEADY STATE)



(a) Housing price



(b) Inflation (in basis points)



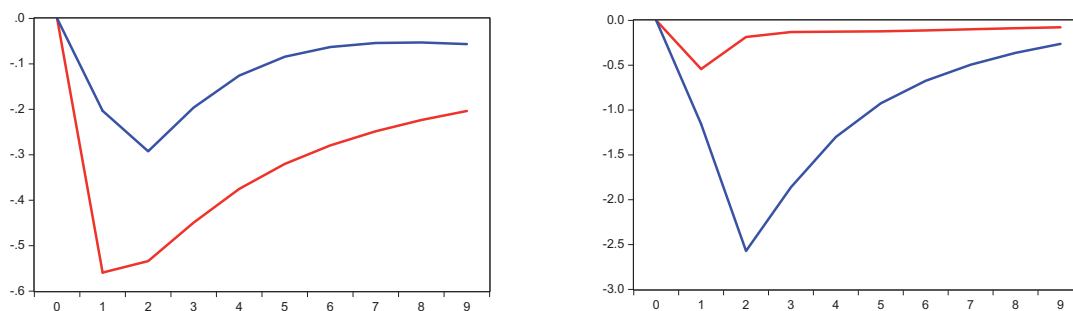
(c) Interest rate (in basis points)

The sign of the wealth effect for impatient indebted homeowners depends on the relative size of the negative housing price effect and the positive Fisher effect. Given our calibration, the drag in wealth linked to the response of housing prices dominates, as shown in Figure 5(c) and Figure 5(e). The size of the drop in wealth for impatient homeowners is a negative function of the level of housing holdings at the steady state. As reported in Table B.4 in Appendix B, the level of housing at the steady state is an increasing function in household indebtedness. Therefore, the response of wealth for impatient indebted homeowners with high leverage is much larger than the response for homeowners with low leverage and without liabilities.

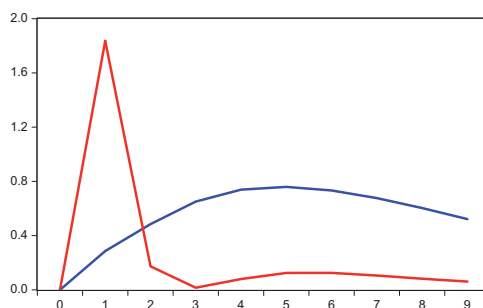
The credit effect for impatient indebted homeowners is clearly positive. The borrowing ability of these households is determined by the expected value of their housing holdings. As shown in Figure 3, housing prices decline on impact but then converge steadily to their steady-state level from below. The fall in current housing prices increases the demand for housing by non-Ricardian households, which increases the total value of the collateral because it depends on the discounted expected liquidation value of current housing holdings. Therefore, after a government spending shock, there is an expansion of mortgage credit (blue lines in Figure 5(d) and Figure 5(f)). Despite the potentially large negative wealth effect, the



Figure 4: PATIENT HOUSEHOLDS: RESPONSES TO A GOVERNMENT SPENDING SHOCK (IN DEVIATIONS FROM STEADY STATE)



(a) Consumption (red) and wealth (blue)      (b) Housing investment (red) and capital investment (blue)

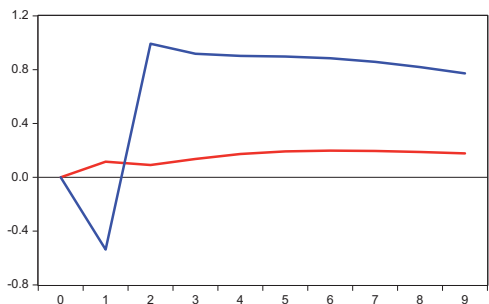


(c) Private debt (red) and public debt (blue)

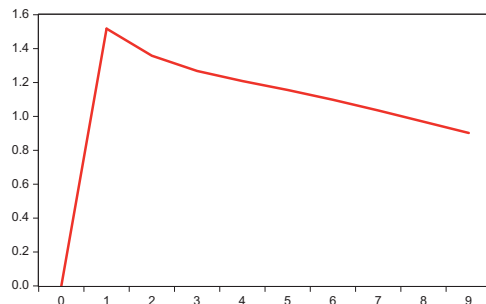
positive income and credit effects dominate so that the response of consumption is positive for all impatient indebted homeowners.

The response of consumption among impatient homeowners is positively correlated with the level of indebtedness. Figure 6 shows that the consumption response on impact of impatient indebted homeowners with high leverage (green line) is larger than the response of impatient indebted homeowners with low leverage (red line), which is larger than the response of impatient indebted homeowners without liabilities (blue line). These results are along the lines of Cloyne and Surico (2017), who conclude that consumption by indebted homeowners is more sensitive to fiscal shocks than that of homeowners without a mortgage.

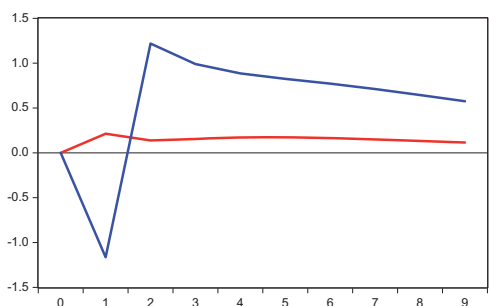
Figure 5: IMPATIENT HOMEOWNERS: RESPONSES TO A GOVERNMENT SPENDING SHOCK (IN DEVIATIONS FROM STEADY STATE)



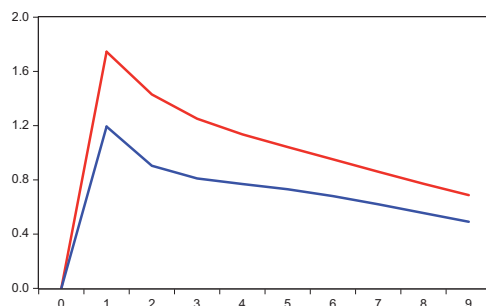
(a) Homeowners without liabilities: Consumption (red) and wealth (blue)



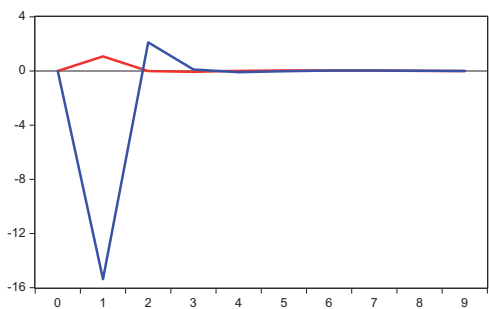
(b) Homeowners without liabilities: Housing investment



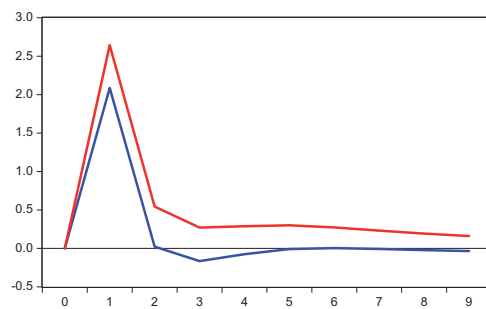
(c) Homeowners with low leverage: Consumption (red) and wealth (blue)



(d) Homeowners with low leverage: Housing investment (red) and debt (blue)

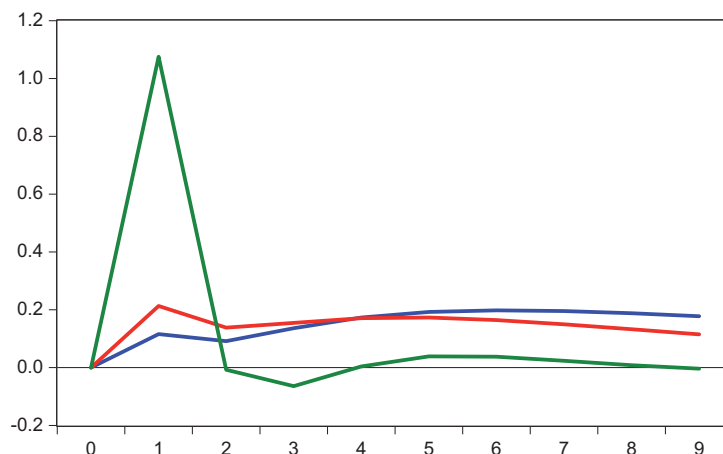


(e) Homeowners with high leverage: Consumption (red) and wealth (blue)



(f) Homeowners with high leverage: Housing investment (red) and debt (blue)

Figure 6: IMPATIENT HOMEOWNERS: RESPONSE OF CONSUMPTION TO A GOVERNMENT SPENDING SHOCK (IN DEVIATIONS FROM STEADY STATE)



*Note:* The blue line represents the response of impatient homeowners without liabilities, the red line is the response of impatient homeowners with low leverage, and the green line represents the response of impatient homeowners with high leverage.

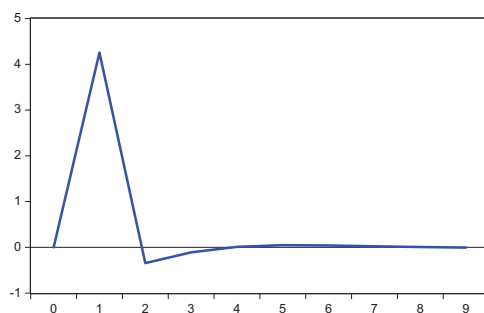
For impatient non-homeowners, the wealth effect on impact is always non-negative. Impatient households without assets or liabilities have a zero wealth effect, and, hence, their consumption response mimics the response of labor income, as shown in Figure 7(a). Given the inflationary pressures, the wealth effect for households holding only liabilities is unambiguously positive. Moreover, the credit effect for impatient households with negative wealth is also positive, as reported in Figure 7(c). The positive income, wealth, and credit effects imply the strong response of consumption (red line) in Figure 7(b).

Figure 8 shows that the responses of individual consumption range from a 0.5 percent decline for patient households to over a 4 percent increase for impatient non-homeowners. Moreover, this figure shows that in our model, the response of individual consumption is negatively correlated with the level of wealth. These results are along the lines of the recent empirical evidence linking wealth and consumption such as Anderson et al. (2016); Carroll et al. (2014); Kaplan et al. (2014); and DeGiorgi and Gambetti (2012).

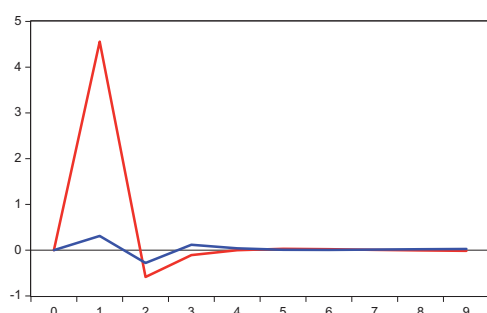
## 6.2 Aggregate Responses

The relative weight of each type of household in the population determines the sign and magnitude of the aggregate consumption multiplier. The two extreme responses to a fiscal shock are associated with Ricardian and indebted impatient households without assets, *EK* households. Therefore, changes in the relative share of these two types of households in the overall population are key in the transmission of fiscal shocks. Table 8 in Section 3 shows that, since 1999, the shares that have changed the most are precisely the ones at the opposite ends of the distribution.

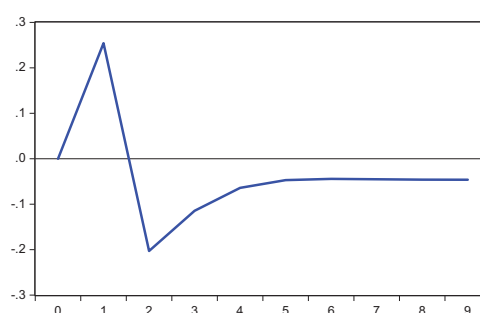
Figure 7: IMPATIENT NON-HOMEOWNERS: RESPONSES TO A GOVERNMENT SPENDING SHOCK (IN DEVIATIONS FROM STEADY STATE)



(a) Non-homeowners without liabilities: Consumption



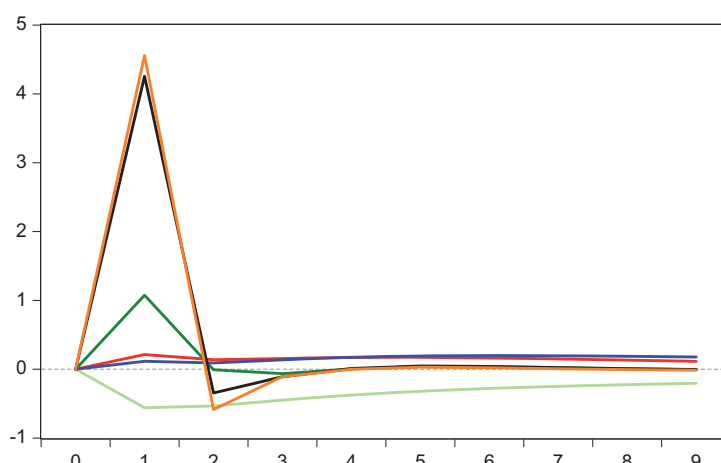
(b) Non-homeowners with liabilities: Consumption (red) and wealth (blue)



(c) Non-homeowners with liabilities: Debt

We assess the effect of the observed changes in households shares in the transmission of government spending shocks by computing the multipliers for economies that are identical except for the shares of household types. Table 11 reports the evolution of the aggregate impact multipliers. Given the theoretical nature of our exercise, and the assumptions made in their calculation, we do not draw any particular conclusion from the absolute values or the sign in the case of the employment multiplier in Table 11. We focus on the relative variation across cross-sections of the United States because the evolution of the multipliers over time shows the effect of the change in the distribution of household wealth and debt in the population. This exercise provides an indicator of what can be missed, in terms of the effects of fiscal policy, in models that do not allow for a fine enough disaggregation of the household sector.

Figure 8: RESPONSE OF CONSUMPTION TO A GOVERNMENT SPENDING SHOCK (IN DEVIATIONS FROM STEADY STATE)



*Note:* The light green line represents the response of patient households, the blue line is the response of impatient homeowners without liabilities, the red line corresponds to the response of impatient homeowner with low leverage, the green line is the response of impatient homeowners with high leverage, the black line is the response of impatient households without assets or liabilities, and the orange line represents the response of households with negative wealth.

Table 11: THE EVOLUTION OF FISCAL EFFECTS

	1999	2001	2003	2005	2007	2009	2011	2013
Output	1.540	1.557	1.555	1.640	1.737	2.115	2.173	2.412
Consumption	1.159	1.192	1.188	1.351	1.533	2.253	2.363	2.814
Hours	2.207	2.232	2.229	2.352	2.490	3.035	3.119	3.463
Employment	0.024	0.010	0.011	-0.061	-0.148	-0.512	-0.573	-0.825

*Note:* The multipliers are defined as percentage variation of the variable on impact.

In the years before the Great Recession, these multipliers remain fairly stable, but they have changed substantially since 2005. The output multiplier increases 50 percent from 1999 to 2013, with about 80 percent of that increase occurring between 2005 and 2013. The increase in the size of the output multiplier is similar to the change in the response of aggregate consumption.<sup>9</sup>

The model predicts an increase in real wages following the expansion in government spending that is consistent with the empirical evidence (Galí, Vallés, and López-Salido, 2007; Caldara and Kamps, 2008; Pappa, 2009; and Andrés, Boscá and Ferri, 2015). According to our model, the wage increase becomes stronger as the share of constrained consumers – in particular, impatient non-homeowners, *HNH* and *EK* types – increases. If we consider the optimal wage and hours equations (equation 24 and equation 23, respectively) we can

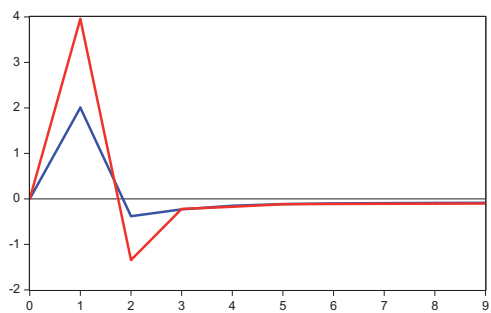
<sup>9</sup>All of the results are robust to alternative parameterizations, other thresholds in the empirical identification of the different households types ( $a = 0.25$  and  $a = 0.75$ ), and distributing transfers/taxes among households according to their total income. Table A.3 in Appendix A reports the sensitivity analysis.

show that an increase in the share of impatient indebted households without assets,  $\tau^{EK}$ , strengthens workers' bargaining power, given that the marginal utility of consumption of this type of household,  $\lambda_t^{EK}$ , falls strongly after the fiscal shock. The higher bargaining power of workers is reflected in the higher wages and hours worked of employed workers. Higher wages limit the incentives of firms to create new jobs through vacancy posting because additional vacancies now have a lower expected surplus. Firms are more prone to meet the additional output demand through a strong increase in hours worked per employee than through job creation. In this way, the model predicts a simultaneous increase in the output multiplier and a reduction in the employment multiplier so that recoveries driven by fiscal expansions are less intense in job creation as we move from a primarily Ricardian economy to one with a relatively large share of severely constrained households.

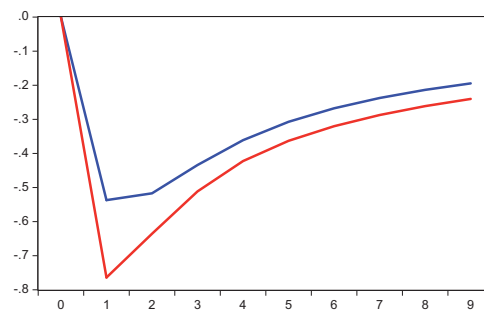
The evolution of the total hours and employment multipliers suggests that the changes in the distribution of households have strengthened the response of the intensive labor margin versus the extensive margin to government spending shocks. Figure 9 reports the impulse response functions for aggregate hours and employment in 1999 and in 2013. As shown in Figure 9 and in Table 11, while government spending shocks were neutral on employment in the early years under analysis, they have had a crowding-out effect on employment since the Great Recession, and the positive effect on total hours has increased over time. Our results point toward not just a smaller crowding-in effect for employment but also a crowding-out of the extensive margin with a contemporaneous enhancement of the crowding-in effect for the intensive margin. We argue that the main takeaway regarding the evolution of the employment multiplier is that the ability of government shocks to generate employment, if any, has become weaker over time.

In the literature, there is no consensus about the effect of government spending shocks on employment: Caldara and Kamps (2008), using VAR analysis, estimate that employment does not respond to government spending shocks, while Alesina et al. (2002) show that expansionary fiscal policy puts upward pressure on private-sector wages, leading to a decline in profits and employment. Cantore et al. (2014) show, in a model with search and matching, deep habits, and a CES technology function with a low elasticity of substitution between labor and capital, that a jobless recovery – a recovery with low job creation – can be generated after a positive government spending shock. In particular, they show that jobless recoveries are compatible with environments with smaller model-implied employment multipliers. Recently, Klein (2017b) shows that in periods of high leverage, the employment multiplier is smaller than in periods characterized by low leverage.

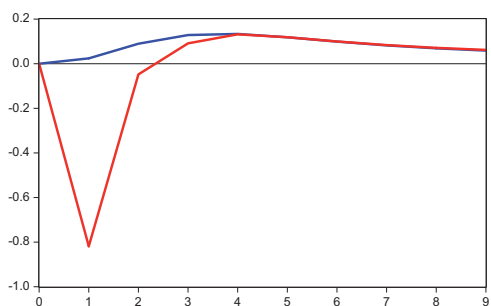
Figure 9: IMPULSE RESPONSE FUNCTIONS (IN DEVIATIONS FROM STEADY STATE): AGGREGATE VARIABLES, 1999 VERSUS 2013



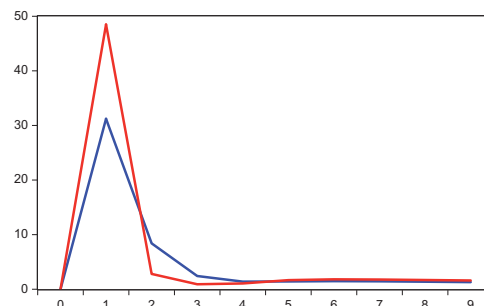
(a) Wage



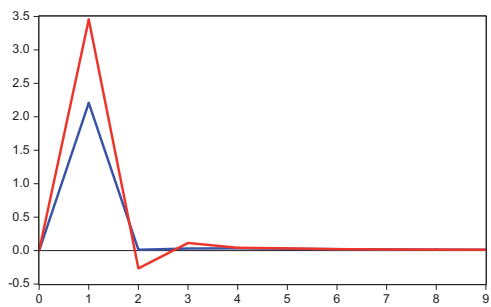
(b) Housing price



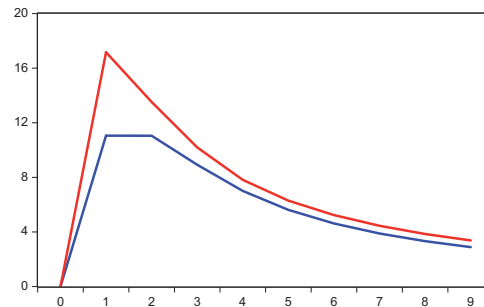
(c) Employment



(d) Inflation (basis points)



(e) Hours



(f) Interest rate (basis points)

*Note:* The blue line represents the response in an economy with the empirical weights of 1999. The red line is the response with the 2013 empirical weights.



## 7 Government spending multipliers and wealth distribution

### 7.1 Wealth Inequality and the Fiscal Multiplier

In this section, we look at the link between the distribution of wealth and the effects of fiscal policy shocks. According to the Gini coefficients reported in Table 12 for all observations in the PSID, wealth inequality has increased during the sample period. Visual inspection suggests that the increase in the Gini coefficient in wealth from 0.843 in 1999 to 0.869 in 2013 is mostly due to divergences between household groups, as the within-group coefficients have remained more stable. We can compare the between-groups coefficient – the second column in Table 12 – with the Gini coefficient implied by our model, which is based on treating each group as a representative household.

Table 12: GINI COEFFICIENTS (NON-HOUSING REAL WEALTH)

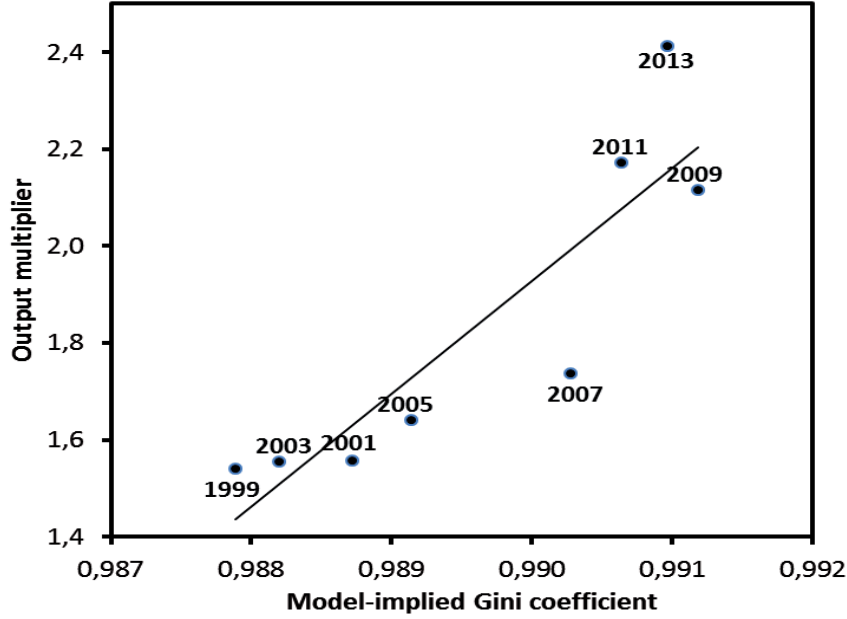
	PSID	Sample	R	HH	BL	BH	HNH
1999	0.862	0.851	0.729	0.589	0.516	0.494	0.545
2001	0.856	0.843	0.708	0.597	0.531	0.508	0.582
2003	0.858	0.844	0.712	0.529	0.470	0.500	0.580
2005	0.867	0.853	0.718	0.530	0.512	0.487	0.566
2007	0.874	0.861	0.729	0.564	0.483	0.475	0.580
2009	0.885	0.872	0.734	0.538	0.522	0.494	0.562
2011	0.884	0.872	0.732	0.530	0.502	0.494	0.548
2013	0.885	0.874	0.732	0.567	0.588	0.469	0.533

*Note:* The first column refers to the overall PSID population, while the second column reports the coefficients for the sub-sample we consider in the analysis.

In Figure 10, we plot the model-implied output multipliers against the model-based Gini coefficients. Both variables are computed using the observed household shares (see Table 8) and the model-implied wealth. Figure 10 shows a positive correlation between the output multiplier and wealth inequality. Given that the output multiplier increases with the share of constrained agents in the economy, we argue that our model suggests that discretionary fiscal policy can be more effective in more unequal economies.

Figure 11 shows the correlation between the model-implied Gini coefficients and the ones obtained for the sample of the PSID we used in identifying household types. There is a large positive correlation between the simulated and the observed wealth inequality indexes. Therefore, we conclude that our model is capable of reproducing a significant proportion of the observed mean variation in wealth inequality. This result is consistent with the positive association between wealth inequality and the aggregate marginal propensity to consume documented by Brinca et al. (2016); Carroll et al. (2014); and Krueger et al. (2016).

Figure 10: OUTPUT MULTIPLIER AND INEQUALITY IMPLIED BY THE MODEL



## 7.2 Welfare Effects

So far, we have assessed the effects of government spending shocks on household consumption across household types. But households' utility also depends on their real estate holdings and leisure. So to evaluate the distributional consequences of government spending shocks in a more general way, we compute the effect of these shocks on households' welfare. We define welfare  $\bar{V}^i$  as the discounted sum of a household  $i$  period utility, conditional on the economy being at the steady state in period 0 (common to all the experiments) and remaining constant throughout

$$\bar{V}^i = \sum_{t=0}^{\infty} (\beta^i)^t \left[ \ln(\bar{c}_t^i) + \phi_x^i \ln(\bar{x}_t^i) + \bar{n}_{t-1} \phi_1 \frac{(1-\bar{l}_{1t})^{1-\eta}}{1-\eta} + (1-\bar{n}_{t-1}) \phi_2 \frac{(1-\bar{l}_2)^{1-\eta}}{1-\eta} \right],$$

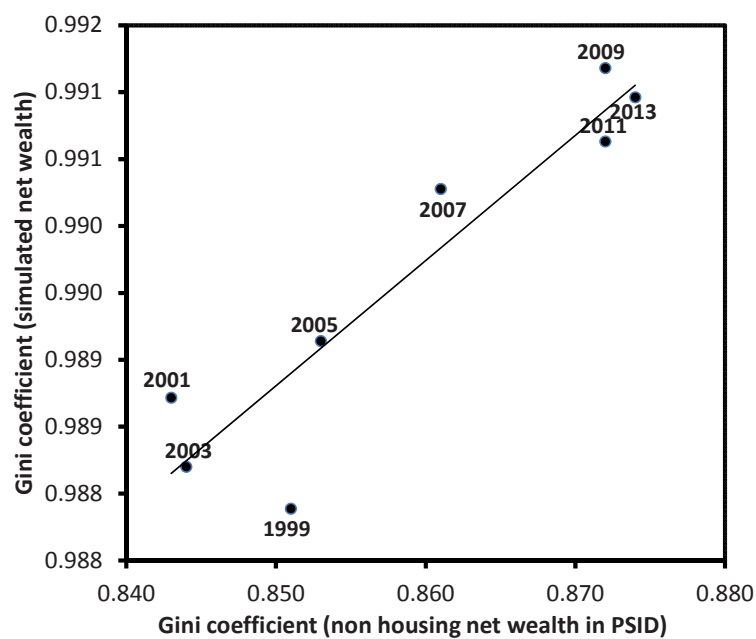
where  $i$  is the index referring to household's type. We define  $V^{i,s}$  as the welfare of a type  $i$  household under a shock, conditional on the state of the economy in period  $t = 0$  and taking into account the reaction of the variables before returning again to their initial steady state

$$V^{i,s} = \sum_{t=0}^{\infty} (\beta^i)^t \left[ \ln(c_t^{i,s}) + \phi_x^i \ln(x_t^{i,s}) + n_{t-1}^s \phi_1 \frac{(1-l_{1t}^s)^{1-\eta}}{1-\eta} + (1-n_{t-1}^s) \phi_2 \frac{(1-l_2)^{1-\eta}}{1-\eta} \right], \quad (30)$$

where  $c_t^{i,s}$ ,  $x_t^{i,s}$ ,  $n_{t-1}^s$ , and  $l_{1t}^s$  denote consumption, housing, employment rate, and hours per worker, respectively, under a fiscal shock.

We calculate the welfare cost  $\Delta^i$  associated with a fiscal measure as the fraction of steady-state consumption that a household would be willing to give up in order to be as well off

Figure 11: GINI COEFFICIENT



after the fiscal shock –, that is,

$$V^{i,s} = \sum_{t=0}^{\infty} (\beta^i)^t \left[ \ln [\bar{c}_t^i (1 - \Delta^i)] + \phi_x^i \ln (\bar{x}_t^i) + \bar{n}_{t-1} \phi_1 \frac{(1 - \bar{l}_{1t})^{1-\eta}}{1-\eta} + (1 - \bar{n}_{t-1}) \phi_2 \frac{(1 - \bar{l}_{2t})^{1-\eta}}{1-\eta} \right]. \quad (31)$$

Thus, from (30) and (31)

$$\Delta^i = 1 - \exp\left\{ \left( V^{i,s} - \bar{V}^i \right) (1 - \beta^i) \right\}, \quad (32)$$

where a negative value for  $\Delta$  implies a welfare gain.

Figure 12: WELFARE EFFECTS ACROSS TIME. BY HOUSEHOLD TYPE

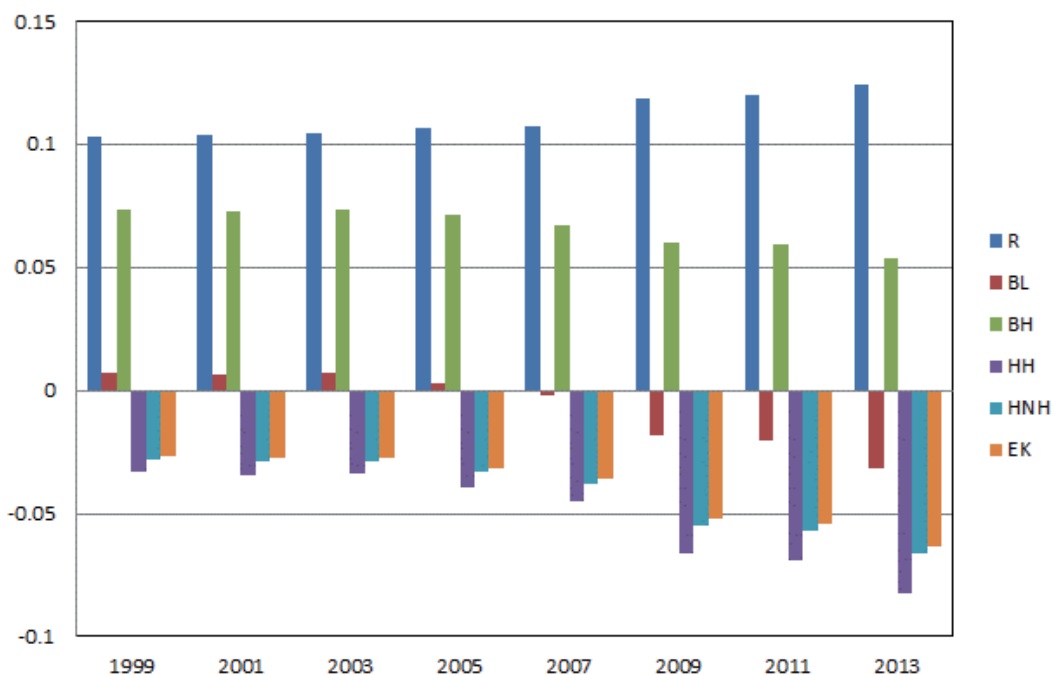


Figure 12 shows the welfare costs, if positive, and gains, if negative, for each type of household over time. After a government spending shock, welfare for Ricardian households (the richest type of households), but also for high- and low-leveraged impatient households with housing, *BH* and *BL*, declines, while welfare improves for all other types of impatient households. The welfare benefit from fiscal expansions increases considerably after 2007, mainly for the poorest types (*HH*, *HNH*, and *EK* households). Therefore, we argue that fiscal interventions are more effective in redistributing consumption when there is a higher degree of inequality.

Fiscal policy may thus have a non negligible distributional effect on welfare grounds, even under the assumption that government spending is pure waste and does not directly affect preferences. How each household's welfare is affected depends on her position in the financial market. By the same token, and related to the current austerity debate, our results point towards important welfare effects of fiscal consolidations that could harm the less financially well-off part of the population, in line with the results obtained by Klein and Winkler (2017).

## 8 Conclusion

We explore the macroeconomic implications of government spending shocks in an economy populated by six representative agents that differ in their attitude towards savings, real estate holdings, and access to credit. In particular, we propose classifying households in the PSID into six types: (i) patient or Ricardian households; (ii) impatient households with real estate holdings and no liabilities; (iii) impatient households with housing and a high loan-to-value ratio; (iv) impatient households with housing and a low loan-to-value ratio; (v) impatient households without access to credit and without housing; and (vi) impatient households without housing but with access to non-mortgaged credit. We show that, since the Great Recession, the share of patient households has declined, while the share of indebted households with no assets has increased.

We calibrate a DSGE model according to the observed evolution of household shares in the population to show that the heterogeneity in the household consumption response can account for important variations in the size of fiscal multipliers over time. More precisely, we find that our model is capable of accounting for a variety of facts that have been recently documented in the relevant literature: (i) the response of individual consumption to a government spending shock is negatively correlated with the individual's net wealth and positively correlated with the level of indebtedness; (ii) the size of the fiscal multiplier is very sensitive to the distribution of wealth, increasing significantly with the fall in the share of Ricardian households and the increase in the share of indebted impatient consumers with no assets; (iii) the employment multiplier declines as the share of agents with zero or negative wealth in the population increases; (iv) output multipliers are positively correlated with wealth inequality; and (v) the welfare effect of fiscal shocks across households depends on their financial position: poorer (wealthier) households are the winners (losers) of increases in public spending.

In the model, we have restricted households to behave identically in the labor market, because we wanted to focus on the role played by their balance sheet position in the transmission of government spending shocks. A natural extension of our work is to explore the relationship between households' balance sheet heterogeneity and labor income heterogeneity in a macro model informed by micro data, which is next in our research agenda.

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## A Tables

Table A.1: GINI COEFFICIENTS

	1999	2001	2003	2005	2007	2009	2011	2013
Non-housing wealth	0.851	0.843	0.844	0.853	0.861	0.872	0.872	0.874
Income	0.461	0.479	0.473	0.485	0.485	0.487	0.490	0.502

Notes: Gini coefficient computed using the subsample of the PSID used in the analysis for each wave.

Table A.2: MEDIANS OF THE DISTRIBUTIONS IN 1999

Household	Non-housing wealth	Income
Patient: R	65,652	39,550
Impatient: HH	4,271	25,628
Impatient: BL	10,599	44,699
Impatient: BH	8,543	44,580
Impatient: HNH	3,164	22,955
Impatient: EK	-949	15,029

Table A.3: SENSITIVITY ANALYSIS: MULTIPLIERS FOR 1999 AND 2013

	Output		Consumption		Hours		Employment	
	1999	2013	1999	2013	1999	2013	1999	2013
<i>Benchmark</i>	1.540	2.412	1.159	2.814	2.207	3.463	0.024	-0.825
$\lambda^w \Rightarrow 0.4$ to 0.5	1.657	2.958	1.388	3.831	2.376	4.252	-0.062	-1.110
$r_\pi = 0.30$ to 0.25	1.645	2.628	1.306	3.157	2.358	3.776	-0.005	-0.954
$\rho_g = 0.75$ to 0.80	1.468	2.294	1.011	2.584	2.104	3.294	0.106	-0.694
$\beta^I = 0.95$ to 0.97	1.519	2.347	1.115	2.685	2.178	3.369	0.034	-0.770
$m^{BH} = 0.985$ to 0.90	1.465	2.167	1.023	2.360	2.100	3.109	0.081	-0.550
$m^{EK} = 0.5$ to 0.985	1.590	2.442	1.252	2.872	2.279	3.507	-0.042	-0.897
$\omega = 0.75$ to 0.70	1.125	1.496	0.639	1.452	1.610	2.143	0.065	-0.364
$\phi = 5.5$ to 7.5	1.618	2.709	1.252	3.261	2.319	3.892	0.100	-0.834
$a = 0.5$ to 0.25	1.285	1.712	0.653	1.473	1.841	2.455	0.211	-0.139
$a = 0.5$ to 0.75	1.712	3.185	1.498	4.282	2.454	4.581	-0.125	-1.688
$trh^R \neq trh^i$	2.166	3.518	2.284	4.859	3.108	5.064	-0.377	-2.249

Note:  $\lambda^w$  is worker's bargaining power,  $r_\pi$  is response to inflation in the Taylor rule,  $\rho_g$  is autocorrelation coefficient of the government spending shock,  $\beta^I$  is discount rate of impatient households,  $m^{BH}$  is loan-to-value ratio for impatient households with high leverage,  $\omega$  is Calvo parameter,  $m^{EK}$  is loan-to-value ratio for impatient households with negative wealth, and  $\phi$  is investment adjustment costs parameter,  $a$  is income-to-wealth threshold,  $trh^R \neq trh^i$  is transfers received/taxes paid by all households according to their total income, which for Ricardians is the sum of labor income, the return on capital, and the return on private and public debt; and for impatient households, it is just labor income.

## B Steady-state analysis

Table B.4 reports the steady state levels of consumption, labor income, and gross and net wealth across the six household types in our model economy. The last column in Table B.4 reports the wealth-to-labor income ratio, which shows substantial variability. Despite the large degree of heterogeneity in net wealth at the steady state, the assumption on identical labor income translates into a more egalitarian distribution of consumption.<sup>10</sup>

Table B.4: STEADY-STATE VALUES

	Cons <sup>1</sup>	Lab income <sup>1</sup>	Net wealth	Assets	Liabilities	Ratio <sup>2</sup>
	(1)	(2)	(3)	(4)	(5)	(3)/(2)
R	0.766	0.578	36.846	36.846	0	15.9
HNH	0.578	0.578	0	0	0	0
HH	0.578	0.578	1.585	1.585	0	0.68
BL	0.551	0.578	0.972	3.668	2.696	0.42
BH	0.513	0.578	0.099	6.632	6.533	0.04
EK	0.575	0.578	-0.287	0	0.287	-0.12

Notes:<sup>1</sup>Quarterly data. <sup>2</sup>In annual terms

At the steady state, Ricardian consumers achieve the highest level of per capita consumption, followed by impatient households with no liabilities, *HNH* and *HH*. The steady-state consumption of impatient households with no liabilities is identical irrespective of whether they are homeowners, *HH*, or not, *HNH*. For households participating in the credit market, per capita consumption at the steady state is inversely related with their indebtedness level. Households use their income for consumption and interest payments on debt. Therefore, given that labor income is identical across households, heavily indebted consumers can only afford lower levels of consumption at the steady state. In our calibration, the indebtedness of impatient households with negative wealth, *EK*, is lower than that of impatient homeowners. Therefore, the consumption level at the steady state for *EK* households exceeds that for *BH* and *BL* households.

## C Comparison with Kaplan et al. (2014)

Kaplan et al. (2014) use a two-asset model with different liquidity characteristics for each asset to argue that there may be households behaving like traditional hand-to-mouth consumers, consuming their current income completely, while holding potentially large amounts of illiquid assets – the so-called wealthy hand-to-mouth consumers. While Kaplan et al.

<sup>10</sup>In Table B.4, the dispersion in labor income is, by construction, zero, and, hence, lower than that of net wealth. Table A.2 in Appendix A shows that the observed dispersion in (median) non-housing wealth is larger than the dispersion in (median) income.

(2014) incorporate households with positive wealth to the hand-to-mouth pool, they exclude households with negative wealth. Kaplan et al. (2014) estimate the shares of non-hand-to-mouth, *N-HtM*; wealthy hand-to-mouth, *W-HtM*; and poor hand-to-mouth consumers, *P-HtM*, using two alternative surveys for the United States: the Survey of Consumer Finances and the PSID. Using the PSID, their definition of income reduces to labor earnings of the household plus government transfers and wealth is defined as the sum of net liquid wealth and net illiquid wealth. The latter is defined as the net value of home equity plus the net value of other real estate plus the value of private annuities or IRAs and the value of other investments in trusts or estates, bond funds, and life insurance policies. Net liquid wealth is defined as the difference between liquid assets and liquid debt. Liquid assets include the value of checking and savings accounts, money market funds, certificates of deposit, savings bonds, and Treasury bills plus directly held shares of stock in publicly held corporations, mutual funds, or investment trusts. Before 2011, they define liquid debt as the value of debts other than mortgages, such as credit cards, student loans, medical and legal bills, and personal loans. Since 2011, liquid debt only includes credit card debt. Kaplan et al. (2014) use a threshold strategy to separate hand-to-mouth behavior from intertemporally optimizing agents. A household is classified as non-hand-to-mouth, *N-HtM*, if her wealth exceeds half of her income.<sup>11</sup> A hand-to-mouth household is wealthy hand-to-mouth, *W-HtM*, if she holds positive net illiquid wealth and poor hand-to-mouth, *P-HtM*, if she holds a non-positive net illiquid wealth.

Table C.5 reports the percentages of each type of household we consider in the paper that would be classified as *N-HtM*, *W-HtM* or *P-HtM* by Kaplan et al. (2014). For example, the first row in Table C.5 shows that of the Ricardian households we identify in the PSID, 86 percent would be classified as *N-HtM* by Kaplan et al. (2014), 6 percent would have been classified as *W-HtM*, and 9 percent as *P-HtM*. Among the impatient homeowners, those without liabilities, *HH*, are mostly classified as intertemporally optimizing agents by Kaplan et al. (2014). Note that the definition of wealth in Kaplan et al. (2014) includes the net equity of the main home, which for *HH* households is positive. Hence, it is more likely that *HH* households satisfy the threshold condition with housing wealth despite not satisfying it when considering non-housing wealth. For indebted impatient households, 88 percent of those with low loan-to-value ratio, *BL*, are considered to be *N-HtM*, while only 38 percent of those with high loan-to-value ratio, *BH*, are classified as such. About half of the *BH* households are classified as *W-HtM* consumers. As expected, the vast majority of impatient households without assets are classified as *P-HtM* by Kaplan et al. (2014)'s identification strategy.

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<sup>11</sup>Kaplan et al. (2014) restrict wealth for households in their sample to be non-negative, but net worth can be negative.

Table C.5: COMPARISON TABLE: PERCENT ADDS BY ROW, YEAR 1999

	NHTM	WHTM	PHTM
Patient: R	85	6	9
Impatient: HH	75	25	0
Impatient: BL	88	12	0
Impatient: BH	38	52	10
Impatient: HNH	4	14	82
Impatient: EK	1	8	90

In Table C.6, we report which percentage of households classified as *N-HtM*, *W-HtM* or *P-HtM* by Kaplan et al. (2014) would be classified in each of our types. For example, out of the *N-HtM* consumers, only 67 percent would be considered Ricardians while 31 percent would be classified as impatient homeowners. Most *W-HtM* households are classified as impatient indebted homeowners with a high loan-to-value ratio, *BH*, followed by Ricardians, *R*, and impatient households without assets or liabilities, *HH*. Finally, *P-HtM* households mostly fall in the two categories we define for impatient non-homeowners.

Table C.6: COMPARISON TABLE: PERCENT ADDS BY COLUMN, YEAR 1999

	NHTM	WHTM	PHTM
Patient: R	67	15	10
Impatient: HH	6	6	0
Impatient: BL	14	6	0
Impatient: BH	11	47	4
Impatient: HNH	2	18	45
Impatient: EK	0	8	40

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