Heterogeneous Household Finances and the Effect of Fiscal Policy

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January 2017

Abstract

This paper develops a model with heterogeneous households in terms of net worth and collaterizable assets. Using sample weights estimated from the PSID, we show that balance-sheet heterogeneity is key to characterizing the aggregate effects of government spending along different dimensions. We find that: *(i)* the response of individual consumption to a government spending shock is negatively correlated with household's net worth and also depends on her access to mortgage and non-mortgage credit, which implies that the size of the fiscal multiplier is sensitive to the distribution of household types; *(ii)* the response of aggregate employment is negatively correlated with the share of impatient households; as the weight of these households in total population increases firms rely more on adjustments in the intensive margin to meet the fiscal induced boost in aggregate demand, thus generating jobless recoveries; *(iii)* the output multiplier is positively correlated with wealth inequality; and *(iv)* while a government spending shock has a welfare cost for wealthy households, it delivers a welfare gain for constrained households.

JEL Classification: E21, E62

Keywords: household finances, fiscal policy, heterogeneity, household debt, housing collateral.

We thank Lea E. Rendell for outstanding research assistance. We thank seminar participants at the 12th Dynare Conference (Rome), LACEA-LAMES Medellin 2016, 13th Euroframe Conference (Utrecht), CGBCR conference (Manchester), LISER, and the 41st SAEe (Bilbao). Javier Andrés, José E. Boscá, and Javier Ferri acknowledge the financial support of the Fundación Rafael del Pino; BBVA Research; the Spanish Ministry of Economy and Competitiveness (grant ECO2014-53150-R); and the Generalitat Valenciana (Consellería d'Educació, Investigació, Cultura i Esports (grant GVPROMETEO2016-097). The views expressed in this paper are solely the responsibility of the authors and should not be interpreted as reflecting the views of the Board of Governors of the Federal Reserve System.

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1 Introduction

The onset of the Great Recession drew renewed attention to discretionary fiscal policy as a tool to ameliorate the adverse economic effects of the crisis. During the subsequent recovery, researchers and policy makers have engaged in discussions about the effects of fiscal consolidations on output and employment. Also, the financial turmoil in 2008 brought about an important recomposition of the balance sheets of many households, restricting their ability to obtain credit. Moreover, the prices of financial and real assets plummeted and deflationary pressures increased the real value of debt, further deteriorating households' balance sheets. Much of the recent policy analysis has been carried out within the New Keynesian dynamic stochastic general equilibrium (DSGE) framework that relies on the representative agent assumption. These models have been criticized for abstracting from many financial features, such as debt and asset prices, that are relevant drivers of private spending and hence of the effectiveness of stabilization policies. In this paper we set up a DSGE model with heterogeneous households to study the effect of the observed changes in the distribution of households' finances on the transmission mechanism of government spending shocks. In the model, we consider household heterogeneity along three related dimensions that shape their balance sheets: time preference, real estate holdings, and access to credit. Our model features savers and spenders (Campbell and Mankiw (1991); Galí, Vallés and López-Salido (2007)), differences in portfolio compositions (Kaplan, Violante and Weidner (2014)); and also differences in the capacity to extract collateral from real estate holdings (Iacoviello (2005); Kiyotaki and Moore (1997)) or expected income (Eggertsson and Krugman (2012)).

Using the Panel Study of Income Dynamics (PSID), we identify six types of households as a function of their balance-sheet characteristics. First, we classify households as patient (Ricardian) versus impatient using a threshold rule, which, in the spirit of Kaplan, Violante and Weidner (2014), is based on the magnitude of the non-housing net worth relative to income. Among impatient households, we consider five categories depending on their real estate holdings and their access to credit. On the one hand, among those with real estate holdings, we have households with high, low, or zero loan-to-value ratios. On the other hand, impatient households without collateralizable assets can either borrow against their labor income or hold no liabilities. We document that the shares of these six household categories in the PSID were quite stable until 2007, when the share of impatient consumers with no collateralizable assets but non-mortgaged debt increased at the expense of a reduction in the share of Ricardian households.

We then develop a relatively standard DSGE model that is nonetheless populated by these different household types. The model also features search and matching frictions and bargaining over real wages, and addresses three related important facts regarding the effect of government spending shocks in mature economies, in particular in the aftermath of the financial crisis. First, the individual response of consumption to government spending shocks is sensitive to the financial position of the household (DeGiorgi and Gambetti (2012)). Second, the size of the output multiplier is positively correlated with wealth inequality (Brinca et al. (2016)). Third, whereas the consumption response to government spending shocks is high, mostly in periods of economic and financial distress, the employment response has been much weaker (Caldara and Kamps (2008)), giving rise to jobless recoveries (Cantore, Levine and Melina (2014)). Based on a realistic calibration, our model establishes a common thread among these pieces of evidence: financial heterogeneity and the increasing share of households holding negative net wealth in the population. Our positive analysis is complemented with a discussion of the welfare implications of discretionary government spending shocks in economies with balance-sheet heterogeneity for households.

According to our model economy, the effects of fiscal policy shocks on consumption are very sensitive to the structure of the balance-sheet of the household. As standard in the literature the response of patient households' consumption to an increase in government spending is mildly negative, while impatient households' consumption rises. We show that the response of consumption for the latter is increasing with their indebtedness level, being the strongest for those consumers with liabilities and no assets. Thus, the aggregate marginal propensity to consume and the output multiplier are very sensitive to the distribution of household across categories. For example, the model-implied output multiplier is about 55 percent larger at the end of the sample than in 1999, mostly due to the increase in the share of indebted consumers without collateralizable assets. On the flip side, the sharp response of consumption of these households reduces the marginal utility of further consumption putting an additional upward pressure on wages. Therefore, in the model, firms become more reluctant to post new vacancies relying on adjustments in the intensive margin to meet the boost in demand. Consequently, the increase in the output multiplier since 1999 is paired up with a decline in the employment multiplier.

In our model, the size of the fiscal effect is positively correlated with wealth inequality. In particular, we find a strong correlation between the Gini coefficient implied by the distribution of net wealth in the model and the output multiplier. Also, the effect of government spending shocks in individual welfare is substantially different across households categories. For example, while an increase in government spending implies a welfare loss for Ricardian households and impatient consumers with collateralizable assets, it implies a welfare gain for the remaining impatient households. Thus, the aggregate welfare cost 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 lowest part 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.

Section 2 presents a succinct review of the recent empirical literature on the macroeconomic implications of alternative household balance sheets. Section 3 contains a description of the data set and the criteria used to identify the different households' categories according to their financial position. Section 4 introduces the theoretical model that is used to draw the aggregate consequences of financial heterogeneity. In section 5, we discuss the calibration strategy and the results for the baseline case. Section 6 explores the transmission mechanism of government spending shocks in the DSGE model. Section 7 analyzes the evolution of the fiscal multiplier given the observed pattern for household finances in the U.S. from 1999 to 2013 and analyzes the related issues of wealth inequality and welfare effects of fiscal shocks. Section 8 concludes.

2 Related Literature

In standard Neoclassical models, households' behavior satisfies the Ricardian equivalence. Their consumption decisions are based on an intertemporal budget constraint so that an expansionary fiscal shock financed by current or future lump-sum taxes has a negative wealth effect lowering consumption. However, the empirical response of consumption to fiscal shocks is positive. In order to reconcile the empirical evidence with theoretical models, Galí, Vallés and López-Salido (2007) incorporate rule-of-thumb or hand-to-mouth consumers, who consume completely their current income, in a standard New Keynesian model in conjunction with Ricardian households. In this environment, there is a positive comovement between consumption and government spending shocks. Traditionally, hand-to-mouth households have been identified in survey data as those with zero net worth in their balance sheets. However, as highlighted by Kaplan, Violante and Weidner (2014), the proportion of households with zero net worth in the microeconomic data is relatively small so as to be able to account for the macroeconomic evidence regarding the response of consumption to fiscal shocks.

Kaplan, Violante and Weidner (2014) propose to identify the characteristics of hand-to-mouth household behavior through the lenses of a two-asset model in which assets have different liquidity characteristics. Following the model implications, they use survey data on consumer finances in several countries to identify as not hand-to-mouth (*N-HtM*) households, those holding significant amounts of liquid wealth. In particular, they assume that holding average liquid wealth balances larger than half of the household earnings in a given period implies that the household behaves following Ricardian equivalence. They highlight the diversity of hand-to-mouth households, distinguishing between wealthy hand-to-mouth households, with positive holdings of illiquid assets, and poor hand-to-mouth households, with no holdings of illiquid assets. Using the U.S. Survey of Consumer Finances (SCF) from 1990 to 2010, they show that, on average, 31 percent of households are hand-to-mouth, of which two thirds are wealthy hand-to-mouth. If households were classified using the traditional wealth approach, the share of hand-to-mouth consumers in the U.S. would have been only 14 percent. Thus, Kaplan, Violante and Weidner (2014) conclude that neglecting the existence of wealthy hand-to-mouth consumers clearly underestimates the share of hand-to-mouth households in the economy. Combining data from the U.S. Consumer Expenditure Survey (CEX) and the PSID, Kaplan, Violante and Weidner (2014) show that the marginal propensity to consume from transitory income shocks is significantly larger for both wealthy hand-to-mouth and poor hand-to-mouth households than for not hand-to-mouth households.

Recently, there has been a growing interest in assessing the effects of fiscal policy with heterogeneous households. Using VAR model analysis for OECD countries, Brinca et al. (2016) document a strong positive correlation between wealth inequality, measured by the Gini coefficient, and the magnitude of fiscal multipliers. Anderson, Inoue and Rossi (2015) explore the relative importance of household income heterogeneity in determining the sign and size of the consumption response to fiscal shocks. They use data from the CEX in order to study the consumption reaction by income quintile to fiscal shocks identified using the narrative approach of Ramey (2011). They conclude that government spending policy shocks tend to decrease consumption inequality since while the consumption reaction of the wealthiest households is consistent with Ricardian equivalence, the consumption of the poorest households significantly increases after an expansionary fiscal shock.

One strand of the literature has focused on measuring the heterogenous responses of households to tax changes. Using the CEX database, Misra and Surico (2014) estimate the marginal propensity to consume out of the 2001 and 2008 tax rebates in the U.S. using quantile regressions and conclude that households that are homeowners and have high levels of mortgage debt have the largest marginal propensity to consume out of tax rebates. Cloyne and Surico (2016) estimate the consumption responses to U.K. income tax changes identified using a narrative approach. They conclude that mortgage debt positions play a key role in the transmission of fiscal shocks. In particular, they show that while the response of consumption by homeowners without a mortgage to an income tax change is not significant; homeowners with high leverage ratios strongly respond to income tax shocks, being their response even larger than that of renters. Sahm, Saphiro and Slemrod (2015), using the University of Michigan Survey of Consumers, characterize a high degree of heterogeneity in response to the 2011 payroll tax cut and its expiration in 2013. In particular, they identify the so-called balance-sheet households who smooth debt repayment after tax cuts and reduce consumption after tax increases. The relative weight of this type of households is large enough so as to reduce the effectiveness of fiscal stimuli due to their deleveraging in response to tax cuts.

Another strand of the literature has explored the responses to government spending shocks. DeGiorgi and Gambetti (2012) use the CEX database to study the response of the consumption distribution to government spending shocks identified using a VAR model. They conclude that after a government spending shock, consumption increases at the bottom of the distribution and it falls at the top, while the middle of the distribution is quite unresponsive. Therefore, they argue that government spending shocks reduce, temporarily, consumption inequality. Following Blundell, Pistaferri and Preston (2008), Giavazzi and McMahon (2012) combine the PSID and CEX databases to estimate the effects of government spending shocks on consumption and labor supply decisions of heterogeneous households. Their combined dataset comprises 3,000 households from 1967 to 1992. They use the identification strategy developed by Nakamura and Steinsson (2011), which allows them to control for time-specific aggregate effects. While they can estimate the direct effect of government spending on consumption, they cannot identify the indirect wealth effects. They conclude that there is a significant degree of heterogeneity in the responses to government spending shocks.

Recently, using a panel for 14 advanced economies from 1998 to 2012, Jaramillo and Chailloux (2015) estimate the wealth and income effects of fiscal policy on consumption. They conclude that the contribution to consumption from an increase in financial or housing assets would be more than offset if financed fully through increases in household debt. Therefore, the balance-sheet or net wealth composition of households seems key in assessing the effects of fiscal policy.

3 Household Heterogeneity in the PSID

In the spirit of Kaplan, Violante and Weidner (2014), we consider a threshold strategy to classify households in the PSID according to their balance-sheet composition. However, rather than focusing in the degree of liquidity of their net wealth we pay special attention to real estate holdings, the level of indebtedness, and the nature of debt to distinguish among households with different rates of time preference and access to credit. We define the threshold strategy for identification as a function of the non-housing net worth to income ratio. We assume that holding a significant amount of non-housing wealth, in particular holding non-housing wealth balances larger than half of the household's monthly income, is consistent with Ricardian behavior. Housing holdings are not included in the definition of wealth for these purposes, since 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. Thus, non-housing net worth is total wealth in the PSID net of the equity value of any real estate holdings, and includes 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, students loans, medical or legal bills, personal loans), the value of private annuities or IRAs, the value of shares of stock in publicly held corporations, mutual funds or investment trusts, the value of other investments in trusts or estates, bond funds, life insurance policies, special collections, and other assets 'on wheels'.[1]. Our definition of income includes salaries and other compensation plus private and government transfers[2].

Table 1 summarizes our identification strategy, which uses the threshold approach described above as the main characteristic to separate patient from impatient households. We report the estimated weights using PSID data in Table2 for all survey waves between 1999 and 2013. The relative weight of patient households has been declining from 43 percent in 1999 to 37 percent in 2013. On average, our identification strategy delivers a percentage of patient households, 41 percent, that is smaller than the 54 percent share of non hand-to-mouth households estimated by Kaplan, Violante and Weidner (2014) using PSID data.

Table 1: Household classification

Household	Wealth	Homeowner
Patient	$LW_t^i \geq 0.5 * inc_t^i$	Unrestricted
Impatient	$LW_t^i < 0.5 * inc_t^i$	Unrestricted

Notes: LW_t^i denotes household's i holdings of wealth in period t and inc_t^i is her income.

We argue that the above household classification can be refined to gain further insights on the transmission of fiscal shocks. In particular, we propose to consider five types of impatient

[1] This definition of wealth corresponds to the PSID variable Wealth 1 minus the net value of real estate holdings. Notice that this definition of wealth is similar in spirit to the original measure of liquid wealth using the SCF in Kaplan, Violante and Weidner (2014), being the main difference that we include investment in private retirement accounts in the definition of non-housing *wealth*. Also our definition of housing wealth is more restrictive than the illiquid net wealth measure using PSID data in Kaplan, Violante and Weidner (2014).

[2] 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; temp assistance for needy families (state program), other welfare; pensions/annuity; lump sum payments (inheritances, itemized deductions); and financial support given to others.

Table 2: PSID Sample Weights (in %)

	1999	2001	2003	2005	2007	2009	2011	2013
Patient	43	43	43	42	42	38	38	37
Impatient	57	57	57	58	58	62	62	63

households according to their housing holdings and their access to credit. We first distinguish between homeowners and non-homeowners. Among the former, we consider three types of households depending on the quality of the collateral services provided by their real estate holdings. We label those impatient homeowner households without mortgage liabilities as *HH* consumers. Among the impatient homeowner households with liabilities, we distinguish between those highly indebted, *BH*, and those with low leverage ratios, *BL* (Iacoviello (2005); Andrés, Boscá and Ferri (2015)). Empirically, we classify indebted homeowners as being *BH* (*BL*) if their leverage ratio exceeds (is below) the median leverage ratio in the sample. We also classify impatient non-homeowner households depending on their liabilities position. On the one hand, *HNH* households do not hold any assets nor liabilities and, hence, they consume all their available income (Galí, Vallés and López-Salido (2007)). On the other hand, *EK* households are those with no assets but with non-collateralized outstanding debt (Eggertsson and Krugman (2012)). In the PSID, *EK* households are those with negative liquid wealth since they have debts other than mortgages, which includes credit cards, student loans, medical or legal bills, and personal loans. Table 3 summarizes our identification strategy and Table 4 reports the estimated weights using PSID data.

Table 3: Household classification: Our proposal

	Wealth	Homeowner	High Leverage	Low Leverage	Mortgage
Patient: R	$LW_t^i \geq 0.5 * inc_t^i$	?	?	?	?
Impatient: HH	$0 < LW_t^i < 0.5 * inc_t^i$	Yes	No	No	No
Impatient: BL	$0 < LW_t^i < 0.5 * inc_t^i$	Yes	No	Yes	Yes
Impatient: BH	$0 < LW_t^i < 0.5 * inc_t^i$	Yes	Yes	No	Yes
Impatient: HNH	$0 < LW_t^i < 0.5 * inc_t^i$	No	–	–	–
Impatient: EK	$LW_t^i \leq 0$	No	–	–	–

The shares of the different household categories remained quite stable until the onset of the financial crises. Until 2007, the share of Ricardian households has been about 43 percent, that of impatient homeowner households without mortgage liabilities about 4 percent and of impatient homeowners with mortgages, 18 percent on average. The share of impatient

Table 4: 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

households with no assets and no liabilities has been 19 percent, while that of impatient households with no assets but with debt has been about 16 percent. Since 2007, however, the share of patient households declines reaching 37 percent in 2013, while the share of impatient households with no assets but with liabilities increases steadily reaching 24 percent at the end of the sample. The shares of the remaining types of impatient households remain stable thorough the financial crisis and the subsequent recovery.

4 The Model

We put forward a model that merges the standard New Keynesian model, augmented with search and matching frictions, with a formal treatment of balance-sheet heterogeneity in the household sector. We assume that there is perfect risk sharing among household members and that all workers are equally productive and delegate to a trade union the negotiation of wages and hours with firms. In equilibrium, all households earn the same labour income, which allows us to isolate the effect of the other determinants of consumption in our model, namely the balance sheet of the household and her access to credit. Abstracting from the potential interactions between employment status and household balance-sheet composition may seem a strong assumption but Arrondel et al. (2014) show that the structure of household wealth varies with the level of income but not significantly with employment status in the Eurosystem Household Finance and Consumption Survey. However, we keep the search and matching environment because, as shown by Andrés, Boscá and Ferri (2015), the response of the intensive and extensive margin in response to fiscal shocks is key to explain the size of the output multiplier in the presence of financial heterogeneity.

4.1 Households

The economy is populated by N households who differ in the 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 savers/lenders that own illiquid assets (real estate), but do not have liabilities. In our economy, these households coexist with financial constrained individuals who are more impatient than Ricardian households, some of them are homeowners, while others have no access to real estate ownership. Among those impatient homeowners, we distinguish three types: *(i) HNH* households who can purchase and own houses but do not have access to credit; *(ii) BH* households who can borrow against a high proportion of the expected value of their real estate holdings; and *(iii) BL* households who can borrow against a low proportion of the expected value of their home. Impatient homeowners with access to credit resemble the borrowers in Kiyotaki and Moore (1997) and Iacoviello (2005). We consider two types of impatient households that do not own housing: *(i) HNH* households who are along the lines of traditional hand-to-mouth consumers introduced by Galí, Vallés and López-Salido (2007), so, as they do not have access to financial markets, they have a zero net worth; and *(ii) EK* households who borrow against their current and expected future labour income as in Eggertsson and Krugman (2012). Thus, *EK* households have only liabilities and no assets. Table 5 summarizes the classification of households in the model economy.

Table 5: HOUSEHOLD CLASSIFICATION

	β	Access to credit	Homeowner	Leverage
R	Patient	Yes	Yes	Unrestricted
HH	Impatient	No	Yes	No
BL	Impatient	Yes	Yes	Low
BH	Impatient	Yes	Yes	High
HNH	Impatient	No	No	No
EK	Impatient	Yes	No	Unrestricted

Preferences specification 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, $1 - l_{1t}$, and unemployed members, $1 - l_2$, where l_{1t} stand for hours worked per employee and l_2 stands for the hours devoted to job seeking by the unemployed members of the household, which are exogenously given.

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

where β_i is the type-specific discount rate, ϕ_x^i is the type-specific parameter governing preferences over housing, η is the Frisch elasticity of labour supply, ϕ_1 is the valuation of leisure by the employed members of the households, and ϕ_2 is the valuation of leisure by the unemployed members. The employment rate is n_t^i and $(1 - n_t^i)$ stands for the unemployment rate.

The law of motion of the employment rate, n_t^i, is given by

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

Under our model assumptions, $n_t^i = n_t$ for all households and jobs are destroyed each period at the exogenous rate σ. Likewise, new employment opportunities come at the rate ρ_t^w that represents the probability that an unemployed worker finds a job, which is taken as exogenous by individual workers but it is endogenously determined at the aggregate level. Actually, ρ_t^w can be defined as the number of matched workers during period t over the volume of unemployed workers at the beginning of period t

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

where v_t stands for the number of active vacancies during period t, and χ_1 and χ_2 are the parameters of the matching function. Let us define here the marginal value of employment for a worker, λ_{ht}^i as

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

where Ω^i represents *ith*-household value function; the first term captures the value of the cash-flow generate by the new job; the second term represents the net utility from the newly created job; and the third term represents the "capital value" of an additional employed worker conditional on keeping the employment status.

Given that the labour market decisions both regarding the extensive margin (employment) and the intensive margin (hours worked) are identical for all households, they receive the same labour income. Thus, heterogeneity in consumption is driven by differences in balance-sheet composition. We assume that Ricardian households are more patient than impatient households, thus $\beta^R > \beta^{HtM}$. In the remainder of this subsection, we describe the problem faced by each type of household.

4.1.1 Ricardian Households

Ricardian households, who are patient agents, are the only savers in the economy. They lend d_t^R to the private sector and d_t^p to the public sector. Debt contracts are 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 assumed to be the only ones who own physical capital, k_t^R, and undertake productive investment j_t^R, which is subject to increasing marginal costs of adjustment. In our model economy, firms make extraordinary profits that we assume Ricardian households receive in the form of dividends, f_t^R.

Patient consumers choose paths for consumption, c_t^R, housing holdings, x_t^R, leisure, private lending, d_t^R, public lending, d_t^P, and investment, j_t^R to optimize their lifetime utility subject to the following budget constraint:

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

where $w_t n_{t-1} l_{1t}$ is labour income,q_t stands for housing real price, $p_t\left[x_t^R - x_{t-1}^R\right]$ is housing investment, and trh_t are lump sum transfers (taxes) from (to) the government.

The capital accumulation equation is given by

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

4.1.2 Impatient homeowners

Impatient homeowners consume all their disposable income; but, while *BH* and *BL* households are indebted, *HNH* consumers do not hold any liabilities. Therefore, the budget constraint for *HH* households is given by

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

Indebted impatient homeowners, $i = \{BH, BL\}$, face the following budget constraint

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

and the borrowing constraint

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

with $m^{BH} > m^{BL}$.

We assume that the preference towards housing is identical for Ricardians and impatient homeowners, $\phi_x^R = \phi_x^{HH} = \phi_x^{BH} = \phi_x^{BL}$.

4.1.3 Impatient non-homeowners

Impatient non-homeowbers do not have access to the real estate market and, hence, do not choose housing. In particular, we assume that their valuation of homeownership is zero by imposing $\phi_x^j = 0$ in the utility function. While *EK* households can borrow against their labour income, *HNH* households do not have access to credit. 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

$$b_t^{EK} \leq m^{EK} \left(0.1 w_t n_t l_t + \mathbb{E}_t \left[\sum_{j=1}^{3} 0.3 \frac{\left(1+\pi_{t+j}\right) w_{t+j} n_{t+j} l_{1,t+j}}{1+r_t^n} \right] \right) \tag{10}$$

and their budget constraint by

$$c_t^{EK} + \left(1+r_{t-1}^n\right) \frac{b_{t-1}^{EK}}{1+\pi_t} = w_t n_{t-1} l_{1t} + b_t^{EK} \tag{11}$$

The budget constraint of impatient consumers with no access to ownership nor credit is as follows

$$c_t^{HNH} = w_t n_{t-1} l_{1t} \tag{12}$$

4.2 Business sectors

Production is organized in three different levels: *(i)* a wholesale sector (indexed by j) where firms use labour and capital to produce a homogeneous good that is sold in a competitive market at a price P_t^w; *(ii)* an intermediate sector with firms (indexed by l) that buy the homogeneous good and transform it, without the use of any other input, into a firm-specific variety that is sold in a monopolistically competitive market; and *(iii)* a competitive retail firm that buys differentiated varieties, y_t^l, from the intermediate sector at a price P_t^l and transforms them into an homogeneous final good, y_t, which is sold at price P_t.

4.2.1 Retail Sector

The competitive retail aggregator buys differentiated goods from firms in the intermediate sector and sells an homogeneous final good, y_t, at price P_t. Each variety y_t^l is purchased at a price P_t^l. The retailer's profit optimization problem is given by

$$Max_{y_t^l} \left\{ P_t y_t - \int_0^1 P_t^l y_t^l d_l \right\},$$

subject to

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

where $\theta > 1$ is a parameter that can be expressed in terms of the elasticity of substitution between intermediate goods, $\varkappa$, since $\theta = \frac{1+\varkappa}{\varkappa}$. The price of the final good is given by:

$$P_t = \left[\int_0^1 \left(P_t^l \right)^{1-\theta} dl \right]^{\frac{1}{1-\theta}}. \tag{14}$$

4.2.2 Intermediate Goods Sector

There is a continuum of infinitely lived producers of intermediate goods, indexed by $l \in [0,1]$, operating under monopolistic competition. Intermediate firms buy the wholesale good at price P_t^w, 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 staggered price framework à la Calvo (1983). At any given period, a producer is allowed to reoptimize her price with probability $(1-\omega)$. When reoptimization is possible, an intermediate firm l chooses the price $P_t^\star$ that maximizes the present value of her expected profits. Each period, a proportion ω of firms do not reoptimize prices and set them using a partial indexation rule: $P_t^l = (1+\pi_{t-1})^\varsigma P_{t-1}^l$. The aggregate price level is given by

$$P_t = \left[\omega \left(P_{t-1} \pi_{t-1}^\varsigma \right)^{1-\theta} + (1-\omega) \left(P_t^* \right)^{1-\theta} \right]^{\frac{1}{1-\theta}}. \tag{15}$$

4.2.3 Wholesale Sector

There is a continuum of infinitely lived wholesale producers, indexed by $j \in [0,1]$, operating under perfect competition. Firms produce an homogeneous good using labour and capital. Capital demand and vacancy posting are decided by solving the following cost minimization problem

$$\min_{k_t, v_t} E_t \sum_{t=0}^{\infty} \beta_R^t \frac{\lambda_{1t+1}^R}{\lambda_{1t}^R} \left(r_{t-1} k_{t-1} + w_t n_{t-1} l_{1t} + \kappa_v v_t \right), \tag{16}$$

subject to the production function

$$y_t = A k_{t-1}^{1-\alpha} (n_{t-1} l_{1t})^{\alpha}, \tag{17}$$

and the law of motion for employment

$$n_t = (1-\sigma) n_{t-1} + \rho_t^f v_t, \tag{18}$$

λ_1^R stands for the Lagrange multiplier associated to the budget constraint for Ricardian households who are the owners of firms in the economy. The probability of filling a vacancy at any given period t, ρ_t^f is given by

$$\rho_t^f v_t = \chi_1 v_t^{\chi_2} \left[(1 - n_{t-1}) \, l_2 \right]^{1-\chi_2}. \tag{19}$$

The optimal vacancy posting is given by

$$\kappa_v = \beta_R \rho_t^f E_t \frac{\lambda_{1t+1}^R}{\lambda_{1t}^R} \frac{\partial V_{t+1}}{\partial n_t}. \tag{20}$$

and reflects that firms choose the number of vacancies in such a way that the marginal recruiting cost per vacancy, κ_v, is equal to the expected present value of opening the vacancy, where $\frac{\partial V_{t+1}}{\partial n_t}$ represents the next period firm's marginal value of an additional job.

4.3 The Labour Contract

Following Boscá, Doménech and Ferri (2011), 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 proceeds by maximizing the aggregate marginal value of employment for workers and distributes employment according to the shares in the working-age population. Thus, all households receive the same wage, work the same number of hours, and have the same unemployment rate.

The Nash bargaining problem maximizes the weighted product of the parties' surpluses from employment. The optimal real wage and hours worked is given by

$$\begin{aligned} w_t l_{1t} &= \lambda^w \left[mc_t \alpha \frac{y_t}{n_{t-1}} + \frac{\kappa_v v_t}{1-n_{t-1}} \right] + (1-\lambda^w) \frac{1}{1-\eta} \left[\phi_2 (1-l_2)^{1-\eta} - \phi_1 (1-l_{1t})^{1-\eta} \right] \sum_{i \in I} \frac{\tau^i}{\lambda^i_{1t}} \\ &+ (1-\lambda^w)(1-\sigma-\rho^w_t) \sum_{\widetilde{i} \in \widetilde{I}} \tau^i_t \mathbb{E}_t \left[\frac{\lambda^{\widetilde{i}}_{ht+1}}{\lambda^{\widetilde{i}}_{1t+1}} \left(\beta^R \frac{\lambda^R_{1t+1}}{\lambda^R_{1t}} - \beta^{\widetilde{i}} \frac{\lambda^{\widetilde{i}}_{1t+1}}{\lambda^{\widetilde{i}}_{1t}} \right) \right] \end{aligned} \tag{21}$$

$$mc_t \alpha \frac{y_t}{n_{t-1} l_{1t}} = \phi_1 (1-l_{1t})^{-\eta} \sum_{i \in I} \frac{\tau^i}{\lambda^i_{1t}}. \tag{22}$$

where $\lambda^w \in [0,1]$ reflects workers' bargaining power, $i \in I$ refers to all types of households, and $i \in \widetilde{I}$ refers to the impatient consumers.

4.4 Policy Instruments and Resources Constraint

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

$$1 + r^n_t = \left(1 + r^n_{t-1}\right)^{r_R} \left[(1+\pi_t)^{1+r_\pi} \left(\frac{y_t}{\overline{y}} \right)^{r_y} (1+\overline{r}^n) \right]^{1-r_R}, \tag{23}$$

where $\overline{y}$ and $\overline{r}^n$ are steady-state levels of output and interest rate, respectively. The parameter r_R captures the extent of interest rate inertia, and r_π and r_y represent the weights given to inflation and output objectives.

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

$$d^P_t = g_t + trh_t + \frac{1+r^n_{t-1}}{1+\pi_t} d^P_{t-1}. \tag{24}$$

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

$$trh_t = trh_{t-1} - \psi_1 \left[\frac{d^P_t}{gdp_t} - \overline{\frac{d^P}{gdp}} \right] - \psi_2 \left[\frac{d^P_t}{gdp_t} - \frac{d^P_{t-1}}{gdp_{t-1}} \right], \tag{25}$$

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

$$y_t = A_t k^{1-\alpha}_{t-1} (n_{t-1} l_{1t})^\alpha = c_t + j_t \left(1 + \frac{\phi}{2} \left[\frac{j_t}{k_{t-1}} \right] \right) + g_t + \kappa_v v_t. \tag{26}$$

5 Calibration

The calibration strategy consists of using standard values in the literature for some parameters and matching some relevant data moments for the US economy. Table 6 reports the parameter values for the household-related parameters. Our benchmark calibration uses the estimated PSID weights for 1999: Ricardian households represent 43 percent of the population and, hence, 57 percent of the population are impatient consumers. Among impatient homeowners, households without liabilities, HH, represent 5 percent of the overall population, households with a high loan-to-value ratio, BH, are 11 percent and those with a low loan-to-value, BL, are 6 percent. Impatient non-homeowners amount to 35 percent of the population. Among those, households without liabilities, HNH, are 19 percent of the population and the indebted ones, EK, represent 16 percent of the overall population. As in Iacoviello (2005), we assume that the subjective intertemporal discount rate of patient households is $\beta^R = 0.99$, while the discount factor for impatient households is equal to 0.95. All households that own houses in our economy share the same preferences on housing, $\phi_x = 0.12$. This value, as well as the the total stock of housing, X, depends on the value we assign to the ratio of assets of patient households $(\overline{b}^R)$ to total output $(\overline{y})$ in the steady state. Following Iacoviello (2005), we set $\overline{b}^R/\overline{y}$ so that the total stock of housing over yearly output is 140 percent. We assume that low-leveraged homeowners, BL, can borrow up to 73.5% of the expected value of their real estate holdings, while high-leveraged homeowners, BH, can leverage up to 98.5%. We assume that EK households can borrow against 50% of the weighted sum of their current and future labour income.

Table 6: Calibrated Parameters: Household sector

Type	τ^i	β	ϕ_x^i	m^i
R	0.43	0.99	0.12	$--$
HH	0.05	0.95	0.12	$--$
BL	0.06	0.95	0.12	0.735
BH	0.11	0.95	0.12	0.985
HNH	0.19	0.95	0	$--$
EK	0.16	0.95	0	0.50

The remaining set of parameters is shown in Table 7. We consider standard values for the labour share in the Cobb-Douglas technology, $\alpha = 0.7$, and the depreciation rate of physical capital, $\delta = 0.025$. We set the elasticity of matching to vacancies χ_2 equal to 0.5 as in Monacelli, Perotti and Trigari (2010). Following Andolfatto (1996) and Chéron and Langot (2004), we set *(i)* the exogenous transition rate from employment to unemployment $\sigma = 0.15$;

(ii) the probability of a vacant position becoming a productive job $\overline{\rho}^f = 0.9$; *(iii)* the fraction of time spent working $\bar{l}_1 = 1/3$; and *(iv)* the fraction of time households spend searching $l_2 = 1/6$. The long-run employment rate is set to $\overline{n} = 0.75$ as in Choi and Ríos-Rull (2009). Furthermore, we assume that the equilibrium unemployment is socially efficient (see Hosios (1990), which implies that $\lambda^w = 1 - \chi_2 = 0.4$. This value of worker's bargaining power is an average between the commonly used 0.5 and the 0.3 value estimated by Christiano, Trabandt and Walentin (2011) and also calibrated in Liu, Miao and Zha (2013). For the intertemporal labour elasticity of substitution, we consider $\eta = 2$ implying that average individual labour supply elasticity $\left(\eta^{-1}\left(1/\overline{l_1} - 1\right)\right)$ is equal to 1 as in Andolfatto (1996). The adjustment costs parameter for productive investment $\phi = 5.5$, is taken from QUEST II, which considers the same function as ours for capital installation costs. The parameter values of the Phillips curve are also standard in the literature. We set the elasticity of substitution of final goods $\theta = 6$ so that the markup at the steady state is $\frac{\theta}{\theta - 1} = 1.2$. The Calvo parameter, ω, is set to 0.75 so that prices change every four quarters on average. The partial indexation parameter, ς, is assumed to be 0.4. Regarding Taylor's rule, we assume $r_R = 0.73$ and $r_\pi = 0.30$.

Table 7: Calibrated Parameters

Preferences:			
Labour elasticity, η	2		
Leisure preference (empl.), ϕ_1	1.59	Leisure preference (unempl.), ϕ_2	1.04
Technology:			
Labour share in production, α	0.7	Depreciation rate of capital, δ	0.025
Elasticity of final goods, θ	6	Entry fixed cost, κ_f	0.167
Frictions:			
Probability of not changing prices, ω	0.75	Investment adjustment costs, ϕ	5.5
Inflation indexation, ς	0.4		
Labour market:			
Matching elasticity, χ_2	0.6	Transition rate, σ	0.15
Workers' bargaining power, λ^w	0.4	Cost of vacancy posting, κ_v	0.04
Scale parameter matching, χ_1	1.56	LR employment ratio, $\bar{n}$	0.75
Vacancy filling probability, $\bar{\rho}^f$	0.9		
Policy:			
Fiscal reaction parameter, ψ_1	0.01	Fiscal reaction parameter, ψ_2	0.2
Interest rate smoothing, r_R	0.73	Interest rate reaction, r_π	0.30
Interest rate reaction, r_y	0		

We normalize both steady-state output, $\overline{y}$, and real housing prices, $\overline{q}$, to one. Steady-state government expenditure $\overline{g}/\overline{y}$, is set to 17 per cent, the historical average in the U.S. We calibrate the cost of vacancy posting $\kappa_v = 0.04$ so that the ratio of recruiting expenditures to output is 0.5 percentage points as in Chéron and Langot (2004) and Choi and Ríos-Rull (2009)[3]. The scale parameter of the matching function, χ_1, can be computed using the identity that matching flows equals the flow of jobs that are lost evaluated at the steady state[4].

The long-run value of total factor productivity, $A = 1.50$, is calibrated from the production function to obtain the steady-state value of Tobin's q ratio, $\frac{\overline{\lambda}_2^l}{\overline{\lambda}_1^l}$. The return on capital $(\overline{r})$ comes from the first-order conditions and the steady-state value for capital stock $(\overline{k})$ from the capital demand equation. Capital stock, together with the depreciation rate and the adjustment cost parameter, allows us to calculate the value of gross investment for the steady state and, using the aggregate constraint, the level of consumption $\overline{c}$. The steady-state value of the nominal interest rate $\overline{r}^n$, is related to the intertemporal discount rate of Ricardian households through the steady-state version of the first-order condition for consumption. The value for the lump-sum transfers in the steady state is such that from the government budget constraint the resulting debt-to-output ratio is 73 per cent in annual terms. In order to compute κ_f, we use the following equality between the source of income and aggregate spending

$$c + j\left(1 + \delta\frac{\phi}{2}\right) + g_t = nwl + rk + \kappa_f$$

where $\kappa_f = \tau^R f_t^R$.

Steady-state levels of the marginal utilities of consumption of the different types of consumers, $\overline{\lambda}_1^R$, $\overline{\lambda}_1^{HNH}$, $\overline{\lambda}_1^{HH}$, $\overline{\lambda}_1^{BL}$, $\overline{\lambda}_1^{BH}$, and $\overline{\lambda}_1^{EK}$ come from their respective first-order conditions. As regards leisure preference parameters in the household utility function, $\phi_1 = 1.59$ is calculated from the steady-state version of expression (22). A system of seven equations implying the steady state of expression (4) for the six categories of individuals and equation (21) is solved for ϕ_2, $\overline{\lambda}_h^R$, $\overline{\lambda}_h^{HNH}$, $\overline{\lambda}_h^{HH}$, $\overline{\lambda}_h^{BL}$, $\overline{\lambda}_h^{BH}$, and $\overline{\lambda}_h^{EK}$. The resulting value for ϕ_2 is 1.04. Therefore the calibrated values for ϕ_1 and ϕ_2 imply that the value attributed to leisure by an employed worker is well above that attributed by an unemployed worker.

6 Inspecting the mechanism: Simulation results

We use the model to analyze the role played by households balance-sheet heterogeneity in shaping the short-run response of consumption to a transitory government spending shock. In this section, we proceed using the wealth distribution implied by our benchmark calibration.

[3]Given the values for the transition rate, the long-run employment rate and the vacancy filling probability, we can compute the long-run value for vacancies $\bar{v} = \sigma\bar{n}/\bar{\rho}^f = 0.125$, and given that the ratio of recruiting expenditures to output is equal to $\kappa_v\bar{v}/\bar{y}$, we can compute the cost of vacancy posting

[4]Matching flows at the steady state are equal to $\chi_1\bar{v}^{\chi_2}\left[(1-\bar{n})\, l_2\right]^{1-\chi_2}$ and the flow of jobs lost $\sigma\bar{n}$.

Table 8 reports the steady state levels of consumption, labour income, and net wealth (and its distribution between assets and liabilities) across the six household categories in our model economy. The last column in Table 8 reports the wealth-to-labour-income ratio, which shows substantial heterogeneity. Despite the large degree of heterogeneity in net wealth at the steady state, the assumption on identical labour income translates into a more egalitarian distribution of consumption.[5]

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 for 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 the liabilities held. Households use their income for consumption and debt interest payment. Therefore, given that labour income is identical across households, heavily indebted consumers can afford lower levels of consumption at the steady state. For example, the indebtedness ability of *EK* households is lower than the one of impatient homeowners. Therefore, the consumption level at the steady state for *EK* exceeds that for *BH* and *BL*.

Table 8: Steady state values

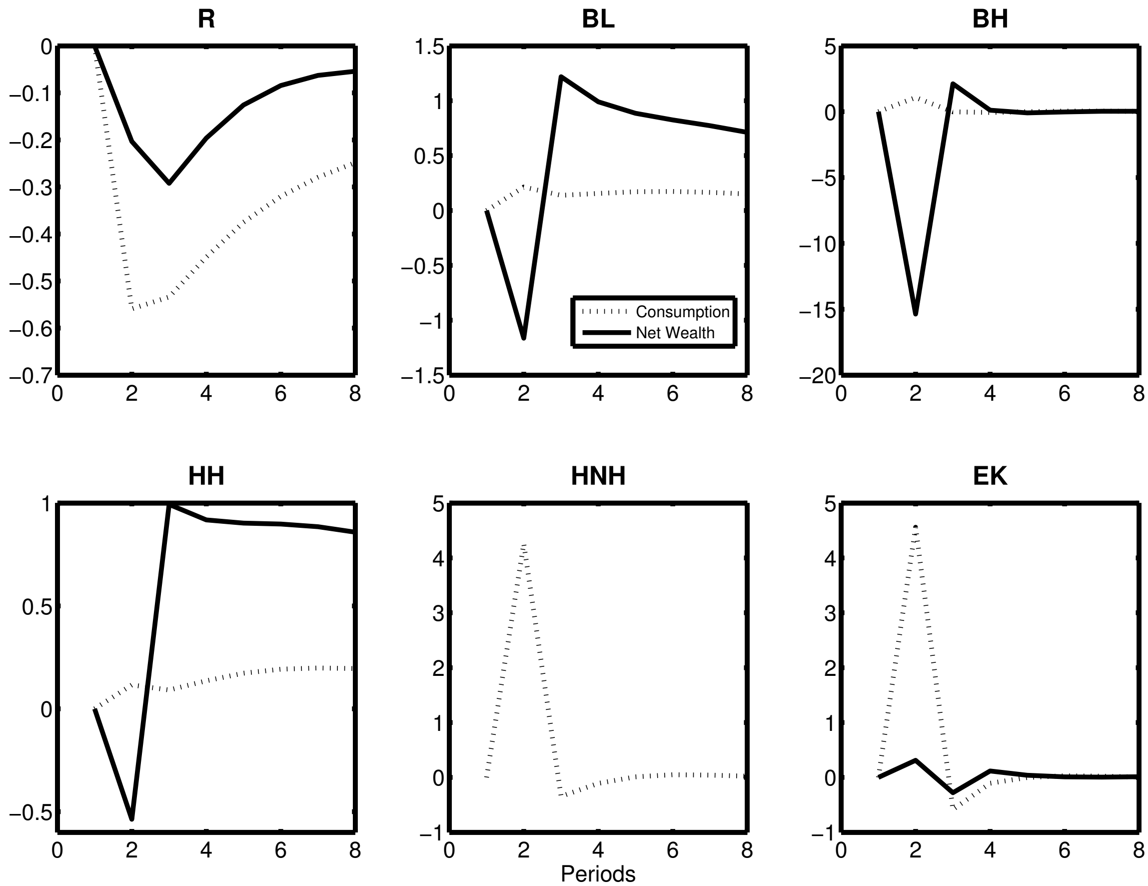
	Cons	Lab income	Net wealth	Assets	Liabilities	Ratio
	(1)	(2)	(3)	(4)	(5)	(3)/(2)
R	0.766	0.578	36.846	36.846	0	63.7
HNH	0.578	0.578	0	0	0	0
HH	0.578	0.578	1.585	1.585	0	2.74
BL	0.551	0.578	0.972	3.668	2.696	1.68
BH	0.513	0.578	0.099	6.632	6.533	0.17
EK	0.575	0.578	-0.287	0	0.287	-0.50

We explore the effects of a government spending shock that increases GDP by 1 percent for each type of household in Figure 1. The fiscal shocks is assumed to have an autocorrelation of 0.75. Each panel reports the response, in deviations from steady state, of consumption – the dotted line – and net worth – the solid line. As shown in Figure 2, after an expansionary government spending shock, hours per worker, employment, and real wages increase significantly inducing a strong response of labour income, which, by assumption, is identical across households. As in Andrés, Boscá and Ferri (2015), we obtain that expansionary fiscal shocks translate into deflationary pressures on housing prices (see Figure 7 in the Appendix).

[5]Using the European Household Finance and Consumption Survey, Carrol, Slacalek and Tokuoka (2014) find a substantial degree of heterogeneity in wealth-to-permanent-income ratios.

Hence, net worth of all homeowners in our model economy falls. Net worth rebounds immediately after the initial response for impatient consumers, while for patient households, net worth slowly converges to its steady state level from below. The individual responses for consumption are widely different ranging from a 0.5 percent decline for lenders to over a 4 percent increase for impatient non-homeowners.

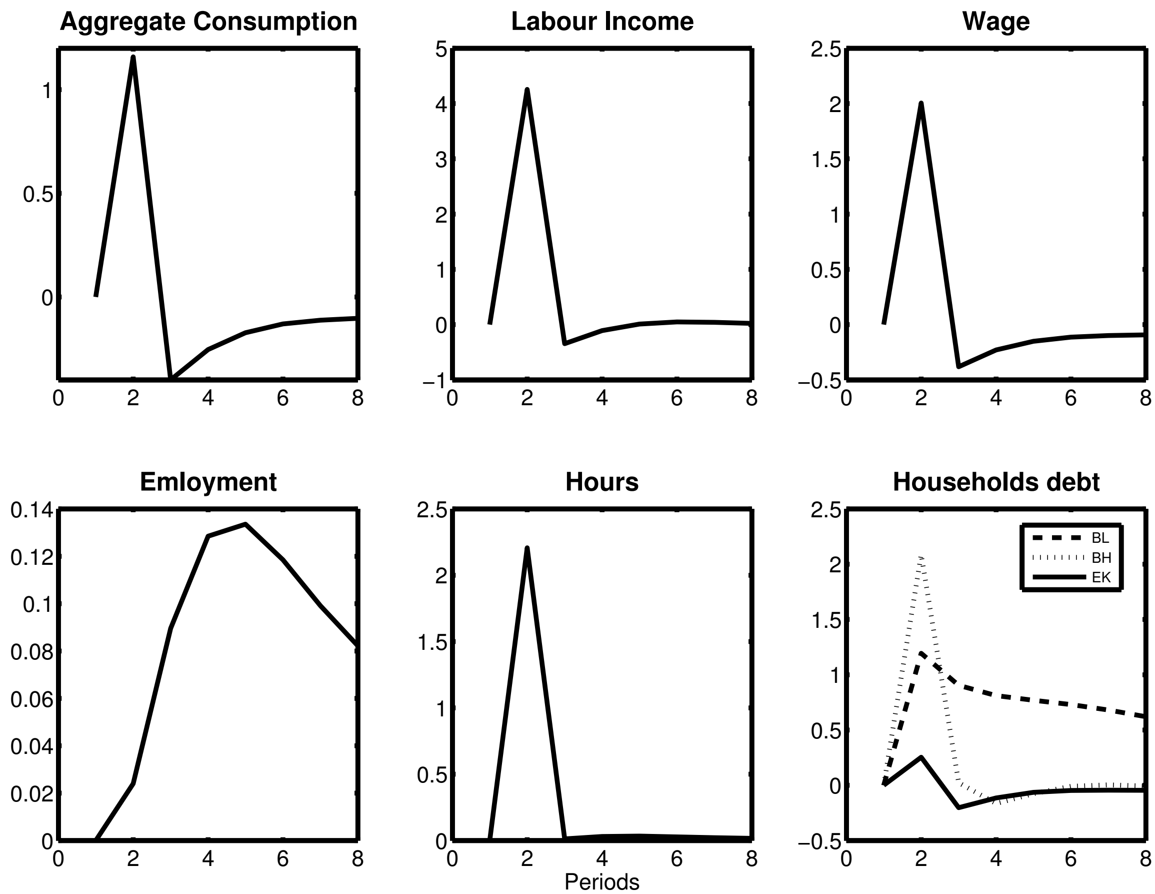
Figure 1: RESPONSE OF CONSUMPTION AND NET WEALTH TO A GOVERNMENT SPENDING SHOCK (IN DEVIATIONS FROM STEADY STATE)



To better understand the impact multiplier of individual consumption, we explore the implicit consumption function for each type of household. Abstracting from firm's profits and transfers, the current level of consumption for Ricardian households is a function of their net worth and their labor income.

$$c_t^R = \mathfrak{F}_R \left((1 - \delta + r_t)\, k_{t-1}^R + q_t x_{t-1} + \left(1 + r_{t-1}^n\right) \frac{d_{t-1}^P + d_{t-1}^R}{1 + \pi_t}; \quad w_t n_{t-1} l_{1t} \right),$$

Figure 2: IMPULSE RESPONSE FUNCTIONS (IN DEVIATIONS FROM STEADY STATE): AGGREGATE VARIABLES



where the first component in the function $\mathfrak{F}_R(\cdot)$ is household net worth and the second component is her labor income. The response of consumption to a change in government spending depends on the sign of the wealth and income effects and their interaction. As stated earlier, the expansionary effects of fiscal shocks imply a positive labor income effect on consumption. However, the decline of housing prices erode the value of real estate assets held by Ricardian households, which deteriorates net worth. Moreover, the economic expansion linked to the fiscal shocks translates into inflationary pressures reducing the real value of nominal debts, which implies a reduction of the net worth of lenders. Therefore, the wealth effect of a government spending shock is unambiguously negative for patient households. The decline in net worth overcomes the positive labor income effect and the consumption of patient households declines.

For impatient households, the sign of the wealth effect is ambiguous, being positive or negative depending on their balance-sheet composition. Households with real estate holdings are subject to the decline in housing prices, which reduces net worth. But the Fisher effect reduces the real burden of credit for indebted households, which has a positive effect on net worth. The relative importance of each of these two opposite effects determines the sign of the wealth effect for impatient households. The implicit consumption function also depends upon the flow of new credit for households with access to financial markets. In our calibration, for indebted households borrowing against the future value of their real estate holdings, the response of credit to a fiscal policy shock is positive.

Let us consider the implicit consumption function for impatient indebted homeowners, BH and BL, which depends upon net worth, labor income, and credit:

$$c_t^j = \mathfrak{F}_j \left(q_t x_{t-1} - \left(1 + r_{t-1}^n\right) \frac{b_{t-1}^j}{1+\pi_t}; \quad w_t n_{t-1} l_{1t}; \quad b_t^j \right)$$

and, hence, into an The size of the decline in net worth driven by asset price depreciation is smaller than for patient households since impatient households only hold one type of assets: housing. In addition, the inflationary pressure of expansionary fiscal shocks reduces the real burden of debt and, hence, increase net worth. In our calibration, the asset price effect dominates the Fisher effect so that the sign of the wealth effect for BH and BL households is negative. Despite the initial decline in house prices, the positive economic outlook after an expansionary fiscal policy shock translates into an increase in the expected value of housing collateral[6] and, hence, into an increase in the amount of credit available. The positive labor income effect and positive credit effect more than compensate the negative wealth effect so that consumption for impatient households with assets and liabilities increases after an expansionary government spending shock. Figure 1 shows that the relative size of the positive response of consumption after an increase in government spending is a positive function of the leverage ratio held by the impatient households with assets and liabilities. The larger response of consumption for BH households is driven by the stronger response of credit to the fiscal shock as shown in Figure 2.

The implicit consumption function for impatient homeowners without liabilities, HH, is given by

$$c_t^{HH} = \mathfrak{F}_{HH} \left(q_t x_{t-1}; \quad w_t n_{t-1} l_t \right)$$

In this case, the sign of the wealth effect is unambiguously negative given the contraction in housing prices after a positive fiscal shock. The relative size of the positive labor income effect

[6] Andrés, Boscá and Ferri (2015) show that immediately after an initial decline, housing prices start recovering so that the expected value of real estate holdings is larger than their current value.

more than compensates the negative wealth effect so that consumption for HH households shows a small increase upon impact.

For impatient households with no assets and no liabilities, HNH, consumption is fully determined by their labor income. Therefore, their consumption response is strongly positive following the evolution of labor income.

Finally, the implicit consumption function for impatient indebted non-homeowners, EK, is given by

$$c_t^{EK} = \mathfrak{F}_{EK}\left(-\left(1+r_{t-1}^n\right)\frac{b_{t-1}^{EK}}{1+\pi_t}; \quad w_t n_{t-1} l_{1t}; \quad b_t^{EK}\right) \tag{27}$$

The Fisher effect on the liabilities side of the balance sheet implies a positive wealth effect for EK households. The credit effect is also positive since the average of current and expected labor income increases. Therefore, given our calibration, impatient households with no assets but with liabilities have the strongest positive response of consumption to a positive government spending shock.

We have shown the large diversity in consumption responses for each household category. The relative weight of each type of household in the population determines the sign and relative magnitude of the aggregate consumption multiplier. The two extreme responses to a fiscal shock are associated with Ricardian and EK households. Therefore, changes in the relative share of these two types of households in the overall population is key to assessing the transmission of fiscal shocks.

In Table 9, we show the numerical counterparts of these impact responses using the following decomposition

$$\frac{c_t^i\text{-}c^i}{c^i}=\mathfrak{F}_i^{\prime *}\left(\frac{NW^i}{c^i}\frac{NW_t^i-NW^i}{NW^i}; \quad \frac{wnl_1}{c^i}\frac{w_t n_{t-1} l_{1t}-wnl_1}{wnl_1}; \quad \frac{b^i}{c^i}\frac{b_t^i-b^i}{b^i}\right),$$

which shows the weight of the marginal propensity to consume out of each source of funds, net worth, labor income and fresh credit, along with the change in each component for different household types.

Table 9 confirms the substantial heterogeneity across households in the consumption expenditure response induced by the shock. There is a clear negative relationship between the response of consumption and household net wealth. The stronger response of households with lower wealth is consistent with recent empirical evidence linking wealth and consumption (Carrol, Slacalek and Tokuoka (2014); Kaplan, Violante and Weidner (2014); Angrisani, Hurd and Rohwedder (2015)). The central columns highlight the fact that balance sheets are pivotal in the reaction of household consumption, which has been documented empirically by Parker et al. (2013), Agarwal and Quian (2014), Acconcia, Corsetti and Simonelli (2015),

Table 9: Sources of the impact consumption response

	$\frac{c_t^i - c^i}{c^i}$	$\left(\frac{NW^i}{c^i}\right)\left(\frac{NW_t^i - NW^i}{NW^i}\right)$	$\left(\frac{wnl_1}{c^i}\right)\left(\frac{w_t n_{t\text{-}1} l_{1t} - wnl_1}{wnl_1}\right)$	$\left(\frac{b^i}{c^i}\right)\left(\frac{b_t^i - b^i}{b^i}\right)$	NW^i
R	-0.0056	-0.0962	0.0321	—	36.846
BL	0.0021	-0.0205	0.0447	0.0576	0.972
BH	0.0108	-0.0298	0.0480	0.2636	0.099
HH	0.0012	-0.0148	0.0426	0.0000	1.585
HNH	0.0426	0.0000	0.0426	0.0000	0
EK	0.0456	0.0015	0.0428	0.0012	-0.287

Sahm, Saphiro and Slemrod (2015), and Surico and Trezzi (2015).

In our model, the negative response of Ricardian households' consumption is mostly driven by the decline in net worth. Although the effect of fresh credit availability is quite small in the case of EK households, the strong response of consumption is driven by the positive wealth effect. Fresh credit is the main driver explaining the differences between BL and BH consumers' spending decisions. The two channels pulling down the consumption multiplier of HH households are declining wealth and, more importantly, diversion of spending towards additional housing.

In order to further explore the link between households' financial position and consumption in response to a government spending shock, we compute the aggregate impact multiplier for output, consumption, hours worked, and employment in counterfactual economies. Let us start by considering an economy with only Ricardian households. As reported in the first row of Table 10, in such an economy, the government spending shock triggers the standard crowding out effect in consumption that, along with a similar effect on different forms of investment, implies a small output multiplier. The effect on both total hours and employment is positive, but relatively less strong for the latter suggesting that hours per employee are increasing significantly.

In the following rows, we keep the share of Ricardian at 50 per cent and distribute the remaining 50 per cent equally among the different types of non Ricardian consumers in a sequential way. For example, in the second row the population is split on equal proportions between Ricardian and HH households, while in the last row each of the different classes of non-Ricardian households represent 10 per cent of the total population. The particular sequence we have chosen for this exercise implies a continuous increase in the size of the multiplier as we are adding new household categories to the economy. This exercise provides a rough indicator of what we 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. The output

Table 10: Fiscal effects

	$\frac{\Delta y_t}{\Delta g_t}$	$\frac{\Delta c_t}{\Delta g_t}$	$\frac{\Delta(n_{t-1}l_{1t})}{nl_1}$	$\frac{\Delta n_{t-1}}{n}$
R	0.854	-0.144	1.223	0.449
R+HH	0.868	-0.086	1.242	0.421
R+HH+BL	0.869	-0.087	1.244	0.424
R+HH+BL+BH	0.876	-0.076	1.254	0.443
R+HH+BL+BH+HNH	0.980	0.056	1.403	0.402
R+HH+BL+BH+HNH+EK	1.102	0.207	1.578	0.330

Note: (1) and (2) are impact multipliers. (3) and (4) are relative variations (%)

multiplier to a government spending shock increases by about 55 percent in between the first and the last rows. Most of the variation in the output multiplier is driven by the variation in the consumption multiplier suggesting that the other components of aggregate demand reacting to the government spending shock are less sensitive to changes in the household distribution.

The last two columns in Table 10 show the different pattern of the responses of the intensive and extensive margin to an increase in government spending, as the share of severely constrained households (HNH and EK types) in the economy rises. While the increase in total hours is significantly greater in the last two rows, the increase in employment (new job openings) is much weaker. There is a direct link among the consumption response, total hours worked , wages, and output. But as highly constrained households (whose consumption increases by more) are included in the simulations, the marginal utility of further consumption falls reinforcing the trade union's position in wage bargaining. 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), Andrés, Boscá and Ferri (2015), and Pappa (2009)). According to our model, this wage rise is stronger as the number of constrained consumers, in particular HNH and EK types, increases. The second term in the equation for optimal wage and hours worked, equation (21), shows that an increase in the share of EK consumers, τ^{EK}, whose marginal utility of consumption λ_t^{EK} falls strongly due to the sharp rise in consumption, strengthens the workers' bargaining power, which is reflected in higher wages and higher hours worked for those employed. Thus, the increase in demand is met by increasing average hours worked per employee, but much less so by an increase in new jobs. Higher wages and longer working hours by employed workers discourage firms from incurring in the cost of posting additional vacancies that now carry a lower expected surplus.[7] In this way, the model predicts a simultaneous increase in output multipliers and a reduction in employment multipliers that make the recovery less intense in job creation.

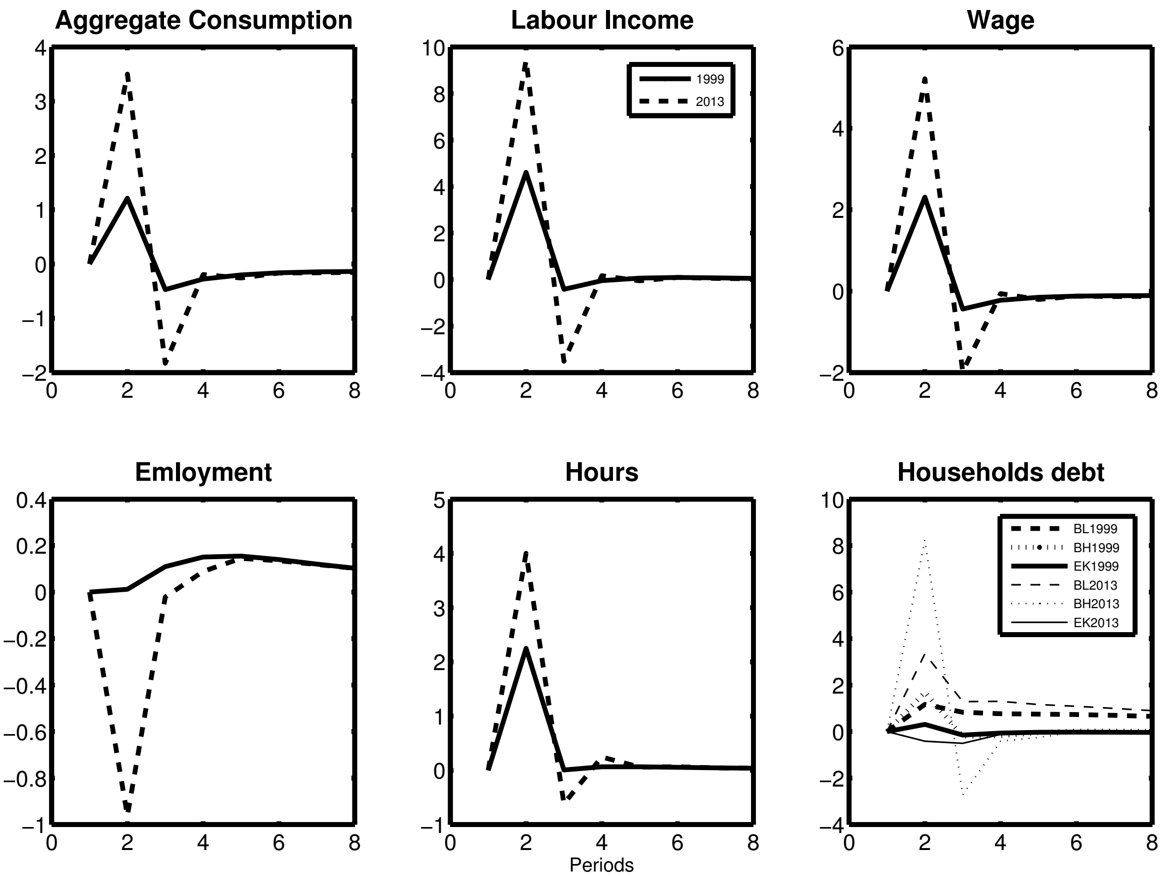
Using the empirical weights reported in Table 4, we compute the macroeconomic effects of a transitory government spending shock equivalent to a 1 percent increase in output. We report our results in Table 11. In the years prior to the Great Recession, the fiscal multiplier remains fairly stable. However, between 2005 and 2013, the fiscal multiplier increases 55 percent. This pattern is mostly driven by the change in the response of aggregate consumption linked to the increase in the share of impatient households with no assets but with liabilities and the decline in the share of patient households. The evolution of the total hours multiplier and the employment multiplier highlight that the changes in the distribution of households enhances the response of the intensive margin over the extensive margin in the labor market after a government spending shock. As illustrated in Figure 3, when comparing the impulse response functions using 1999's household distribution versus 2013's one, government spending shocks evolved from being neutral for employment to having a crowding-out effect while their positive effect on total hours worked has increased over time. The negative response of employment after an expansionary government spending shock over the most recent years is along the lines of the observed jobless recovery after the financial crisis. Our results are robust to alternative parameterizations as reported in Table 12 in the Appendix.

Table 11: THE EVOLUTION OF FISCAL EFFECTS

	1999	2001	2003	2005	2007	2009	2011	2013
$\frac{\Delta y_t}{\Delta g_t}$	1.540	1.557	1.555	1.640	1.737	2.115	2.173	2.412
$\frac{\Delta c_t}{\Delta g_t}$	0.753	0.775	0.772	0.879	0.996	1.465	1.536	1.830
$\frac{\Delta(n_{t-1}l_{1t})}{nl_1}$	2.207	2.232	2.229	2.352	2.490	3.035	3.119	3.463
$\frac{\Delta(n_{t-1})}{n}$	0.024	0.010	0.011	-0.061	-0.148	-0.512	-0.573	-0.825

[7] Cantore, Levine and Melina (2014) show that the divergent response of the extensive and intensive margins in a search and matching model may explain the recent U.S. pattern of recovery after the financial crisis. Their explanation is based on the presence of deep habits and a low elasticity of substitution between capital and labor in the production function.

Figure 3: IMPULSE RESPONSE FUNCTIONS (IN DEVIATIONS FROM STEADY STATE): AGGREGATE VARIABLES, 1999 VS 2013

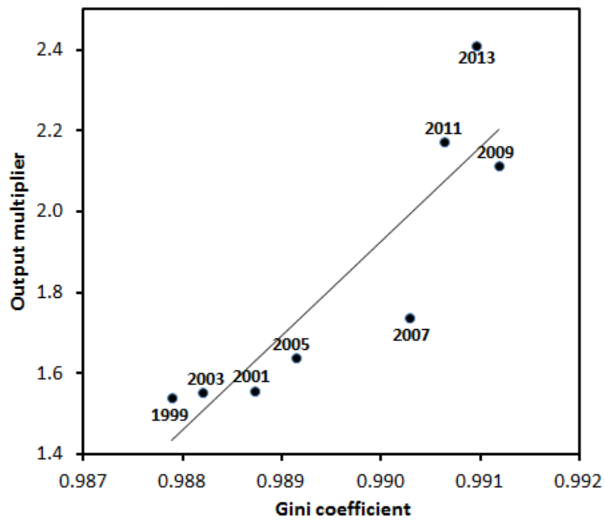


7 Government Spending Multipliers and Wealth Distribution

7.1 Wealth inequality and the fiscal multiplier

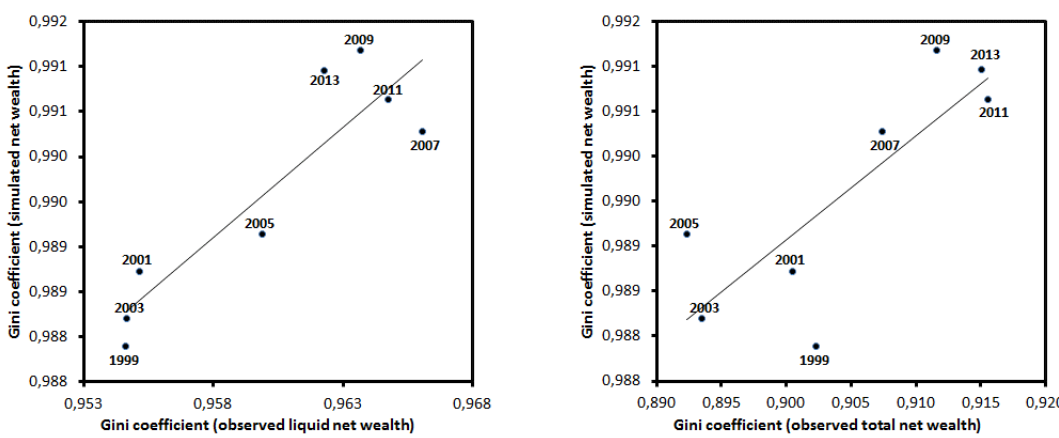
We assess the link between the distribution of wealth and the effects of fiscal policy shocks by plotting the output multipliers against the model-based Gini coefficients as in Figure 4. Both the output multipliers and the Gini coefficients are computed using the observed distribution of households in Table 4. Figure 4 shows a clear correlation between the output multiplier and wealth inequality. The output multiplier increases as the share of constrained agents in the economy increases, suggesting that discretionary fiscal policy is more effective in more unequal economies. This result is consistent with the positive association between wealth inequality and the aggregate marginal propensity to consume documented by Carrol, Slacalek and Tokuoka (2014).

Figure 4: OUTPUT MULTIPLIER AND INEQUALITY



The Gini coefficients in Figure 4 have been calculated using the observed shares of the different households groups and the model implied steady state net wealth for each of them. In Figure 5, we show the correlation between these Gini coefficients and the ones obtained using the observed distribution of the group average wealth in the PSID. No matter whether we use liquid net wealth (left panel) or total net wealth (right panel), we find that the positive correlation between the simulated and the observed wealth inequality indexes is very high (0.9 and 0.81 respectively). We conclude that our model is capable of reproducing a large share of the observed mean variation in wealth inequality.

Figure 5: GINI COEFFICIENT



7.2 Welfare effects

We have assessed the effects of government spending shocks on household consumption across households categories. But households' utility also depends on their real estate holdings and leisure. So in order to assess the distributional consequences of government spending shocks in a more general way, we compute their effect on households' welfare. We define welfare $\overline{V}^i$ 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

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

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

$$V^{i,s} = \sum_{t=0}^{\infty} (\beta^i)^t \left[\begin{array}{c} \ln\left(c_t^{i,s}\right) + \phi_x^i \ln\left(x_t^{i,s}\right) + n_{t-1}^s \phi_1 \frac{(1-l_{1t}^s)^{1-\eta}}{1-\eta} \\ +(1-n_{t-1}^s)\phi_2 \frac{(1-l_2)^{1-\eta}}{1-\eta} \end{array} \right], \tag{28}$$

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 Δ^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 after the fiscal shock, that is

$$V^{i,s} = \sum_{t=0}^{\infty} (\beta^i)^t \left[\begin{array}{c} \ln\left[\overline{c}_t^i \left(1-\Delta^i\right)\right] + \phi_x^i \ln\left(\overline{x}_t^i\right) + \overline{n}_{t-1}\phi_1 \frac{(1-\overline{l}_{1t})^{1-\eta}}{1-\eta} \\ +(1-\overline{n}_{t-1})\phi_2 \frac{(1-\overline{l}_2)^{1-\eta}}{1-\eta} \end{array} \right]. \tag{29}$$

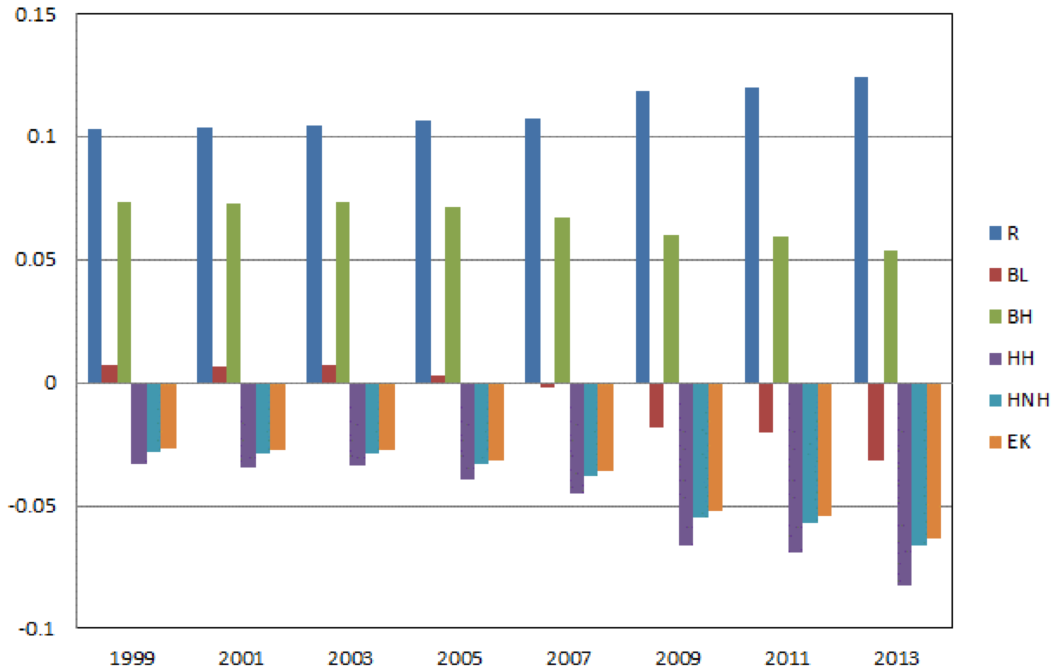
Thus, from (28) and (29)

$$\Delta^i = 1 - \exp\{\left(V^{i,s} - \overline{V}^i\right)\left(1-\beta^i\right)\} \tag{30}$$

where a negative value for Δ implies a welfare gain.

Figure 6 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 and leveraged impatient households with housing, BH and BL, declines while welfare improves for all the other types of impatient households. The benefit in terms of consumption units from fiscal expansions increases considerably after 2007, mainly for the poorest categories (HH, HNH and EK households). Therefore, we argue that fiscal interventions are most effective in redistributing consumption when there is a higher degree of inequality.

Figure 6: Welfare effects across time, by household category



The main message arising from our welfare result is that fiscal policy may generate a non negligible welfare distributional response, even under the assumption that government spending does not directly affect preferences. The way in which each household welfare is affected depends on her position in the financial market. By the same token, and related with the current austerity debate, our results point towards important welfare effects of fiscal consolidations that could harm the most to the less favoured part of the population.

8 Conclusion

In this paper, we revisit the long-standing research question on what are the aggregate effects of fiscal policy shocks in a model that allows for balance-sheet heterogeneity in the household sector along three related dimensions: attitude towards savings, real estate holdings and access to credit. In particular, we propose classifying households in the PSID into 6 categories: *(i)* patient or Ricardian households; *(ii)* impatient households with real estate holding 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 credit. We show that, since the Great Recession, the share of patient households declines while the share of indebted impatient households with no assets increases.

Using a DSGE model and the empirical shares of the population observed in the PSID, we show that balance-sheet heterogeneity in the household sector is key to understanding the aggregate effects of fiscal shocks. In particular, we find that: *(i)* the response of consumption to a government spending shock is negatively correlated with household net worth; *(ii)* the size of the fiscal multiplier is very sensitive to the distribution of households increasing significantly after the share of Ricardians falls and that of indebted impatient consumers with no assets increases; *(iii)* the employment multiplier has declined over time as the upward pressure on wages (that stems from a bargaining process in which agents with reductions in the marginal utility of consumption gain importance) makes firms more reluctant on posting new vacancies and rely more on the intensive labor margin to meet the additional demand, thus generating anemic job recoveries when the proportion of agents with more limited access to credit (in particular those without collateralizable assets) is sufficiently high; *(iv)* output multipliers are positively correlated with wealth inequality; and *(v)* the welfare impact of fiscal shocks across households depends on their financial position: poorer (wealthier) households are the winners (losers) of increases in public spending.

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A Appendix

Figure 7: IMPULSE RESPONSE FUNCTIONS TO A GOVERNMENT SPENDING SHOCK (IN DEVIATIONS FROM STEADY STATE)

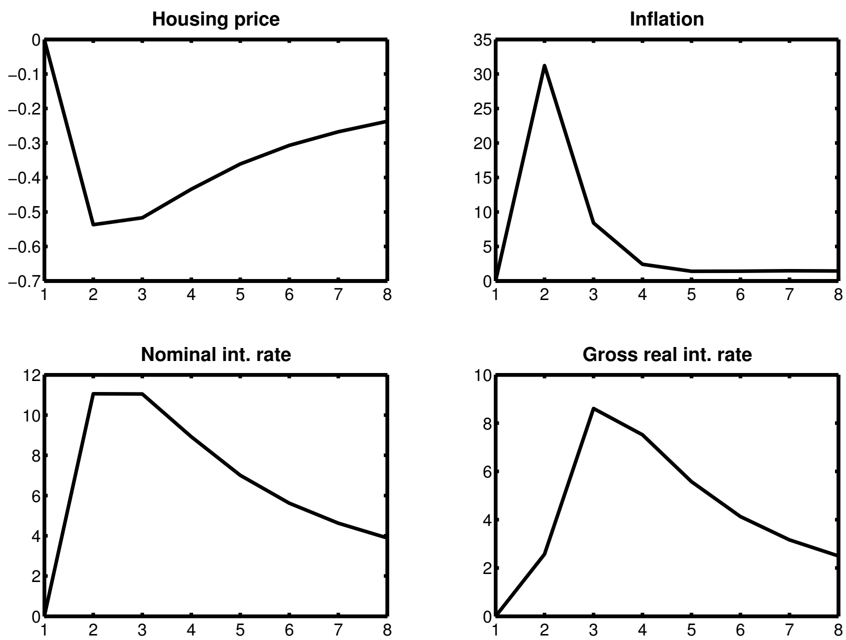

Table 12: SENSITIVITY ANALYSIS

Parameters			$\frac{\Delta y_t}{\Delta g_t}$		$\frac{\Delta c_t}{\Delta g_t}$		$\frac{\Delta(n_{t-1}l_{1t})}{nl_1}$		$\frac{\Delta(n_{t-1})}{n}$	
			1999	2013	1999	2013	1999	2013	1999	2013
Benchmark			1.540	2.412	0.753	1.830	2.207	3.463	0.024	-0.825
	Baseline	New								
λ^w	0.4	0.5	1.657	2.958	0.902	2.491	2.376	4.252	-0.062	-1.110
r_π	0.30	0.25	1.645	2.628	0.849	2.053	2.358	3.776	-0.005	-0.954
ρ_g	0.75	0.80	1.468	2.294	0.657	1.680	2.104	3.294	0.106	-0.694
β^I	0.95	0.97	1.526	2.361	0.734	1.764	2.187	3.390	0.029	-0.786
m^{BH}	0.985	0.90	1.462	2.1591	0.660	1.5249	2.095	3.0986	0.082	-0.5452
ω	0.75	0.77	1.790	3.151	0.959	2.557	2.567	4.531	0.001	-1.228
ϕ	5.5	7.5	1.614	2.689	0.809	2.092	2.314	3.864	0.103	-0.819

NOTES: λ^w is the workers' bargaining power, r_π is the inflation response parameter in the Taylor rule, ρ_g is the autcorrelation coefficient of the fiscal shock, β^I is the discount rate of impatient households, m^{BH} is the loan-to-value ratio for impatient homeowners with a high leverage ratio, ω is the Calvo parameter, and ϕ is the adjustment cost parameter for productive investment.