Online Appendix

for

"Household Debt and the Effects of Fiscal Policy"

Sami Alpanda
University of Central Florida

Melissa Hyunji Song
The University of Sydney

Sarah Zubairy
Texas A&M University

February 19, 2024

A Data sources

A.1 Aggregate data

Table A.1: Data description

Data	Description	Source
NGDP	Nominal GDP	BEA
PGDP	GDP deflator	BEA
GOV	Nominal government purchases	BEA
NCONS	Nominal personal consumptoin expenditure	BEA
NCDUR	Personal consumption expenditures: Durable goods	BEA
NCDC	Personal consumption expenditures: Nondurable goods	BEA
NCSV	Personal consumption expenditures: Service goods	BEA
Population	Population, thousands (POPTHM)	FRED
Hours	Total hours worked	BLS
PBUS	Nonfarm business Sector: Implicit price deflator	BLS
Wages	Nonfarm business sector: Compensation per hour	BLS
Tbill3	3-month Treasury bill (TB3MS)	FRED
HHDEBT	Households and nonprofit organizations; debt securities and loans; liability (CMDEBT)	FRED
HPI	House price index;	
	Price Indexes of New Single-Family Houses Sold Including Lot Value	Census Bereau
	All-Transactions House Price Index for the United States, Index	FRED
	Median sales price for new houses sold (MSPNHSUS)	FRED
Recession	NBER recession periods	FRED
SPF shock	Survey of Professional Forecasters forecast error shock	Ramey (2011)

Note: Table A.1 reports the data source for key aggregate variables. Real values are all deflated by the GDP deflator for the sample period, 1981:Q1-2007:Q1.

A.2 Data by housing tenure groups

We use the U.S. Consumer Expenditure Survey (CEX) data which is available from the U.S. Bureau of Labor Statistics for the sample period, 1981-2007. We use the household expenditure and income data constructed by different types of housing tenure groups following Cloyne, Ferreira and Surico (2020). Consumption data covers non-durable goods and services (food, alcohol, tobacco, clothing and footwear, leisure goods, household services) and durable expenditures (motor vehicles, durable leisure goods, durable household goods). In terms of income data, labor income includes wages and salaries and non-labor income includes income from investments and social payments, net of taxes. Households are excluded from the sample if (i) the income data is missing or the net income is negative, (ii) the expenditure is in either the top or the bottom 1% of distribution, (iii) the household head is aged either below 25 or above 74 years old.

The U.S. Survey of Consumer Finance (SCF) data which is available from the Federal Reserve is also used for the sample period, 1995-2007. This household survey data includes a triennial cross-sectional survey of U.S. households. We use the information on households' balance sheets, wealth and asset positions, pensions, demographic characteristics, and income to classify households who are wealthy hand-to-mouth following Kaplan, Violante and Weidner (2014).

B Asset, Wealth, and Debt to Income Ratio

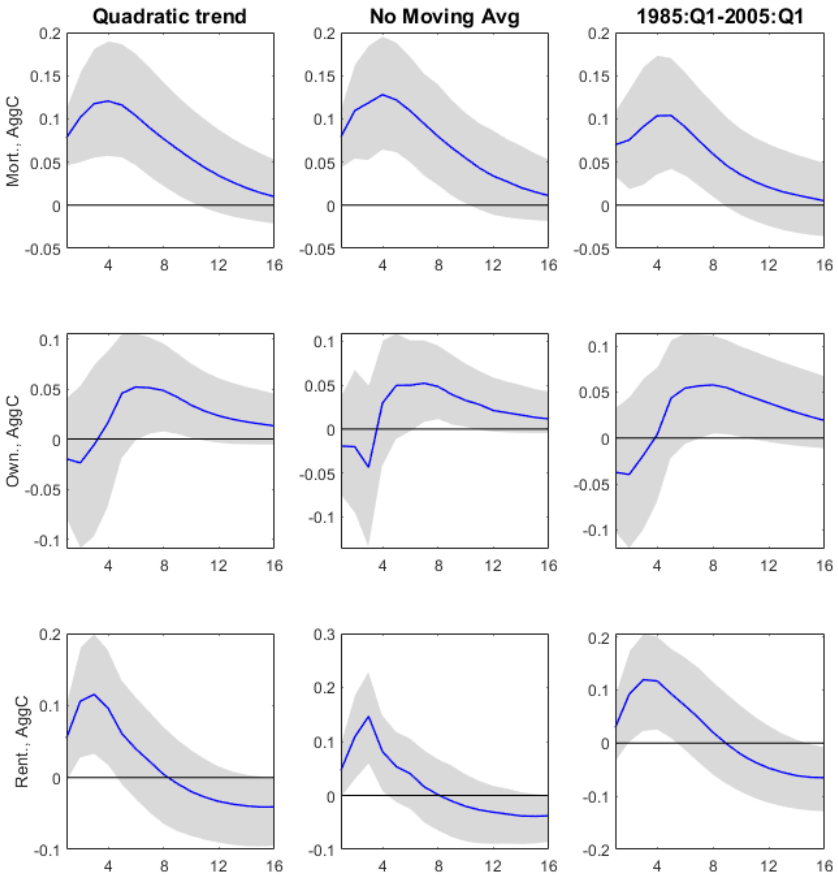
Table B.1: Asset, wealth, and debt to income ratio by housing tenure

	PANEL A: 1995 SCF		PANEL B: 1998 SCF		PANEL C: 2001 SCF		PANEL D: 2004 SCF		PANEL E: 2007 SCF	
Asset	Mean	95% Conf. interval	Mean	95% Conf. interval	Mean	95% Conf. interval	Mean	95% Conf. interval	Mean	95% Conf. interval
Mortgagors	540,976	[525,118, 556,834]	664,010	[644,196, 683,824]	799,320	[775,740, 822,899]	850,222	[826,873, 873,570]	957,274	[931,649, 982,900]
Outright homeowners	599,946	[575,176, 624,715]	820,483	[782,035, 858,931]	1,028,879	[983,941, 1,073,817]	1,186,705	[1,134,975, 1,238,434]	1,367,399	[1,304,774, 1,430,025]
Renters	77,098	[70,687, 83,508]	75,459	[69,744, 81,174]	88,321	[79,961, 96,681]	85,913	[77,562, 94,265]	97,034	[87,667, 106,402]
Net liquid asset										
Mortgagors	46,492	[42,967, 50,018]	90,778	[84,409, 97,147]	115,131	[107,793, 122,468]	90,039	[84,657, 95,421]	92,356	[86,910, 97,803]
Outright homeowners	105,282	[97,034, 113,530]	173,283	[160,420, 186,146]	203,731	[187,892, 219,571]	236,670	[217,578, 255,762]	250,772	[232,421, 269,123]
Renters	12,747	[9,303, 16,192]	11,994	[10,610, 13,379]	19,304	[15,210, 23,399]	14,421	[10,749, 18,092]	16,826	[13,571, 20,082]
Net illiquid asset										
Mortgagors	178,597	[173,314, 183,881]	213,069	[206,743, 219,396]	258,878	[251,567, 266,188]	283,353	[275,083, 291,623]	324,389	[315,765, 333,013]
Outright homeowners	208,039	[201,820, 214,258]	261,544	[252,092, 270,995]	348,328	[334,778, 361,879]	408,219	[392,586, 423,852]	467,158	[447,044, 487,272]
Renters	18,921	[17,124, 20,719]	19,671	[17,592, 21,750]	20,040	[18,003, 22,078]	14,286	[12,769, 15,804]	18,605	[16,509, 20,700]
Home equity										
Mortgagors	96,065	[93,634, 98,495]	107,436	[104,563, 110,309]	136,836	[132,925, 140,746]	168,845	[163,892, 173,798]	192,533	[187,676, 197,391]
Outright homeowners	148,703	[144,692, 152,714]	170,233	[164,526, 175,939]	212,581	[205,845, 219,318]	270,776	[261,220, 280,331]	303,421	[289,629, 317,214]
Renters	0	0	0	0	0	0	0	0	0	0
Debt to income										
Mortgagors	1.80	[1.74, 1.87]	2.76	[1.97, 3.54]	1.80	[1.74, 1.86]	2.39	[2.29, 2.50]	2.47	[2.41, 2.53]
Outright homeowners	0.51	[0.30, 0.71]	0.25	[0.22, 0.28]	0.28	[0.24, 0.33]	0.32	[0.28, 0.35]	0.51	[0.42, 0.60]
Renters	0.43	[0.39, 0.47]	0.56	[0.47, 0.64]	0.95	[0.40, 1.51]	0.43	[0.40, 0.46]	0.49	[0.45, 0.53]

Note: Table B.1 reports mean and 95% confidence interval value of an asset, net liquid asset, net illiquid asset (including home equity), and debt to income ratio by housing tenure group. Data are from SCF for 1995-2007 and each series is in the corresponding year's dollar.

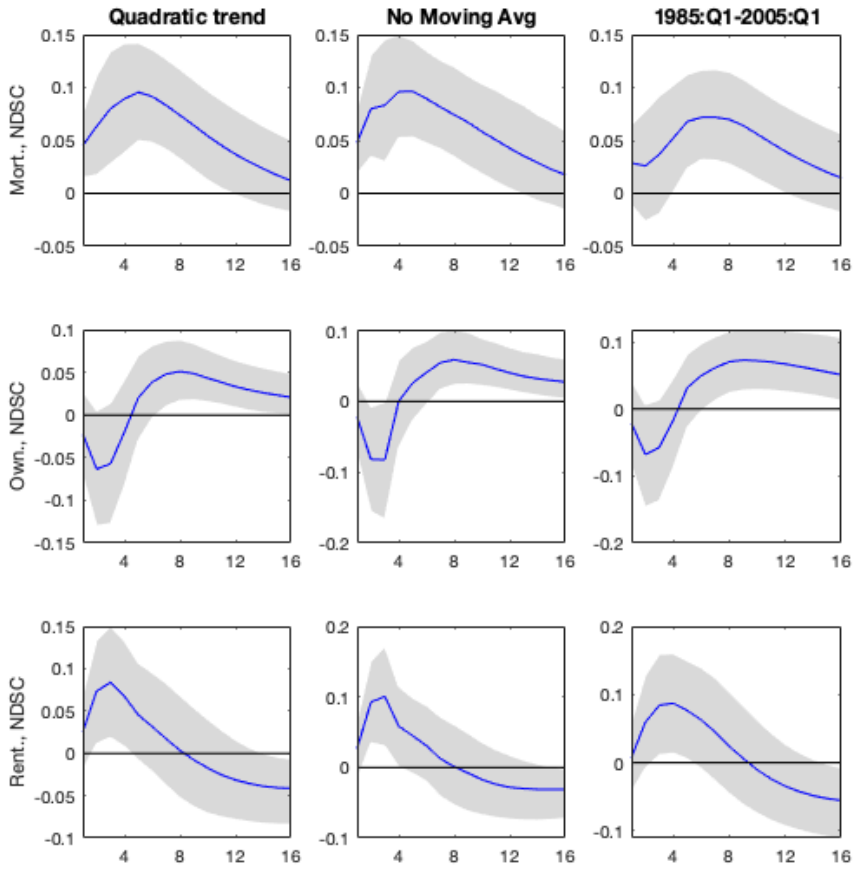
C Robustness checks for empirical analysis

Figure C1: Impulse responses of **aggregate** consumption in response to a positive govt spending shock



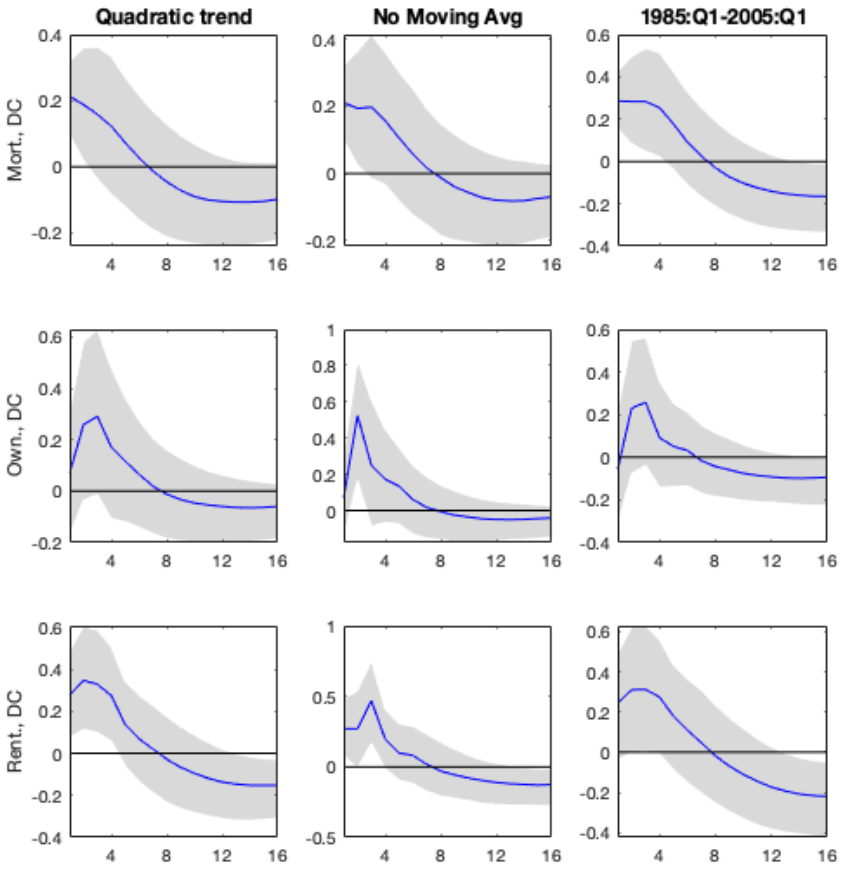
Notes: Figure C1 plots the impulse responses of aggregate consumption in response to a positive government spending shock with 68 % confidence interval bands (shaded area).

Figure C2: Impulse responses of **non-durable** consumption in response to a positive govt spending shock



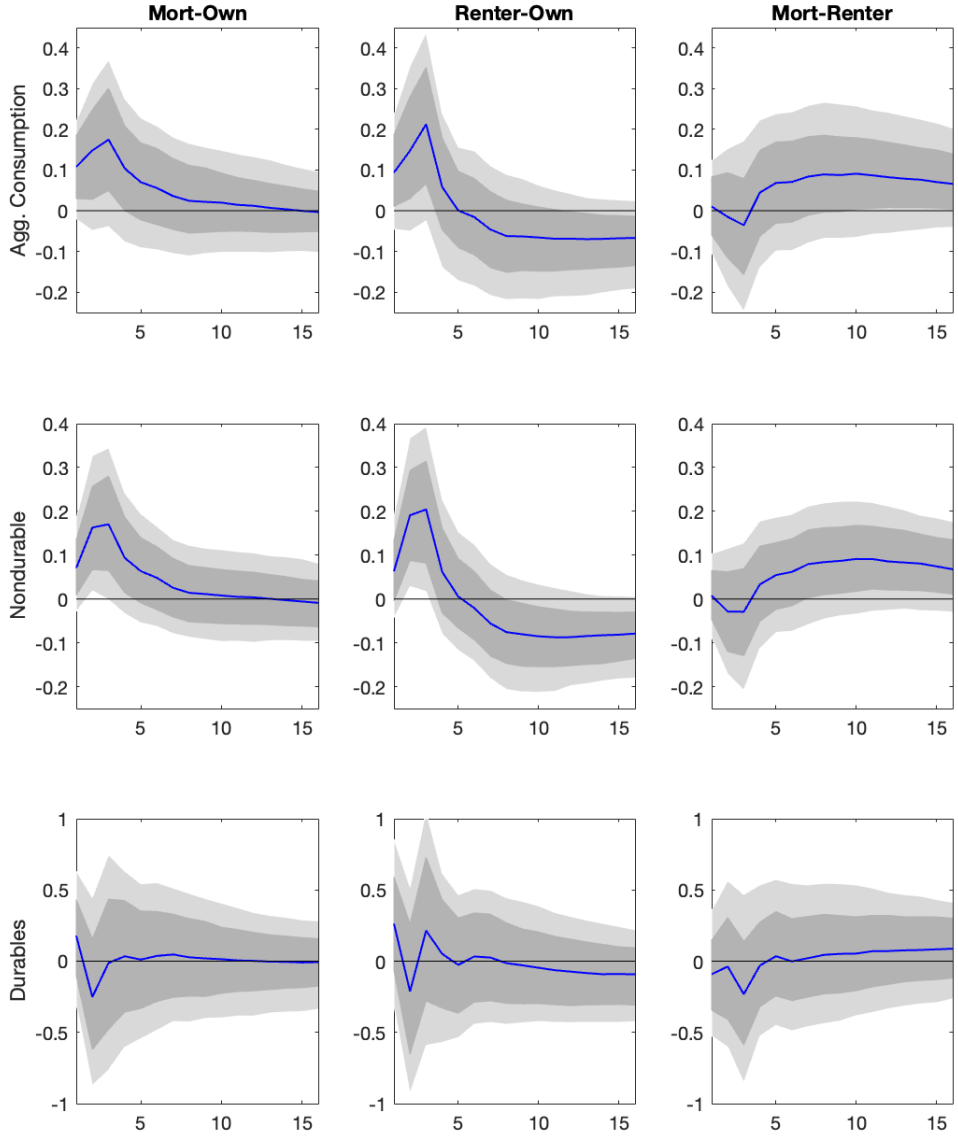
Notes: Figure C2 shows the impulse responses of non-durable consumption responses to a positive SPF shock by each housing tenure group. The shaded area indicates 68 % confidence interval bands.

Figure C3: Impulse responses of **durable** consumption in response to a positive govt spending shock



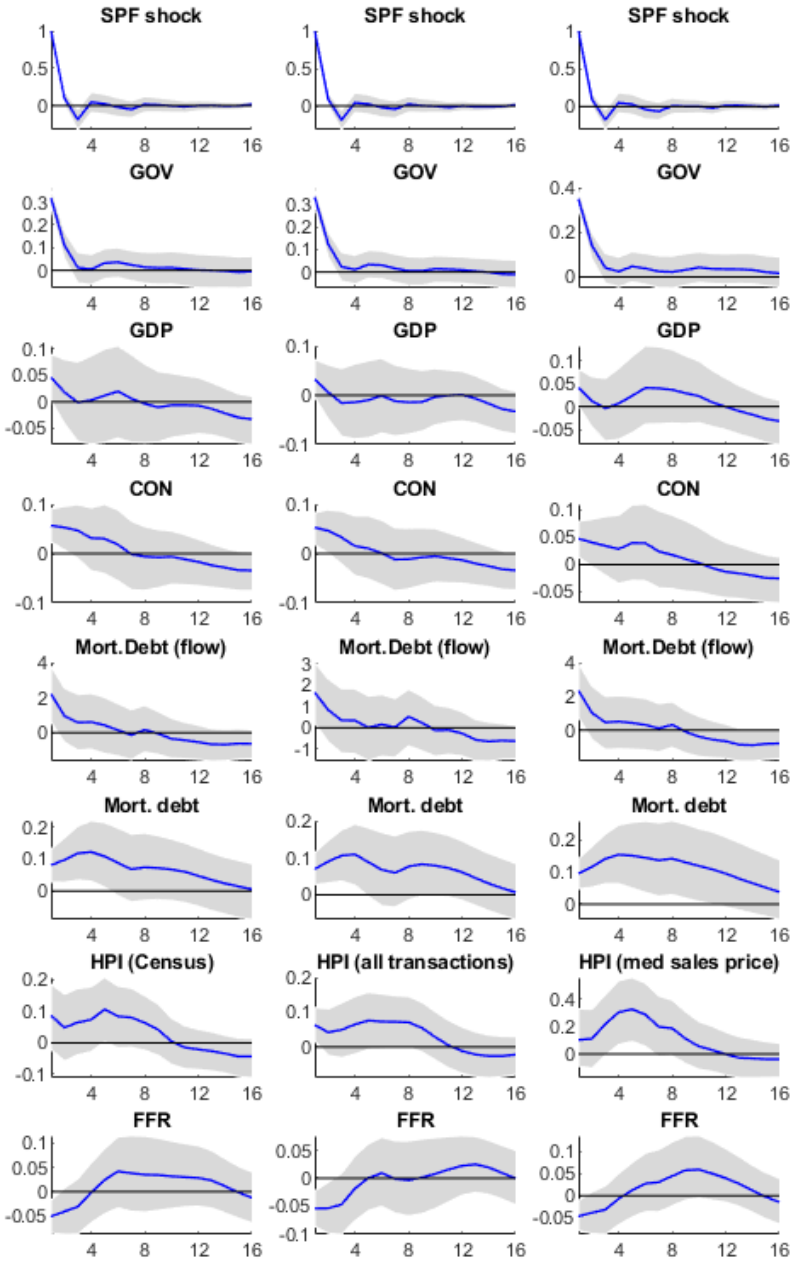
Notes: Figure C3 shows the impulse responses of durable consumption responses to a positive SPF shock by each housing tenure group. The shaded area indicates 68% confidence interval bands.

Figure C4: Impulse Response Differential for consumption across three types of households in response to a positive govt spending shock



Notes: Figure C4 shows the difference in impulse response across three types of agents to a positive SPF shock by each housing tenure group. We consider a VAR where we have the consumption series (aggregate, durable or non-durable) for the three types of households all in the same VAR. This yields essentially the same IRFs as in Figure 2, since our identification of government spending shocks are not sensitive to the addition of consumption variables. We construct our confidence bands for the impulse response functions based on a standard residual-based recursive design bootstrap, as described in Section 12.2.1 Kilian and Lütkepohl (2017). For every bootstrap iteration, we construct a difference object, i.e. IRF differential, to consider statistically significant differences across IRFs. Therefore, in addition to the consumption responses, we also have a distribution of the IRF differential for consumption categories across households. The first column indicates the difference in consumption response (aggregate, non-durable, and durable) across mortgagors and outright homeowners. The second and third columns represent the difference in consumption across renters and outright homeowners and mortgagors and renter households, respectively. We show the median difference (solid line) and the shaded areas indicate 68% and 90% confidence interval bands.

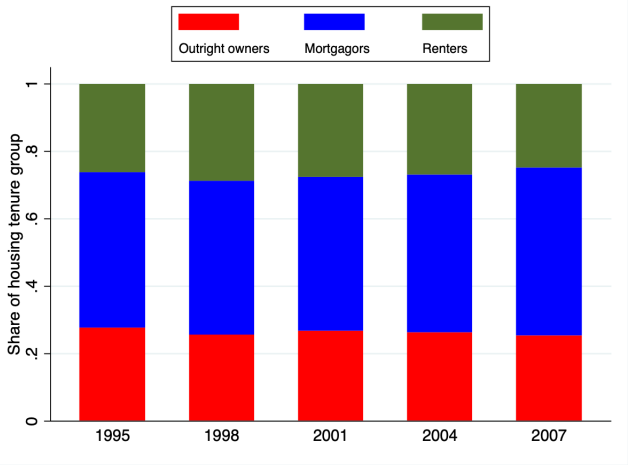
Figure C5: Impulse responses across alternative house price index



Notes: Figure C5 shows the impulse responses of key aggregate variables across three different measures of the house price index (house price index of new single-family houses sold from Census Beraeau, all transactions house price index, and median sales price for new houses sold) in response to a positive SPF shock. The shaded area indicates 68% confidence interval bands.

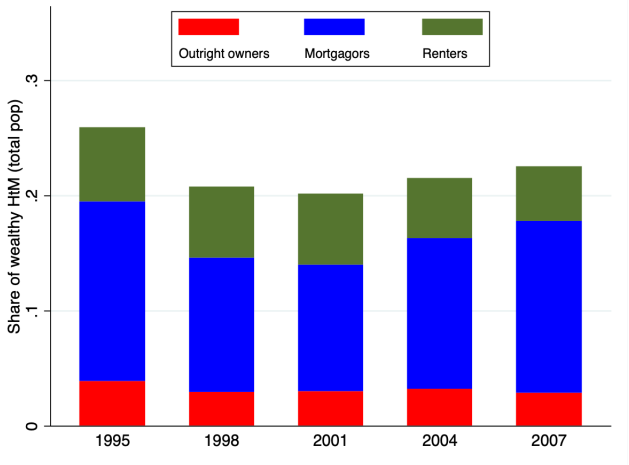
D Share of housing tenure groups

Figure D1: Share of housing tenure group (total population, SCF)



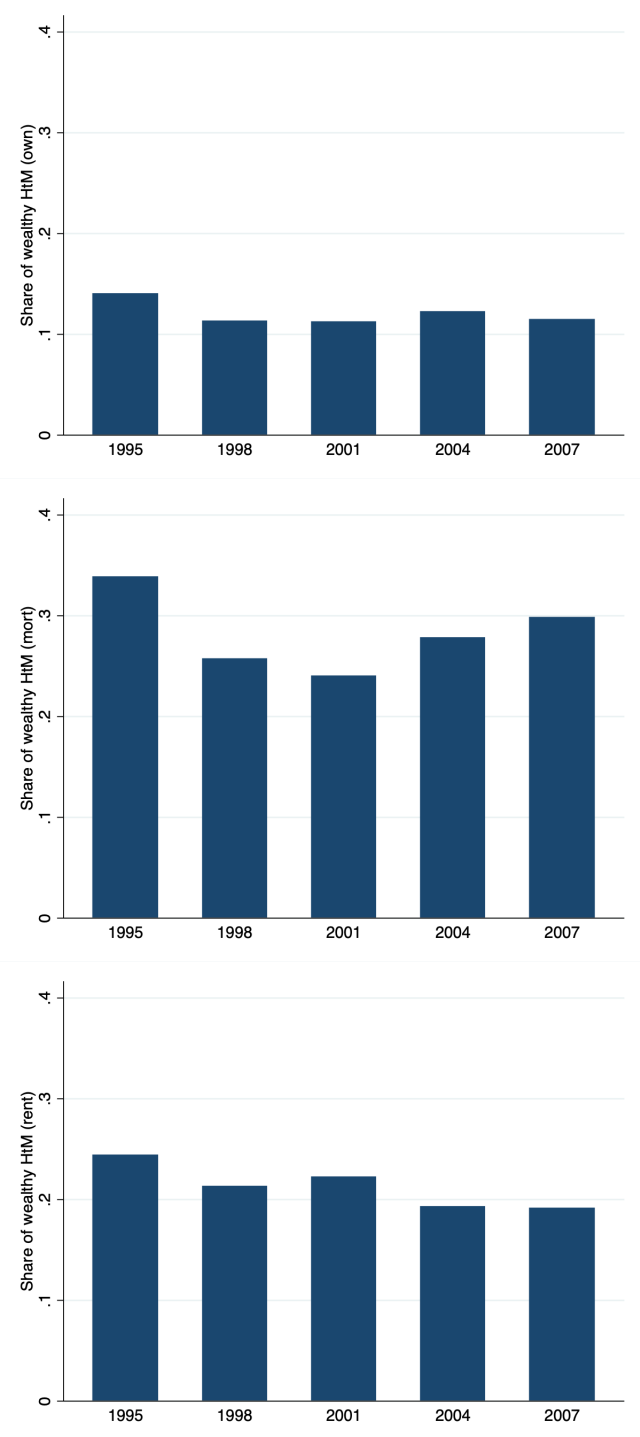
Notes: Figure D1 shows the share of each housing tenure group in the total population.

Figure D2: Share of wealthy hand to mouth by housing tenure group (total population, SCF)



Notes: Figure D2 shows the share of wealthy Hand-to-Mouth (HtM) by housing tenure groups in the total population.

Figure D3: Share of wealthy hand to mouth by housing tenure group (within the group, SCF)



Notes: Figure D3 shows the share of wealthy Hand-to-Mouth (HtM) within each housing tenure group.

E Model: First order conditions

E.1 Patient Households (savers)

$$\theta\left(\frac{s_{P,t}}{c_{P,t}}\right)^{1-\theta}\left[\frac{\upsilon_t}{x_{P,t}}-\beta_P\mu_c E_t\left\{\frac{\upsilon_{t+1}}{x_{P,t+1}}\right\}\right]=(1+\tau_c)\,\lambda_{P,t} \tag{E.1}$$

$$\begin{aligned}\left[1+\tau_p\left(1-\tau_{yP}\right)+\kappa_h\left(\frac{h_{P,t}}{h_{P,t-1}}-1\right)\frac{h_{P,t}}{h_{P,t-1}}\right]q_{h,t}&=\frac{\upsilon_t\xi_h}{\lambda_{P,t}h_{P,t}}\\&+E_t\left[\left(\beta_P\frac{\lambda_{P,t+1}}{\lambda_{P,t}}\right)\left[1-\delta_h+\kappa_h\left(\frac{h_{P,t+1}}{h_{P,t}}-1\right)\left(\frac{h_{P,t+1}}{h_{P,t}}\right)^2\right]q_{h,t+1}\right]\end{aligned} \tag{E.2}$$

$$\begin{aligned}\left[1+\tau_p\left(1-\tau_{yP}\right)+\kappa_h\left(\frac{h_{RP,t}}{h_{RP,t-1}}-1\right)\frac{h_{RP,t}}{h_{RP,t-1}}\right]q_{h,t}&=\left(1-\tau_{yP}\right)r_{hP,t}\\&+E_t\left[\left(\beta_P\frac{\lambda_{P,t+1}}{\lambda_{P,t}}\right)\left\{\left[1-\delta_h+\kappa_h\left(\frac{h_{RP,t+1}}{h_{RP,t}}-1\right)\left(\frac{h_{RP,t+1}}{h_{RP,t}}\right)^2\right]q_{h,t+1}+\tau_{yP}\delta_h\right\}\right]\end{aligned} \tag{E.3}$$

$$\begin{aligned}&\left[1+\kappa_k\left(\frac{k_t}{k_{t-1}}-1\right)\frac{k_t}{k_{t-1}}\right]q_{k,t}\\&=E_t\left[\left(\beta_P\frac{\lambda_{P,t+1}}{\lambda_{P,t}}\right)\left\{\left[1-\delta_k+\kappa_k\left(\frac{k_{t+1}}{k_t}-1\right)\left(\frac{k_{t+1}}{k_t}\right)^2\right]q_{k,t+1}+\left(1-\tau_k\right)r_{k,t+1}+\tau_k\delta_k\right\}\right]\end{aligned} \tag{E.4}$$

$$\begin{aligned}\left[(1+\tau_c)+\kappa_s\left(\frac{s_{P,t}}{s_{P,t-1}}-1\right)\frac{s_{P,t}}{s_{P,t-1}}+\frac{\kappa_s}{2}\left(\frac{s_{P,t}}{s_{P,t-1}}-1\right)^2\right]q_{s,t}&=\frac{(1+\tau_c)(1-\theta)}{\theta}\frac{c_{P,t}}{s_{P,t}}\\&+E_t\left[\left(\beta_P\frac{\lambda_{P,t+1}}{\lambda_{P,t}}\right)\left\{\left[(1+\tau_c)(1-\delta_s)+\kappa_s\left(\frac{s_{P,t+1}}{s_{P,t}}-1\right)\left(\frac{s_{P,t+1}}{s_{P,t}}\right)^2\right]q_{s,t+1}\right\}\right]\end{aligned} \tag{E.5}$$

$$\upsilon_t\xi_n n_{P,t}^{\vartheta}=\lambda_{P,t}\Omega_{nP,t}\left(1-\tau_{yP}\right)w_{P,t} \tag{E.6}$$

$$\begin{aligned}&\left(\frac{\pi_{wP,t}}{\pi}-1\right)\frac{\pi_{wP,t}}{\pi}\\&=E_t\left[\beta_P\frac{\lambda_{P,t+1}}{\lambda_{P,t}}\left(\frac{\pi_{wP,t+1}}{\pi}-1\right)\frac{\pi_{wP,t+1}}{\pi}\frac{\pi_{wP,t+1}}{\pi_{t+1}}\frac{n_{P,t+1}}{n_{P,t}}\right]-\frac{\left(\eta_w-1\right)\left(1-\tau_{yP}\right)}{\kappa_w}\left(1-\theta_w\Omega_{nP,t}\right)\\&\text{where }\theta_w=\frac{\eta_w}{\eta_w-1},\ \pi_{wP,t}=\frac{W_{P,t}}{W_{P,t-1}}\end{aligned} \tag{E.7}$$

$$\frac{\pi_{wP,t}}{\pi_t}=\frac{w_{P,t}}{w_{P,t-1}} \tag{E.8}$$

$$1 = E_t\left[\left(\beta_P \frac{\lambda_{P,t+1}}{\lambda_{P,t}}\right)\left(\frac{1+(1-\tau_b)\,R_t}{\pi_{t+1}}\right)\right] \tag{E.9}$$

$$1 = \Omega_{dP,t} + \Omega_{rP,t} R_t^F \tag{E.10}$$

$$\Omega_{dP,t} + \Omega_{rP,t} R_t^M = E_t\left[\left(\beta_P \frac{\lambda_{P,t+1}}{\lambda_{P,t}}\right)\left(\frac{(1-\tau_b)\,R_t^M + \kappa + (1-\kappa)\left\{\Omega_{dP,t+1} + \Omega_{rP,t+1} R_t^M\right\}}{\pi_{t+1}}\right)\right] \tag{E.11}$$

$$\Omega_{rP,t} = E_t\left[\left(\beta_P \frac{\lambda_{P,t+1}}{\lambda_{P,t}}\right)\left(\frac{1-\tau_b+(1-\kappa)\,\Omega_{rP,t+1}}{\pi_{t+1}}\right)\right] \tag{E.12}$$

E.2 Impatient Households (borrowers)

$$\theta\left(\frac{s_{I,t}}{c_{I,t}}\right)^{1-\theta}\left[\frac{\upsilon_t}{x_{I,t}} - \beta_I \mu_c E_t\left\{\frac{\upsilon_{t+1}}{x_{I,t+1}}\right\}\right] = (1+\tau_c)\,\lambda_{I,t} \tag{E.13}$$

$$\begin{aligned}\left[1+\tau_p\,(1-\tau_{yI}) + \kappa_h\left(\frac{h_{I,t}}{h_{I,t-1}} - 1\right)\frac{h_{I,t}}{h_{I,t-1}} - \phi\mu_t\right] q_{h,t} &= \frac{\upsilon_t \xi_h}{\lambda_{I,t} h_{I,t}} \\ + E_t\left[\left(\beta_I \frac{\lambda_{I,t+1}}{\lambda_{I,t}}\right)\left\{\left[(1-\delta_h)\,[1-\phi\mu_{t+1}] + \kappa_h\left(\frac{h_{I,t+1}}{h_{I,t}} - 1\right)\left(\frac{h_{I,t+1}}{h_{I,t}}\right)^2\right] q_{h,t+1}\right\}\right]\end{aligned} \tag{E.14}$$

$$\begin{aligned}\left[1+\tau_p\,(1-\tau_{yI}) + \kappa_h\left(\frac{h_{RI,t}}{h_{RI,t-1}} - 1\right)\frac{h_{RI,t}}{h_{RI,t-1}} - \phi\mu_t\right] q_{h,t} &= (1-\tau_{yI})\,r_{hI,t} \\ + E_t\left[\left(\beta_I \frac{\lambda_{I,t+1}}{\lambda_{I,t}}\right)\left\{\left[(1-\delta_h)\,[1-(\phi-\Upsilon)\,\mu_{t+1}] + \kappa_h\left(\frac{h_{RI,t+1}}{h_{RI,t}} - 1\right)\left(\frac{h_{RI,t+1}}{h_{RI,t}}\right)^2\right] q_{h,t+1} + \tau_{yI}\delta_h\right\}\right]\end{aligned} \tag{E.15}$$

$$\begin{aligned}\left[(1+\tau_c) + \kappa_s\left(\frac{s_{I,t}}{s_{I,t-1}} - 1\right)\frac{s_{I,t}}{s_{I,t-1}} + \frac{\kappa_s}{2}\left(\frac{s_{I,t}}{s_{I,t-1}} - 1\right)^2\right] q_{s,t} &= \frac{(1+\tau_c)(1-\theta)}{\theta}\frac{c_{I,t}}{s_{I,t}} \\ + E_t\left[\left(\beta_I \frac{\lambda_{I,t+1}}{\lambda_{I,t}}\right)\left\{\left[(1+\tau_c)(1-\delta_s) + \kappa_s\left(\frac{s_{I,t+1}}{s_{I,t}} - 1\right)\left(\frac{s_{I,t+1}}{s_{I,t}}\right)^2\right] q_{s,t+1}\right\}\right]\end{aligned} \tag{E.16}$$

$$\upsilon_t \xi_n n_{I,t}^{\vartheta} = \lambda_{I,t}\Omega_{nI,t}\,(1-\tau_{yI})\,w_{I,t} \tag{E.17}$$

$$\left(\frac{\pi_{wI,t}}{\pi}-1\right)\frac{\pi_{wI,t}}{\pi}$$
$$=E_t\left[\beta_I\frac{\lambda_{I,t+1}}{\lambda_{I,t}}\left(\frac{\pi_{wI,t+1}}{\pi}-1\right)\frac{\pi_{wI,t+1}}{\pi}\frac{\pi_{wI,t+1}}{\pi_{t+1}}\frac{n_{I,t+1}}{n_{I,t}}\right]-\frac{(\eta_w-1)(1-\tau_{yI})}{\kappa_w}(1-\theta_w\Omega_{nI,t}) \tag{E.18}$$
$$\text{where } \pi_{wI,t}=\frac{W_{I,t}}{W_{I,t-1}}$$

$$\frac{\pi_{wI,t}}{\pi_t}=\frac{w_{I,t}}{w_{I,t-1}} \tag{E.19}$$

$$1-\mu_t=\Omega_{dI,t}+\Omega_{rI,t}R_t^F \tag{E.20}$$

$$\Omega_{dI,t}+\Omega_{rI,t}R_t^M=E_t\left[\beta_I\frac{\lambda_{I,t+1}}{\lambda_{I,t}}\left(\frac{(1-\tau_{yI})R_t^M+\kappa+(1-\kappa)\left\{\Omega_{dI,t+1}+\Omega_{rI,t+1}R_t^M\right\}}{\pi_{t+1}}\right)\right] \tag{E.21}$$

$$\Omega_{rI,t}=E_t\left[\beta_I\frac{\lambda_{I,t+1}}{\lambda_{I,t}}\left(\frac{1-\tau_{yI}+(1-\kappa)\Omega_{rI,t+1}}{\pi_{t+1}}\right)\right] \tag{E.22}$$

E.3 Renter Households

$$\theta\left(\frac{s_{R,t}}{c_{R,t}}\right)^{1-\theta}\left[\frac{\upsilon_t}{x_{R,t}}-\beta_R\mu_cE_t\left\{\frac{\upsilon_{t+1}}{x_{R,t+1}}\right\}\right]=(1+\tau_c)\lambda_{R,t} \tag{E.23}$$

$$p_{hP,t}=\frac{\upsilon_t\xi_t\mu_h}{\lambda_{R,t}h_{RP,t}} \tag{E.24}$$

$$p_{hI,t}=\frac{\upsilon_t\xi_t(1-\mu_h)}{\lambda_{R,t}h_{RI,t}} \tag{E.25}$$

$$\left[(1+\tau_c)+\kappa_s\left(\frac{s_{R,t}}{s_{R,t-1}}-1\right)\frac{s_{P,t}}{s_{R,t-1}}+\frac{\kappa_s}{2}\left(\frac{s_{R,t}}{s_{R,t-1}}-1\right)^2\right]q_{s,t}=\frac{(1+\tau_c)(1-\theta)}{\theta}\frac{c_{R,t}}{s_{R,t}}$$
$$+E_t\left[\left(\beta_R\frac{\lambda_{R,t+1}}{\lambda_{R,t}}\right)\left\{\left[(1+\tau_c)(1-\delta_s)+\kappa_s\left(\frac{s_{R,t+1}}{s_{R,t}}-1\right)\left(\frac{s_{R,t+1}}{s_{R,t}}\right)^2\right]q_{s,t+1}\right\}\right] \tag{E.26}$$

$$\upsilon_t\xi_n n_{R,t}^{\vartheta}=\lambda_{R,t}\Omega_{nR,t}(1-\tau_{yR})w_{R,t} \tag{E.27}$$

$$\left(\frac{\pi_{wR,t}}{\pi}-1\right)\frac{\pi_{wR,t}}{\pi}$$
$$= E_t\left[\beta_R\frac{\lambda_{R,t+1}}{\lambda_{R,t}}\left(\frac{\pi_{wR,t+1}}{\pi}-1\right)\frac{\pi_{wR,t+1}}{\pi}\frac{\pi_{wR,t+1}}{\pi_{t+1}}\frac{n_{R,t+1}}{n_{R,t}}\right]-\frac{(1-\tau_{yR})(\eta_w-1)}{\kappa_w}(1-\theta_w\Omega_{nR,t}) \quad \text{(E.28)}$$
where $\pi_{wR,t}=\dfrac{W_{R,t}}{W_{R,t-1}}$

$$\frac{\pi_{wR,t}}{\pi_t}=\frac{w_{R,t}}{w_{R,t-1}} \quad \text{(E.29)}$$

E.4 Non-residential, Residential investment, and Rental services Producers

$$q_{k,t}-\kappa_{ik}q_{k,t}\left(\frac{i_{k,t}}{i_{k,t-1}}-1\right)\frac{i_{k,t}}{i_{k,t-1}}-q_{k,t}\frac{\kappa_{ik}}{2}\left(\frac{i_{k,t}}{i_{k,t-1}}-1\right)^2$$
$$+E_t\left[\beta_P\frac{\lambda_{P,t+1}}{\lambda_{P,t}}\kappa_{ik}q_{k,t+1}\left(\frac{i_{k,t+1}}{i_{k,t}}-1\right)\left(\frac{i_{k,t+1}}{i_{k,t}}\right)^2\right]=1 \quad \text{(E.30)}$$

$$q_{s,t}-\kappa_{\tilde{c}}q_{s,t}\left(\frac{\tilde{c}_t}{\tilde{c}_{t-1}}-1\right)\frac{\tilde{c}_t}{\tilde{c}_{t-1}}-q_{s,t}\frac{\kappa_{\tilde{c}}}{2}\left(\frac{\tilde{c}_t}{\tilde{c}_{t-1}}-1\right)^2$$
$$+\beta_P E_t\left\{\frac{\lambda_{P,t+1}}{\lambda_{P,t}}\kappa_{\tilde{c}}q_{s,t+1}\left(\frac{\tilde{c}_{t+1}}{\tilde{c}_t}-1\right)\left(\frac{\tilde{c}_{t+1}}{\tilde{c}_t}\right)^2\right\}=1 \quad \text{(E.31)}$$

$$q_{h,t}-\kappa_{ih}q_{h,t}\left(\frac{i_{h,t}}{i_{h,t-1}}-1\right)\frac{i_{h,t}}{i_{h,t-1}}-q_{h,t}\frac{\kappa_{ih}}{2}\left(\frac{i_{h,t}}{i_{h,t-1}}-1\right)^2$$
$$+E_t\left[\beta_P\frac{\lambda_{P,t+1}}{\lambda_{P,t}}\kappa_{ih}q_{h,t+1}\left(\frac{i_{h,t+1}}{i_{h,t}}-1\right)\left(\frac{i_{h,t+1}}{i_{h,t}}\right)^2\right]=1 \quad \text{(E.32)}$$

$$\left(\frac{\pi_{hj,t}}{\pi}-1\right)\frac{\pi_{hj,t}}{\pi}$$
$$= E_t\left[\beta_P\frac{\lambda_{P,t+1}}{\lambda_{P,t}}\left(\frac{\pi_{hj,t+1}}{\pi}-1\right)\frac{\pi_{h,t+1}}{\pi}\frac{\pi_{hj,t+1}}{\pi_{t+1}}\frac{h_{Rj,t+1}}{h_{Rj,t}}\right]-\frac{\eta_h-1}{\kappa_{ph}}\left(1-\theta_h\frac{r_{hj,t}}{p_{hj,t}}\right) \quad \text{(E.33)}$$
where $\theta_h=\dfrac{\eta_h}{\eta_h-1}$ for $j\in\{P,I\}$

$$\frac{\pi_{hP,t}}{\pi_t}=\frac{p_{hP,t}}{p_{hP,t-1}} \quad \text{(E.34)}$$
$$\frac{\pi_{hI,t}}{\pi_t}=\frac{p_{hI,t}}{p_{hI,t-1}} \quad \text{(E.35)}$$

E.5 Non-housing goods producers

$$\Omega_{n,t}\left(1-\alpha\right)\psi_P\left(\frac{y_{n,t}+f_{n,t}}{n_{P,t}}\right)=w_{P,t} \tag{E.36}$$

$$\Omega_{n,t}\left(1-\alpha\right)\psi_I\left(\frac{y_{n,t}+f_{n,t}}{n_{I,t}}\right)=w_{I,t} \tag{E.37}$$

$$\Omega_{n,t}\left(1-\alpha\right)\psi_R\left(\frac{y_{n,t}+f_{n,t}}{n_{R,t}}\right)=w_{R,t} \tag{E.38}$$

$$\Omega_{n,t}\alpha\frac{y_{n,t}+f_{n,t}}{k_{t-1}}=r_{k,t}+\frac{\kappa_u}{1+\varpi}\left(u_t^{1+\varpi}-1\right) \tag{E.39}$$

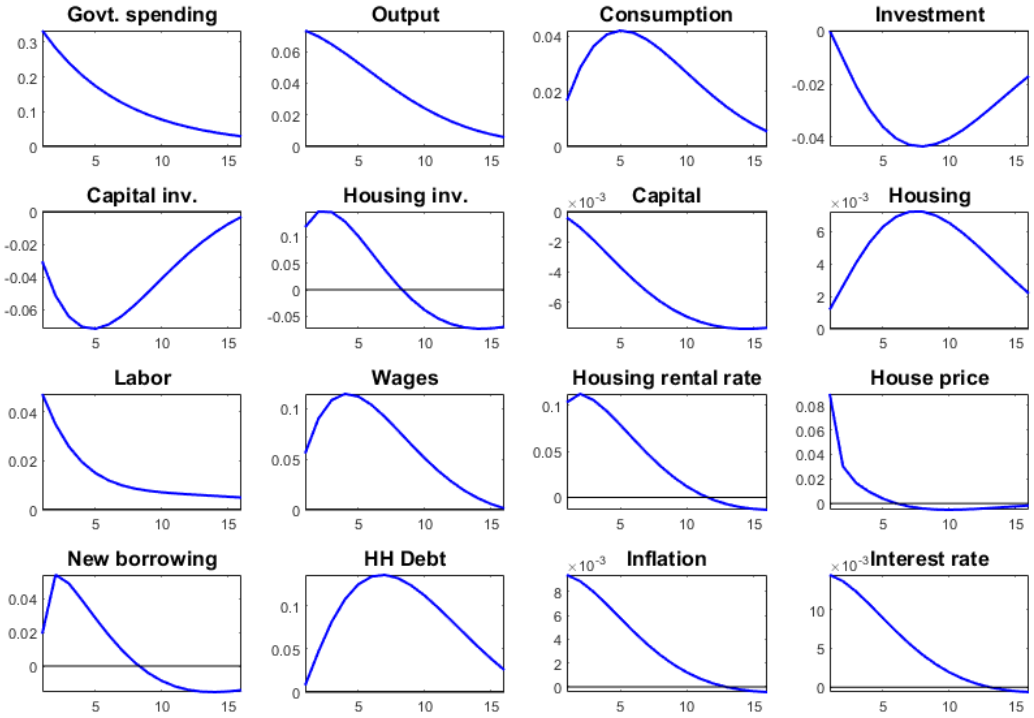
$$\begin{aligned}&\Omega_{n,t}\alpha\frac{y_{n,t}+f_{n,t}}{u_t}=\kappa_u u_t^{\varpi}k_{t-1}\\&\text{where } u=1,\ \kappa_u=\frac{\alpha}{k/y_n}\end{aligned} \tag{E.40}$$

$$\left(\frac{\pi_t}{\pi}-1\right)\frac{\pi_t}{\pi}=E_t\left\{\beta_P\frac{\lambda_{P,t+1}}{\lambda_{P,t}}\left(\frac{\pi_{t+1}}{\pi}-1\right)\frac{\pi_{t+1}}{\pi}\frac{y_{n,t+1}}{y_{n,t}}\right\}-\frac{\eta_n-1}{\kappa_{pn}}\left(1-\theta_n\Omega_{n,t}\right) \tag{E.41}$$

$$\text{where}\quad\theta_n=\frac{\eta_n}{\eta_n-1}$$

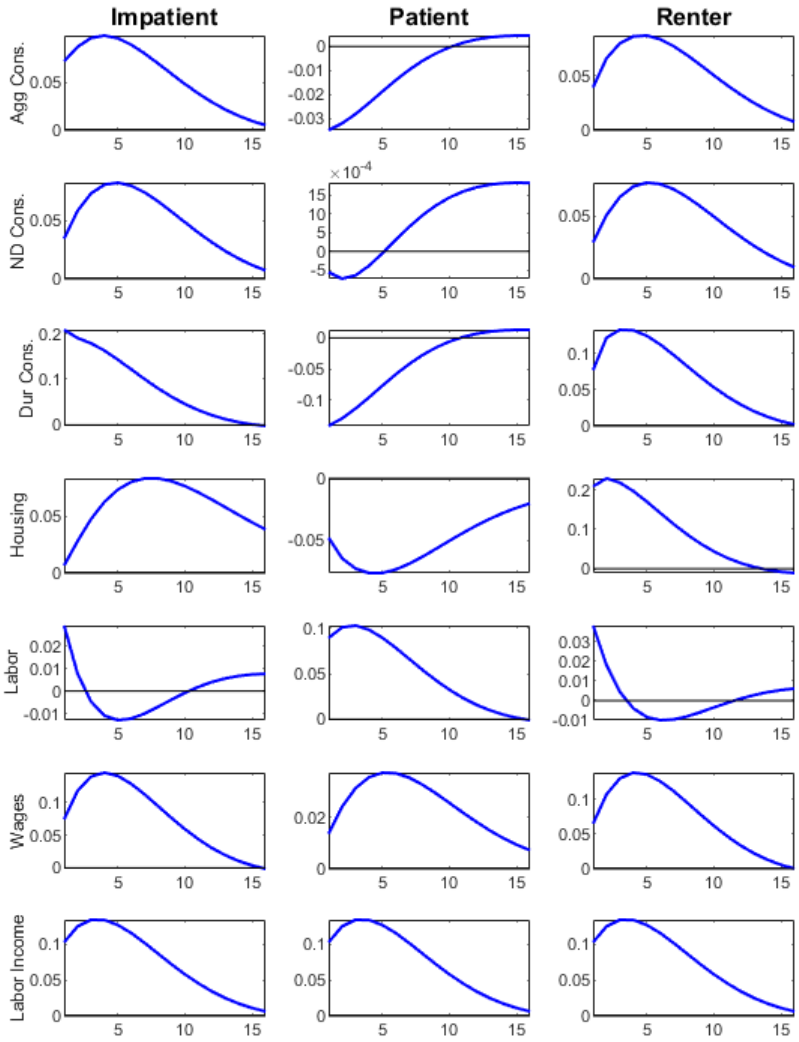
F Model results

Figure F1: Impulse responses for **aggregate** variables in the model



Notes: Figure F1 shows the impulse response of aggregate variables in response to a positive government spending shock in the baseline model with durable goods.

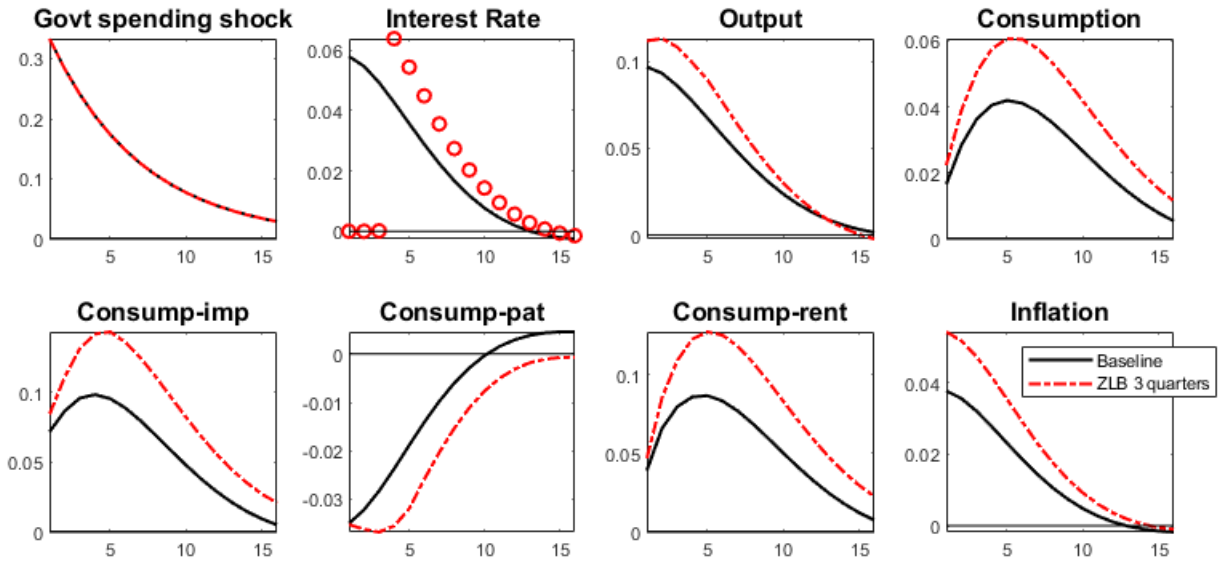
Figure F2: Impulse responses for **disaggregate** variables in the model



Notes: Figure F2 shows the impulse responses of disaggregate variables in response to a positive government spending shock in the baseline model with durable goods.

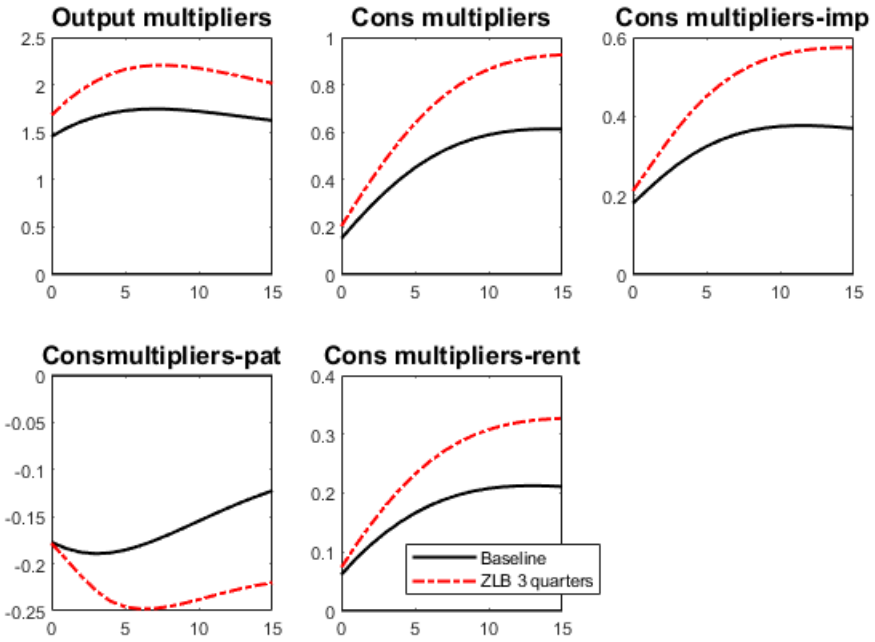
G Multipliers in normal times and during ZLB periods

Figure G1: Impulse responses with ZLB periods



Notes: Figure G1 shows the impulse responses of key aggregate variables and consumption across different households (impatient, patient, and renters) for the baseline model and ZLB period (three quarters).

Figure G2: Cumulative output and consumption multipliers



Notes: Figure G2 plots the cumulative output and consumption multipliers (both aggregate and disaggregate across different households) in and out of ZLB periods. The black solid line represents multipliers during normal times and the red dash-dotted line indicates multipliers under ZLB for three quarters.

References

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