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Essays on Liquidity Constraints and Intertemporal Choice

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by

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Essays on Liquidity Constraints and Intertemporal Choice

This dissertation is dedicated to all those people who are able to stay nice, honest, good-hearted, unbiased, generous to others, and who keeps and spreads kindness despite discouragements and unfairness; who works very hard although whose efforts and accomplishments are unseen and unappreciated; whose weaknesses are exacerbated and unfairly punished, however successes and good deeds are heavily discounted; who believes in divine justice even though cannot find it at that moment; who has to keep going and stay strong under many obstacles, biases, and pressures; who needs to climb long ladders only to reach to an unfair tiny outcome; who does not give up being hardworking, kind, helpful, virtuous, fair, honest and sincere no matter where the circumstances drag them to.

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Abstract

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by

Sümeyye Yıldız

This dissertation explores how households allocate their financial resources across expenditure categories and over time. The interaction between income changes and consumption is important for the well-being of households. This interaction exhibits great heterogeneity across goods as well as across wealth. Notably, when the households are liquidity-constrained, their budget allocation decision is altered substantially. This dissertation analyzes the interaction between household income and intertemporal budget allocation with an emphasis on liquidity constraints.

In the first chapter, I explore how the liquidity constraints affect the household intertemporal allocation of consumption differentially across wealth and across expenditure categories. This chapter comprises two sub-chapters for the theoretical and empirical evaluation of the effect of binding liquidity constraints on intertemporal budget allocation. Further, the chapter compares the effect of liquidity constraints on healthcare expenditure with the effect on non-health consumption in particular on food consumption. I extend a standard incomplete markets model with a health capital in the felicity function. Theoretically, I show that households reduce their healthcare expenditure due to the binding liquidity constraints in the current period, whereas expenditure declines in the next period due to the expected binding constraints one period ahead. I use the extended model to test the incidence of binding liquidity constraints with a linearized Euler equation. Empirically, I show that the test of liquidity constraints for healthcare expenditure reveals different implications than a standard test of liquidity constraints

for nondurable consumption. In particular, current binding constraints and expected binding constraints lead to the opposite direction of bias when the liquidity constraints are omitted. The resulting overall bias depends on which constraint has a stronger effect. Moreover, the correlation between income and healthcare expenditure varies significantly between asset poor and rich families, more than the elasticity of non-health consumption among wealth quintiles. Altogether, my findings show that the effects of liquidity constraints are heterogeneous across households and across expenditure categories.

In the second chapter, I estimate the income elasticity of consumption for various expenditures. Estimating income elasticity of consumption is found to be a challenging task. The causal impact of income changes on expenditure is hard to measure due to the endogeneity of the treatment variable income. I use a shift-share instrumental variable design à la Bartik [1991] to mitigate the endogeneity concerns by exploiting variation due to local labor market exposure to aggregate shocks. I estimate the income elasticity of consumption that results from the changes in national employment growth in industries weighted with regional employment share of the industry. I find an average elasticity of total household consumption in the ranges between 0.4 to 0.53 depending on the construction of the instrument. Food consumption elasticity ranges between 0.11 to 0.2 though is not significantly estimated. Of particular interest for income elasticity estimates is the household out-of-pocket healthcare expenditure which has an elasticity of around 3.14 to 3.59. This finding adds to the discussion of health spending being a luxury good with an elasticity above one which is found in aggregate cross-country or time-series estimates. I find elasticities above one using household-level micro consumption and regional employment growth data, whereas micro studies usually conclude health expenditure elasticities around zero.

In the third chapter, I provide a detailed analysis of household wealth and portfolio allocation. This chapter presents several stylized facts on how households allocate wealth among asset classes, how portfolio allocation changes over the lifecycle and over the business cycle, and how portfolio and income are related. The chapter combines various survey data to show that household income and portfolio allocation are highly correlated especially for middle-income households. Asset accumulation has an inverted-V shape over the lifecycle whereas debt is front-loaded in working ages. Income and consumption follow a hump-shaped over the lifecycle. Old households hold assets in liquid forms. As for the business cycle, the Great Recession has devastating effects on the welfare of households such that both networth and consumption declined, and poverty rates increased. The effect is more severe for non-white, low educated, and female-headed households.

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Chapter 1

Liquidity Constraints and Healthcare Expenditure

1.1 Introduction

Healthcare expenditures have seen a large increase over time in the U.S. and in many other countries. According to Centers for Medicare and Medicaid Services, U.S. healthcare spending has reached to 17.9% of Gross Domestic Product in 2017. Although several insurance schemes exist, households pay around $365.5 billion for out-of-pocket expenditures.[1] This trend is becoming more worrisome for the wellbeing of poor households as income and wealth inequality also rises.

This paper explores how the changes in income and liquidity constraints interact with the healthcare expenditures of households with heterogeneous wealth holdings. More explicitly, the paper assesses whether liquidity constraints bind differentially for healthcare expenditures among wealth groups.

[1] The statistics are from: https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/NationalHealthAccountsHistorical.html

My paper contributes to our understanding of the effect of liquidity constraints on household consumption. I show that this effect is heterogeneous across wealth and across expenditure. In particular, healthcare expenditure has a very different interaction with income across wealth compared to nondurable/ food expenditure. First, this paper provides a methodological contribution by proposing a test of the effect of binding liquidity constraints on the healthcare expenditure using a health capital model. Although the new test is based on the standard test for the effect of liquidity constraints on nondurable consumption, it also differs in important dimensions. The extended test incorporates the tension between current and expectation of one-period ahead binding constraints. This tension results in diverse behavioral responses in consumption between wealthy and poor households. Second, this paper contributes the empirical work in household expenditure by verifying the implications of the test using a representative panel data of U.S. households. I show that healthcare expenditure allocation is different than food expenditure allocation between time periods across wealth quintiles using Panel Study of Income Dynamics (PSID).

I use a life-cycle model with a health capital accumulation. I incorporate health capital à la [Grossman, 1972] into a heterogeneous agent incomplete markets model. Households receive utility from consumption goods and service flow from their health capital. The form of health capital is the pure consumption type among Grossman's alternative models, where health capital enters into the instantaneous felicity function but does not alter the earnings. The theoretical model has testable implications for intertemporal allocation of the nondurable good and health capital in the incidence of binding liquidity constraints. In particular, binding liquidity constraints violate the unconstrained Euler equation. For nondurable consumption, the marginal utility for current consumption is higher than expected marginal utility of next period consumption. For health capital, the current marginal utility is higher relative to next period due to currently binding constraints, whereas it is lower relative to next period due to the expected one-period-ahead binding constraints. Hence, there is a tension between current and expected one-period-ahead binding constraints in determining intertemporal allocation.

I test the effect of binding liquidity constraints on the healthcare expenditure of households. I extend the empirical test for the existence of binding liquidity constraints in explaining the failure of permanent income hypothesis employed first by [Zeldes, 1989] and [Runkle, 1991]. I do the extension for healthcare expenditures using the theoretical model for health capital.

The new test inherits the tension between current and one-period-ahead binding constraints. In particular, I show that for healthcare expenditure growth, current binding constraints and one period ahead expected binding constraints have opposite effects on expenditure growth. Current binding constraints imply an increase in expenditure growth, whereas expectations of one period ahead binding constraints imply a decrease. Furthermore, the specification for the extended test has a more dynamic structure than a standard test for liquidity constraints due to the incorporation of one-period-ahead expectations as well as the stock-flow adjustment for health capital and healthcare expenditures.

The contrary forces generated by current and expected future constraints alter the implication for empirical tests of binding liquidity constraints for healthcare expenditure compared to the standard test for nondurable consumption. In the standard test, the existence of liquidity constraints are often assessed using log-linearized Euler equations and adding an extra regressor into the empirical model. The extra regressor is usually current or lagged values of income which proxy for binding liquidity constraints but should not have any predictive power for consumption growth for an unconstrained household. For a constrained household, a proxy such as current income shows up as negatively correlated with consumption growth due to omitted variable bias. In the test for healthcare expenditure, income as an extra regressor is used as a proxy for current binding constraint and also for expectation of one period ahead binding constraint. I show that current income as a proxy for current binding constraint have a negative correlation, however current income as a proxy for expectation of one period ahead binding constraint have a positive correlation with expenditure growth. Hence, it is an empirical question which effect dominates.

I test the incidence of binding liquidity constraints for both food consumption with the standard test and healthcare expenditure with the extended test using household level panel data. I compare my results with mainly food consumption to relate it to the existing literature on liquidity constraints, which historically use food consumption due to data availability.

My results reveal that the liquidity constraints are binding differentially for healthcare expenditures among wealth quintiles. Further, I show that the effect of binding liquidity constraints on healthcare expenditure differs from the effect on other consumption categories.

As a first motivation for a differential relation of income with food and healthcare expenditure across wealth, I plot Engel curves for food and healthcare expenditures separately for each wealth quintile. I show that Engel curves for healthcare expenditure share is downward sloping for high wealth households, which indicates that it is a necessity. However, Engel curves for low wealth households are slightly upward sloping, which is an indication for luxury goods. On the other hand, food consumption is a necessity for all wealth groups.

Then, I estimate the empirical models for testing the incidence of liquidity constraints. I separately apply the test for food consumption and healthcare expenditure growth for each wealth quintile. I find that the 1^{st}, 2^{nd}, and 3^{rd} quintiles have a negative and significant bias and 4^{th} and 5^{th} quintiles have an insignificant coefficient for food consumption.

This indicates that the liquidity constraints are currently binding for the lowest quintiles. For healthcare expenditure, the test results indicate that lowest quintile has a negative significant bias which means that the current binding constraints are severe for this group and dominates any other effect by expected one-period-ahead binding constraints. On the other hand other quintiles have positive coefficients and significant for the highest quintile, which means that the one-period ahead expected binding constraint dominate the current negative effect. So, even the wealthier households who can spend on their healthcare hold expectations that they can be constrained to spend beyond what they are already spending in the current period.

As a supporting evidence for differential effect, I estimate correlations between income and expenditures. I estimate income elasticity of healthcare expenditure and compare it to the one for non-health expenditures and food consumption. I show that the income elasticity for healthcare expenditure exhibits more variation between wealth quintiles compared to food or combined non-health consumption. The income elasticity varies between 17.5% (for lowest wealth) to - 6.4 % (for highest wealth) for healthcare expenditure. However, it varies between 7.9% to 1.4% for food expenditure.

Related Literature. My paper relates to several strands of the literature in macroeconomics, household finance, and health economics.

First, my paper builds on the vast literature on the response of consumption to changes in economic conditions. More specifically, Permanent Income Hypothesis (PIH) first developed by [Friedman, 1957], and Life Cycle Hypothesis (LCH) by [Ando and Modigliani, 1963] have been tested heavily using both aggregate and cross-sectional data. The PIH/LCH are built on the consumption smoothing motivation of consumers due to diminishing marginal utility. However, most of the empirical tests reject the hypothesis that the consumption is determined by 'permanent income' which is a weighted average of current income and expectations of future income. Hence the claim that consumption does not respond to changes in current income is rejected. [Flavin, 1981] finds that consumption responds to predictable changes in income more than what the permanent income hypothesis suggests. A similar motivation is by [Hansen and Singleton, 1983] who test the response of consumption to anticipated interest rates in a representative agent framework using Euler equations. They find that the rate of consumption growth is too large relative to the observed changes in real interest rates. The 'excess sensitivity' of consumption to current income or real returns in the data is attributed to imperfect credit markets, liquidity constraints, Keynesian behavior (i.e. consumption is proportional to income) or imperfect fit of the model to the data.

My paper contributes to the empirical Euler equation literature that estimates preference parameters or tests the permanent income hypothesis and the existence of liquidity constraints. Euler equation tests are commonly used in the literature because they do not require a closed form solution for the consumption function. Closed form solutions are not possible with general felicity functions and with potentially binding liquidity constraints.

[Hall, 1978] is the earliest paper that introduces Euler equations in showing the stochastic process of consumption, [Mankiw, 1982] and [Startz, 1989] analyzes time series properties of durable goods. [Bernanke, 1985] tests permanent-income hypothesis with adjustment costs and nonseparability. Hall (1988) tests intertemporal elasticity of substitution. [Dynan, 1993] estimates prudence, [Parker and Preston, 2005] decomposes consumption fluctuations and in particular test the precautionary motive. [Attanasio and Low, 2004] evaluate the conditions to use log-linearized Euler equations in estimating consistent preference parameters. [Zeldes, 1989] and [Runkle, 1991] test the PIH and liquidity constraints.

The existence of liquidity constraints in explaining the failure of permanent income hypothesis is explicitly tested by [Runkle, 1991] and [Zeldes, 1989] using household level consumption data. [Runkle, 1991] rejects the presence of liquidity constraints and concludes that the rejection of permanent income hypothesis using aggregate time-series data must be due to aggregation bias. [Zeldes, 1989], on the other hand, shows the presence of liquidity constraints in food consumption. He splits sample based on potentially constrained households and unconstrained households, and tests violations of unconstrained Euler equations in these samples. In the present paper, I follow the methodology of [Runkle, 1991] and [Zeldes, 1989] in testing the presence and the relative power of liquidity constraints using various expenditure categories, namely, food consumption, non-health expenditures and health-care expenditure.

Second, my paper is related to the health literature that investigates the interaction of income with the demand for healthcare and estimates the income elasticity of healthcare expenditures. Due to data limitations as well as identification difficulties, the income elasticity of health expenditure studies did not reach a consensus for the range of elasticity. Most studies find an inelastic demand for healthcare in micro studies. In a world with perfect insurance markets, this must be the case. However, considering the incompleteness and complicated nature of insurance markets, healthcare demand responds to the income changes.

The challenges for elasticity estimation are also due to the measure of healthcare expenditures. Healthcare is considered a 'luxury' good due to an income elasticity above unity using aggregate data, i.e. GDP per capita. However, this is inconsistent with micro data where individuals with higher incomes have a lower share of health-care. [Newhouse, 1977] finds an elasticity around 1.15 and 1.31 in a cross-country study, similarly [Leu, 1986], [Parkin et al., 1987] and [Gerdtham et al., 1992] find elasticities as high as 1.39 among OECD countries. Recently, [Acemoğlu et al., 2013] finds an elasticity around 0.7 in economic subregions comprised of U.S. counties level by exploiting the differential exposure of local areas to the shocks in oil prices. [Di Matteo and Di Matteo, 1998] also finds a similar estimate of 0.77 in Canadian provinces. [2]

Aggregate data, both cross-country or time series, incorporate all healthcare spending in a country. The changes in healthcare incorporate the technological advancements in the health industry over time, or technological and institutional differences across countries. Therefore, these studies are not comparable with micro studies, as the elasticities have different interpretations. Among the few micro studies, [Phelps, 2016] reports elasticities between 0 and 0.2. On the other hand, [Tsai, 2015] finds an income elasticity of 0.81 - 1.03 among the elderly population by exploiting the changes in Social Security legislation. These are the highest estimates among micro studies. As [Getzen, 2000] also reports, the estimates are close to zero using household level data.

By correlation estimations for income elasticity, I provide an intuition for the comparison between variable response of healthcare expenditures and other consumption to income changes among wealth quintiles. I show that the health elasticity varies much more between quintiles than food consumption. Further, I show that health expenditures' interaction with liquidity constraints should be evaluated considering one period ahead expectations which result in distinct behavioral responses. My findings show that in micro level, health-care consumption differs from non-health consumption, in particular from food consumption, in terms of its response to income changes. The closest study to mine that investigate the liquidity-health relationship is by [Gross and Tobacman, 2014] who estimate the effect of the relaxation of liquidity constraints by the 2008 Economic Stimulus Payments on medical care. They find the liquidity increases health care utilization by increasing the need for care such as increasing drug and alcohol related hospitalizations.

Third, my paper is related to the health capital literature that started to flourish after the pioneering work by [Grossman, 1972]. The demand for health is one of the most

[2] [Liu and Chollet, 2006] provide a comprehensive review on various estimates of healthcare elasticities.

fundamental areas in health economics research. [Grossman, 1972] provided a framework to analyze the demand for healthcare and investment over the lifecycle. Health capital is a human capital of an individual which depreciates as one ages and in which she can invest. [Wagstaff, 1986], [Case and Deaton, 2005], [Galama, 2015] are among the ones theoretically and empirically investigating health capital model and health technology. Recently, the macro-health literature incorporates health capital and estimates health technology parameters using simulation methods in order to analyze the impact of several health reforms. For example, [Hall and Jones, 2007] incorporates health status into instantaneous utility and explains the rising health spending as a rational response to changing economic conditions. [Finkelstein et al., 2013] estimate how marginal utility of consumption changes with health and show that marginal utility declines by a declining health status. The impact of health on utility is engaged in the models in [Hall and Jones, 2007], [De Nardi et al., 2010]. Other examples with health technology include [Jung and Tran, 2016], [Feng, 2012], [Kelly, 2017], [Halliday et al., 2017]. [3] A comprehensive health capital model is employed by [Galama and Van Kippersluis, 2018] in order to build a theory of socio-economic disparities over the life cycle. I incorporate health capital into the utility function as in [Jung and Tran, 2016]. I contribute to this literature by incorporating a health capital model in order to analyze the effect of liquidity constraints on expenditure choices of heterogeneous agents borrowing the tools from the consumption literature.

[3]See also [Özkan, 2011],[Pashchenko and Porapakkarm, 2013] and [Conesa et al., 2018] for examples of health shocks without explicit modeling of health capital. Relatedly, [Feenberg and Skinner, 1992] and [French and Jones, 2004] analyze the time-series properties of the health-care cost process.

1.2 Health Capital Model

Households maximize a time separable lifetime utility function discounted with subjective discount factor β. The preferences are defined over consumption $C_{i,t}$ and service flow from health stock, $H_{i,t}$. The markets are incomplete. Without loss of generality, it is assumed that households can borrow and save riskless asset $A_{i,t}$. [4]

$$\max \mathbb{E}_t \sum_{\tau=0}^{T-t} \beta^\tau u(C_{i,t+\tau}, H_{i,t+\tau}; \Theta_{i,t+\tau}) \tag{1.1}$$

subject to:

$$C_{i,t} + d_{i,t} + A_{i,t+1} = (1 + r_{i,t})A_{i,t} + Y_{i,t} \qquad \text{(budget constraint)} \tag{1.2}$$

$$H_{i,t} = (1 - \delta^h)H_{i,t-1} + d_{i,t} \qquad \text{(health capital accumulation)} \tag{1.3}$$

$$C_{i,t} \geq 0, \quad d_{i,t} \geq 0 \qquad \text{(nonnegativity constraints)} \tag{1.4}$$

$$A_{i,t+1} \geq \underline{A} \qquad \text{(liquidity constraint)} \tag{1.5}$$

$$A_{i,0}, H_{i,0} \text{ are given}, \quad H_{i,t} \leq \overline{H} < \infty.$$

Health capital $H_{i,t}$ depreciates at a deterministic rate δ^h. [5] I assume a linear health technology where health expenditures, $d_{i,t}$, are linearly added to the health capital in

[4] As [Zeldes, 1989] points out, other contingent claims market may also exist. The Euler equation holds with respect to other assets as well. The only requirement is that the full set of Arrow-Debreu securities do not exist. For brevity, I ignored any other assets that is available to the households in the model.

[5] The terms *health capital* and *health stock* are used interchangeably throughout the paper.

the current period. [6] [7] The linear and additive health technology is similar to the one proposed by [Grossman, 1972] who first introduced health capital into the literature. Households face uncertainty in their stochastic income streams $Y_{i,t}$ and stochastic ex-post after-tax returns $r_{i,t}$. [8] $\Theta_{i,t}$ is the household specific taste shifter which includes observable and unobservable factors that alter the marginal utility.

The expectation is taken conditional on the filtration $\mathcal{F}_{i,t}$, which is household's information set at time t in the current context. Hence, the operator $\mathbb{E}_t[X]$ for any random variable X denotes the conditional expectation of the form $\mathbb{E}[X|\mathcal{F}_{i,t}]$.

The recursive formulation of the problem can be written as:

$$V_t(A_{i,t}, H_{i,t-1}) = \max_{C_{i,t}, H_{i,t}, A_{i,t+1}} \{u(C_{i,t}, H_{i,t}) + \beta \mathbb{E}_t V_{t+1}(A_{i,t+1}, H_{i,t})\} \tag{1.6}$$

subject to (2)-(5). Substituting (1.2) into the objective function and taking first order conditions give the equilibrium intertermporal conditions where the variable $\lambda_{i,t}$ is the Lagrange multiplier on budget constraint, $\eta_{1i,t}, \eta_{2i,t}$ on non-negativity constraints and $\mu_{i,t}$ on liquidity constraint.

I assume that the Inada conditions hold so that the nonnegativity constraint for nondurable good does not bind ($\eta_{1i,t} = 0, \ \forall i \ \forall t$). [9] Denote the partial derivatives of

[6]The health technology is possibly nonlinear and exhibits decreasing returns to scale e.g. $\alpha d_{i,t}^{\rho}$. However when the Euler equations are linearized the constants α and ρ become part of constants which do not play a role in the main analysis. To save some notation, I ignore curvature in health investment.

[7]The timing in health capital accumulation is chosen so that the current period investment in health spending affects the current utility.

[8]I do not model health shocks explicitly, however I control for health status and health shocks via taste shifter in empirical analysis. I explain possible extensions of the model with health shocks in section 5.

[9]For $\eta_{1i,t}$, the multiplier is always zero with an instantaneous utility function for which Inada conditions hold, i.e. $\partial U(x)/\partial x \rightarrow -\infty \ \ as \ \ x \rightarrow 0$ for x being $C_{i,t}$ or $H_{i,t}$. For $\eta_{2i,t}$, the Inada condition is not enough since the constraint is on health-care expenditure whereas Inada conditions is assumed for health stock which is never zero for an alive human being, so I assume Inada conditions for health stock as well as a nonnegativity constraint for healthcare expenditures since it is not reversible.

felicity function as $u_C^{i,t} = \partial u(C_{i,t}, H_{i,t})/\partial C_{i,t}$ and $u_H^{i,t} = \partial u(C_{i,t}, H_{i,t})/\partial H_{i,t}$.

Proposition 1 *The intertemporal condition for nondurable consumption takes the form:*

$$u_C^{i,t} = \beta \mathbb{E}_t[(1 + r_{i,t+1})u_C^{i,t+1}] + \mu_{i,t}. \tag{1.7}$$

This is a classical result shown in the literature that when the liquidity constraints are binding, i.e. $\mu_{i,t} > 0$, the expected marginal utility in the next period is lower than the marginal utility in the current period. Hence, consumption is expected to grow from period t to t+1.

Assumption 1 *Nonnegativity constraint for healthcare expenditure does not bind, i.e.* $\eta_{2i,t} = 0, \ \forall i, \ \forall t.$

Assumption 2 *Households hold constant expectation about future rate of return,* $\mathbb{E}_t[r_{i,t+1}] = \mathbb{E}_{t+1}[r_{i,t+2}]$.

Proposition 2 *Under Assumptions 1 - 2, the intertemporal condition for health capital takes the following form:*

$$u_H^{i,t} = \beta \mathbb{E}_t[(1 + r_{i,t+1})u_H^{i,t+1}] - \beta(1 - \delta^h)\frac{\mathbb{E}_t[(1 + r_{i,t+1})\mu_{i,t+1}]}{\mathbb{E}_t[1 + r_{i,t+1}]} + \mu_{i,t}. \tag{1.8}$$

Proof: see Appendix A.1. ■

The intertemporal condition for health capital depends on liquidity constraints in the current period as well as expectations about one period ahead liquidity constraints interacted with the rate of return and discounted by time preference and depreciation of health stock. The current binding constraints have a similar impact on the marginal utility of health stock as in nondurable consumption good. On the other hand, the one period ahead expected binding constraints enter the right hand side of the equation negatively. This points to an opposite direction of effect. That is, one period ahead binding constraints increase the expected marginal utility of health stock from period t to t+1.

The health capital accumulation equation and how it enters into the utility function as a service flow is similar to how durable goods and housing are modeled in the literature.[10] However, health capital cannot be collateralized unlike durable consumption goods, hence the level of health stock does not relax the liquidity constraint.[11] In particular, [Browning and Crossley, 2009] show that households cut back the durable expenditures disproportionately compared to non-durable goods when faced with temporary income losses. They argue that the reductions in durable expenditures lead to very small cuts in durable consumption since households continue to enjoy flow utility from existing durable stock. They consider small durables which are subject to irreversibility constraints, that is these goods cannot be resold due to poor resale markets. In this sense, health capital naturally exhibits irreversibility which corresponds to the nonnegativity constraint in the above model.[12] I follow [Browning and Crossley, 2009] to give illustrative special cases for the intratemporal implications of the binding liquidity constraints. Hence, for the following intratemporal illustrative predictions, r is assumed constant.[13]

[10]Examples include but not limited to [Browning and Crossley, 2009], [Cerletti and Pijoan-Mas, 2012], [Skinner, 1989] .

[11]Assuming the black market for kidneys is small and is not accessible by many households.

[12]Their definition of liquidity constraint is that the households cannot borrow against the stock of durables. In the present paper, I assume an ad-hoc borrowing limit $\underline{A}$ which can be a small negative number that is not necessarily zero. The value of the borrowing limit is trivial for the theoretical analysis as long as it differs from the natural borrowing constraint (the constraint that naturally occurs when Inada condition holds as is assumed here) and binds for some households.

[13]I ignore any price effects and r is held constant as in [Browning and Crossley, 2009] for this part only since it makes the derivation straightforward and does not play a crucial role in showing the impact of liquidity constraints in the theoretical model.

In order to emphasize the impact of liquidity constraint, I assume an interior solution in both time periods t and t+1, that is the nonnegativity constraints for the healthcare expenditures at time t does not bind and is not expected to bind for the time t+1 throughout the paper.

Proposition 3 *Under Assumption 1 and assuming r is held constant, the marginal rate of substitution (MRS) between health capital and non-durable consumption goods for household i at time t is:*

$$MRS^{i,t}_{H,C} = \frac{u^{i,t}_H}{u^{i,t}_C} = \frac{\delta^h + r}{1+r} + \frac{(1-\delta^h)\mu_{i,t}}{V^{i,t}_A}. \tag{1.9}$$

Proof: see Appendix A.1. ■

Since $\delta^h < 1$, the marginal rate of substitution between health stock and nondurable consumption in the case of binding liquidity constraint ($\mu_{i,t} > 0$) is more than that of the unconstrained case. Marginal utility of health capital is high relative to the marginal utility of nondurable good, hence the health expenditure is low. This means that the consumer is willing to give up more of health stock in order to consume one additional unit of the nondurable good when she is constrained. Put differently, the cost of additional health stock is higher in terms of nondurable consumption in order to keep the same level of utility. This translates into less willingness to pay for healthcare spending in the case of a binding constraint.

In order to evaluate the situation in terms of healthcare expenditure, as in [Browning and Crossley, 2009], I assume a simple form of homothetic preferences, addilog utility function. Moreover, when r is held constant, the ratio of healthcare expenditure to nondurable good has a simple form.

Lemma 3.1 *Assume $u(C_{i,t}, H_{i,t}) = \ln C_{i,t} + \ln H_{i,t}$ and r is constant. Then, the MRS for the unconstrained case (1.9) with the assumed preferences gives the ratio of health spending to nondurable consumption as:*

$$\frac{d_{i,t}}{C_{i,t}} = \frac{1+r}{\delta^h + r} + \left[1 - (1-\delta^h)\left(\frac{C_{i,t}}{C_{i,t-1}}\right)^{-1}\right]. \tag{1.10}$$

This equation means that the healthcare expenditure to nondurable consumption ratio at t is an increasing and concave function of consumption growth from t-1 to t, $\frac{C_{i,t}}{C_{i,t-1}}$. Note that in the absence of constraints the ratio $\frac{C_{i,t}}{C_{i,t-1}}$ is constant and is equal to $\beta(1+r)$. When the liquidity constraints are binding, there is a noise term that changes over time. In Lemma 3.2, the liquidity constraint at t is not binding $\mu_{i,t} = 0$. However, if the constraint was binding in the previous period, $\mu_{i,t-1} > 0$, then the nondurable consumption growth will be high. This will increase the ratio of healthcare spending to nondurable consumption at t compared to the ratio for a more modest or no growth when the constraint was not binding in the previous period, $\mu_{i,t-1} = 0$. Hence, this shows that the changes in healthcare spending are amplified with the binding liquidity constraint.

1.3 Empirical Specification

I now continue to carry the theoretical predictions into the data. First, I derive the empirical model from the Euler equations of the health capital model.

As in [Zeldes, 1989], I normalize the Lagrange multipliers with positive non-stochastic terms as of time t which will be useful for empirical specification.

$$\mu'_{i,t} = \frac{\mu_{i,t}}{\beta \mathbb{E}_t[(1 + r_{i,t+1})u_C^{i,t+1}]} \tag{1.11}$$

$$\mu''_{i,t} = \frac{\mu_{i,t}}{\beta \mathbb{E}_t[(1 + r_{i,t+1})u_H^{i,t+1}]} \tag{1.12}$$

$$\mu'''_{i,t+1} = \frac{\beta(1-\delta^h)\mathbb{E}_t[(1 + r_{i,t+1})\mu_{i,t+1}]}{\beta \mathbb{E}_t[(1 + r_{i,t+1})u_H^{i,t+1}]\mathbb{E}_t[1 + r_{i,t+1}]}. \tag{1.13}$$

Then, substitution of these into the intertemporal conditions and assuming rational expectations results in the following Euler equations:

$$\beta(1 + r_{i,t+1})\frac{u_C^{i,t+1}}{u_C^{i,t}}(1 + \mu'_{it}) = 1 + e'_{i,t+1} \tag{1.14}$$

$$\beta(1 + r_{i,t+1})\frac{u_H^{i,t+1}}{u_H^{i,t}}(1 + \mu''_{i,t} - \mu'''_{i,t+1}) = 1 + e''_{i,t+1} \tag{1.15}$$

where $e'_{i,t+1}$ and $e''_{i,t+1}$ are the expectational errors for (1.14) and (1.15) respectively, which have conditional mean zero and orthogonal to any information up to time $t+1$: $\mathbb{E}_t[e'_{i,t+1}] = 0$ and $\mathbb{E}_t[e''_{i,t+1}] = 0$.

If expectation errors have conditional mean zero, $\ln(1 + e'_{i,t+1})$ and $\ln(1 + e''_{i,t+1})$ do not have mean zero expectations. Taking second order Taylor expansion gives:

$$\ln(1 + e'_{i,t+1}) = e'_{i,t+1} - \frac{1}{2}e'^2_{i,t+1} + O(e'^3_{i,t+1}) \tag{1.16}$$

$$\ln(1 + e''_{i,t+1}) = e''_{i,t+1} - \frac{1}{2}e''^2_{i,t+1} + O(e''^3_{i,t+1}). \tag{1.17}$$

where the approximation error $O(e^3_{i,t+1}) \to 0$ as $e_{i,t+1} \to 0$. I assume that third and higher order moments are orthogonal to the information set at time t.

Assumption 3 *The felicity function takes additively separable form over non-durable consumption and the service flow from the health stock as well as over time. The consumption good and service flow from health stock take CRRA form.* [14]

$$u(C_{i,t}, H_{i,t}; \Theta_{i,t}) = \left(\frac{C_{i,t}^{1-\phi}}{1-\phi} + \frac{H_{i,t}^{1-\xi}}{1-\xi} \right) exp(\Theta_{i,t}) \tag{1.18}$$

where $\Theta_{i,t}$ is the household specific taste shifter. The coefficients of relative risk aversion for nondurable consumption and health capital , ϕ and ξ, are assumed equal across households.

Proposition 4 *Under Assumptions 1-3 and the results in Propositions 1-2, the Euler equations for non-durable consumption and health capital take the forms:*

$$C_{i,t} = C_{i,t+1} \left(\frac{1 + e'_{i,t+1}}{\beta(1 + r_{i,t+1})(1 + \mu'_{i,t}) exp(\Delta\Theta_{i,t+1})} \right)^{1/\phi} \tag{1.19}$$

$$H_{i,t} = H_{i,t+1} \left(\frac{1 + e''_{i,t+1}}{\beta(1 + r_{i,t+1})(1 + \mu''_{i,t} - \mu'''_{i,t+1}) exp(\Delta\Theta_{i,t+1})} \right)^{1/\xi}. \tag{1.20}$$

[14] I ignore the utility weight on health capital for now since it does not play any role in empirical analysis when it is a constant.

Proposition 5 *Taking natural logs of the results in Proposition 4, (1.19) and (1.20), and rearranging, the specifications for log-linear Euler equation estimations become:*

$$\Delta \ln C_{i,t+1} = \frac{1}{\phi}\{\ln(1+\mu'_{i,t}) + \ln\beta_i + \ln(1+r_{i,t+1}) - \ln(1+e'_{i,t+1}) + \Delta\Theta_{i,t+1}\} \tag{1.21}$$

$$\begin{aligned}\Delta \ln d_{i,t+1} =& \frac{\hat{m}}{\xi}\{\ln(1+\mu''_{i,t} - \mu'''_{i,t+1}) + \ln\beta_i + \ln(1+r_{i,t+1}) - \ln(1+e''_{i,t+1}) + \Delta\Theta_{i,t+1}\} \\ &- \frac{\hat{m}-1}{\xi}\{\ln(1+\mu''_{i,t-1} - \mu'''_{i,t}) + \ln\beta_i + \ln(1+r_{i,t}) - \ln(1+e''_{i,t}) + \Delta\Theta_{i,t}\}\end{aligned} \tag{1.22}$$

where $\Delta \ln C_{i,t+1} = \ln C_{i,t+1} - \ln C_{i,t}$ *is the growth of non-health consumption, and* $\Delta \ln d_{i,t+1} = \ln d_{i,t+1} - \ln d_{i,t}$ *is the growth of health-care expenditures.* $\hat{m}$ *is a constant given as* $\hat{m} = \frac{\overline{m}^{1/\xi}}{\overline{m}^{1/\xi} - (1-\delta^h)}$*, where* $\overline{m}$ *is a fixed number such that Taylor expansion of the term in parentheses in (1.20) is taken around it to linearize the Euler relation for the health capital.*

Proof: The proof and discussion about this proposition is in Appendix A.1. ■

Proposition (5) is the main assertion that gives the empirical specification for the extended test for healthcare expenditures. The equation (1.21) is the log-linearized Euler equation specification that are often used to test for excess smoothness of consumption and for the presence of liquidity constraints in the literature.

The equation (1.22) is the log-linearized Euler equation specification for the health capital model. The dynamics of the model is clearly seen in equation (1.22). First, the linearized Euler equation includes all the variables in (1.21), as well as normalized one period ahead expected liquidity constraint. Moreover, it includes all these terms with one period lags. This shows that healthcare expenditure growth is determined by a more dynamic model compared to nondurable consumption. Second, $\hat{m} > 1$, hence the lag terms in the second line of equation (1.22) enter with a negative coefficient. The contemporaneous terms and lag terms are not taken into account as a simple weighted average for the expenditure growth. Indeed, there is a stock-flow adjustment between time periods. When the health stock is adjusted, the flow responds negatively to the old information. The expenditure responds are stronger to a variable that has a bigger stock. This creates large swings in healthcare expenditure.

The differences between equations (1.21) and (1.22) give a clear direction on how the empirical specification and the standard liquidity constraint test will be extended for the healthcare expenditures.

The felicity function, hence consumption and expenditures, is influenced by household specific tastes that also shift across time. The taste shifter has both observable and unobservable components. I assume each household have a different time preference rate, this is equivalent to having a household fixed effect in the change in taste that also captures unobservable heterogeneity across households. Taste shifter is a function of a third order polynomial in age, education, household size, race, marital status, quadratic polynomial in health indices, an indicator for hospitalization shock, time-invariant household specific shifter and aggregate time shifter:

$$\Theta_{i,t} = g_{i,t}(age_{i,t}, edu_{i,t}, size_{i,t}, race_{i,t}, marital_{i,t}, HI^{a}_{i,t}, HI^{c}_{i,t}, H^{s}_{i,t}) + \zeta_i + \chi_t + \nu_{i,t} \quad (1.23)$$

where ζ_i is the unobservable household fixed effect, χ_t is the aggregate time shifter, and $\nu_{i,t}$ is the innovation in data-generating process for tastes that is assumed to be orthogonal to the observable and unobservable components.

Then, the change in tastes in the Euler equations takes the form:

$$\Delta\Theta_{i,t+1} = \Delta g_{i,t+1} + (\chi_{t+1} - \chi_t) + (\nu_{i,t+1} - \nu_{i,t}) = X'_{i,t+1}\tilde{\Gamma} + (\chi_{t+1} - \chi_t) + (\nu_{i,t+1} - \nu_{i,t}) \tag{1.24}$$

where the term $X'_{i,t+1}\tilde{\Gamma}$ constitutes the variables in $g_{i,t}(.)$ function and it is formulated as;

$$\begin{aligned} X'_{i,t+1}\tilde{\Gamma} =& \gamma_1 age_{i,t} + \gamma_2 age^2_{i,t} + \gamma_3 edu_{i,t} + \gamma_4 size_{i,t} + \gamma_5 HI^a_{i,t} + \gamma_6 HI^c_{i,t} + \gamma_7 H^s_{i,t} + \gamma_8 \Delta HI^a_{i,t+1} \\ &+ \gamma_9 \Delta HI^c_{i,t+1} + \gamma_{10} \Delta H^s_{i,t+1} + \sum_p \gamma^p_{11} race_p + \sum_q \gamma^q_{12} sex_q + \sum_r \gamma^r_{13} mar_r \end{aligned} \tag{1.25}$$

$race_p$ is an indicator function for $p = 1, 2, 3$, $\mathbb{1}[race = p]$, where category 1 indicates White, 2 indicates Black and 3 for others. Similarly, sex_q is an indicator for sex of head, mar_r is an indicator for marital status. $HI^a_{i,t}$ is the acute illness index, $HI^c_{i,t}$ is the chronic illness index, and $H^s_{i,t}$ is the hospitalization shock calculated for head and spouse total.

Differencing drops the household fixed effect from the equation. However, in the empirical specification, I control for unobserved heterogeneity across households due to heterogeneity in discount rates. Moreover, I am adding education, size, chronic and acute health indices, and hospitalization index in levels in order to account for possible nonlinearities that these variables enter in taste-shifter function, as well as a full set of dummies for race, sex and marital status of head. In a robustness analysis, I also control for insurance type with dummies for public insurance, private insurance, and uninsured.

Substituting (1.24) into (1.21) and (1.22) yields the regression equation for non-health consumption growth: [15]

$$\Delta \ln C_{i,t+1} = \underbrace{\frac{1}{\phi}\{\gamma_1 + \frac{1}{2}\sigma_e^2\}}_{\alpha_0^c} + \underbrace{\frac{1}{\phi}\ln\beta_i}_{\alpha_{1i}^c} + \underbrace{\frac{1}{\phi}(\chi_{t+1} - \chi_t)}_{\alpha_{2t}^c} + \frac{1}{\phi}\ln(1 + r_{i,t+1}) + \frac{1}{\phi}X'_{i,t+1}\tilde{\Gamma}$$
$$+ \underbrace{\frac{1}{\phi}\{(\nu_{i,t+1} - \nu_{i,t}) - \ln(1 + e'_{i,t+1}) - \frac{1}{2}\sigma_e^2\}}_{\epsilon_{it+1}^c} + \frac{1}{\phi}\ln(1 + \mu'_{i,t}) \tag{1.26}$$

The Kuhn-Tucker multipliers are not observed, hence they enter the error term. These are combined with the innovation and the terms in expectation error as $u_{it+1}^c = \epsilon_{it+1}^c + \ln(1+\tilde{\mu}'_{i,t})$. Further taking first order Taylor expansion for after-tax return as $ln(1+x) \approx x$, and relabeling the coefficients such that $\alpha_3^c = 1/\phi$ and $\Gamma^c = \tilde{\Gamma}/\phi$ gives;

$$\Delta \ln C_{i,t+1} = \alpha_0^c + \alpha_{1i}^c + \alpha_{2t}^c + \alpha_3^c r_{i,t+1} + X'_{i,t+1}\Gamma^c + u_{it+1}^c \tag{1.27}$$

The regression equation for healthcare expenditure growth is dynamically more involved. It includes the lag values of all covariates, rate of return, and error terms. [16]

[15]By adding σ_e^2 into α_0^c, I am implicitly assuming that expectational errors are drawn from the same distribution for households. However, this is not a critical assumption and does not effect anything, assuming different distributions for each i would place σ_e^2 into α_{1i}^c and the fixed effects would then include the households specific expectational error variation.

[16]The derivation is in Appendix A.1. The error term in healthcare expenditure growth includes lag forecast errors which introduce an MA(1) error structure. Therefore, the instrument set should account for the autocorrelation for consistency of estimates. In empirical analysis I use only time t-1 variables as instruments in instrumental variable regressions.The derivations and detailed arguments regarding these terms are discussed in Appendix A.1 and A.2.

$$\Delta \ln d_{i,t+1} = \alpha_0^d + \alpha_{1i}^d + \alpha_{2t}^d + \alpha_3^d r_{i,t+1} + \alpha_4^d r_{i,t} + X'_{i,t+1}\Gamma_1^d + X'_{i,t}\Gamma_2^d + u_{it+1}^d \tag{1.28}$$

The change in innovations in taste, $(\nu_{i,t+1} - \nu_{i,t})$, is assumed to be stationary and have mean zero. So, conditional on information set at time t, the error terms in (1.27) and (1.28) have mean zero, $\mathbb{E}[\epsilon_{it+1}|\mathcal{F}_{i,t}] = 0$ and $\mathbb{E}[u_{it+1}|\mathcal{F}_{i,t}] = 0$.

The ex-post after-tax real return on savings is household specific and is given as;

$$r_{i,t+1} = \frac{[1 + i_t(1 - \tau_{i,t+1})]}{1 + \pi_{t+1}} - 1 \tag{1.29}$$

where i_t is the nominal interest rate, τ_{it} is the consumer i's marginal tax rate at time t, π_{t+1} is the inflation rate between t and t+1.

The ex-post after tax interest rate for households, $r_{i,t+1}$, is not observed at time t and it is possibly correlated with expectation error on growth of consumption. For this reason, I follow previous papers and use an instrumental variable approach. The instruments for ex-post after-tax returns are the marginal tax rates for head and spouse at time t-1 and log of disposable household income, $\ln y_{i,t-1}$.

I follow [Zeldes, 1989] and [Runkle, 1991] in testing the presence of liquidity constraints. Mainly, the test is based on violation of unconstrained Euler equation for households that are likely experiencing binding liquidity constraints. In this regard the households are stratified into groups based on their wealth. I split the sample based on total household net worth. Then, the identifying assumption is that the household income and asset holdings are not correlated with expectational errors (by rational expectations assumption) and change in innovations in household taste shifters after controlling for change in observables in taste shifters, household and time fixed effects.

For an initial analysis, I split the sample into 2 groups of observations based on median wealth, for the first group the constraints are likely to be binding ($\mu_{i,t} > 0$), and for the second group they are slack ($\mu_{i,t} = 0$). Then, I further split the observations into 5 groups based on wealth quintiles. The motivation to have a finer split is that the degree that the constraints are binding may differ among wealth groups. A finer split will allow one to observe for the pattern in the degree to which the constraints bind. Moreover, since the wealth and consumption are measured with possibly large errors, it is not easy to find the cutoff in dividing into subgroups and any division will be misleading due to extraordinary observations in noisy datasets. Having a finer division increases these concerns on the one hand due to the lower number of observations in each sample, however the difference between quintiles makes binding liquidity constraints more visible, that is, instead of comparing 2 groups, comparing 5 groups makes imperfect division less of a concern.

The aim in this paper is not analyzing the impact of liquidity constraints on consumption per se, but evaluating the differential impact of binding constraints on health-care expenditures versus non-health consumption. Therefore, it is important to emphasize the theoretical implications of the health capital model. The derived Euler equations imply that health-care expenditures might be differing from the optimal level due to binding constraints in the current period as well as expectations about one period ahead binding constraints. Either considering liquidity constraints are persistent for at least one more period, or current binding constraints lead to expectations such that the constraints will also bind in the future, the constrained Euler equations imply that health-care expenditures deviate from unconstrained level more than non-health consumption due to an extra expectation term. [17]

[17]"more" here refers to marginal utilities, not the exact levels, both because of the parameter differ-

1.4 Empirical Assessment

1.4.1 Specification in levels

Before proceeding to Euler equation tests of consumption growth, I will look at the econometric specification in logs of consumption in order to motivate the tests for the differential impact of liquidity constraints on the healthcare expenditures. I estimate income elasticity of non-health consumption and health-care expenditures as a first pass using OLS. Although this specification does not give unbiased elasticities due to many endogeneity concerns, it provides a motivation for a comparative analysis of the liquidity constraints. The econometric models take the following forms:

$$\ln C_{it} = \omega_0^c + \omega_1^c \ln y_{it} + \omega_2^c HI_{i,t}^a + \omega_3^c HI_{i,t}^c + \omega_4^c H_{i,t}^s + W_{it}' \omega_5^c + b_i^c + b_t^c + \iota_{i,t}^c \tag{1.30}$$

$$\ln d_{it} = \omega_0^d + \omega_1^d \ln y_{it} + \omega_2^d HI_{i,t}^a + \omega_3^d HI_{i,t}^c + \omega_4^c H_{i,t}^s + W_{it}' \omega_5^d + b_i^d + b_t^d + \iota_{i,t}^d \tag{1.31}$$

where $\log C_{i,t}$ is the log family consumption and $\ln d_{it}$ is the log of out-of-pocket health-care expenditures. In the empirical assessment, the consumption variable is separately defined as (i) all non-health consumption, (ii) food consumption. Food consumption is used to compare the results with the previous literature since most early papers are relying on household food expenditures such as [Zeldes, 1989] which is the most available consumption category in the data. In the regression equations above, $HI_{i,t}^a$ is an index of family (head and spouse) acute health status. $HI_{i,t}^c$ is an index of family chronic health status, $H_{i,t}^s$ is the index whether head or spouse is hospitalized during the previous year, $\ln y_{i,t}$ is the total family income, $W_{i,t}$ is a vector of control variables that includes family size dummies, race, sex, marital status of head, years of schooling and a quadratic in

ences, also because what a 'unit' health equivalent in terms of the consumption good is very ambiguous.

the age of head, type of health insurance dummies and state dummies, b_i is individual fixed effects and b_t is year fixed effects. The elasticities are estimated separately for each wealth quintile. [18]

1.4.2 Specification in growths

The main tests in the present paper depend on the Euler equations from the health-capital model. Therefore, the model-implied specifications are in growths of consumption rather than levels. Combining constant terms, household specific time-invariant and time-varying terms together and rearranging we reach equations (1.27) and (1.28). Hence, the main tests for the presence of the binding liquidity constraints are done using these equations with an instrumental variable approach. The regressions are run separately for each wealth quintile.

$$\Delta \ln C_{i,t+1} = \alpha_0^c + \alpha_{1i}^c + \alpha_{2t}^c + \alpha_3^c r_{i,t+1} + \alpha_4^c \ln y_{i,t} + X'_{i,t+1}\Gamma^c + u_{it+1}^c \tag{1.32}$$

$$\Delta \ln d_{i,t+1} = \alpha_0^d + \alpha_{1i}^d + \alpha_{2t}^d + \alpha_3^d r_{i,t+1} + \alpha_4^d r_{i,t} + \alpha_5^d \ln y_{i,t} + X'_{i,t+1}\Gamma_1^d + X'_{i,t}\Gamma_2^d + u_{it+1}^d \tag{1.33}$$

In this specification, $\ln y_{i,t}$ is added as an extra regressor to the equation. Under the null hypothesis that the permanent income hypothesis holds, income should not have any explanatory power in variations in consumption growth. However, when the liquidity constraint is binding, the income variable is correlated with the error term and this would bias the coefficient on income which is the essence of the test.

[18] In alternative specifications, I replaced health indices with self-reported health status of head and spouse. The coefficients are less precise for these alternative variables. The reliability of self-reported health status and comparability between households is contentious in the literature. Several researchers have developed indexes to measure the health level, such as a frailty index. However, there is no easy way to assess how healthy an individual is.

Note that $\ln y_{i,t-1}$ is also added as a regressor for health expenditure growth in order to proxy for lag binding constraint.

1.4.3 Data

Data comes from 1999-2015 waves of Panel Study of Income Dynamics (PSID). Starting from 1968, PSID collected data on demographics, employment, asset holdings, expenditures and health factors of 5,000 U.S. households over their life course and their children (SRC sample). Later, more samples added as to represent Latino population and lower income levels (Latino and SEO sample). The survey initially collected food, childcare and housing expenditures, however, after 1999 more comprehensive expenditure categories are added. The empirical analysis in the present paper incorporates all households excluding SEO and Latino samples.

The consumption data uses the aggregated consumption variables imputed by the PSID staff in the main family files. These variables span food, housing, transportation, education, childcare and health-care expenditures and their subcategories. Healthcare expenditure consists of health insurance premiums paid by household and out-of-pocket health-care spending. The wealth variable used in this analysis is all assets net of debt, including home equity. Disposable income is calculated as family unit federal taxable income minus federal, state and social security taxes plus credits.

The ex-post rate of return formulation gives the tax-augmented Fisher equation as $r_{i,t+1} = i_t(1 - \tau_{i,t+1}) - \pi_{t+1}$ as in [Shapiro, 1984] . Nominal interest rate i_t is a monthly average of 3-month T-bill rate in the previous year. The inflation rate is the annual percentage change in Personal Consumption Expenditures (PCE) excluding food and energy extracted from St. Louis Fed database. Marginal tax rates and the variables in disposable income calculations are estimated using NBER's TAXSIM simulator.

I constructed health indices using the categorization employed by [Conley and Thompson, 2011], however the index construction serves a different purpose in the sense that I construct them as a measure of family health status rather than to identify health shocks. Instead, I use the hospitalization index as a proxy for a health shock. Specifically, acute illnesses consists of stroke, heart attack, and cancer. Chronic illnesses consist of diabetes, lung disease, heart disease, psychological problems, arthritis, asthma, memory loss, and learning disorder. The index is the sum of the existence of each illness for head and spouse combined. Acute and chronic health indices indicate the state of health in the family. Hospitalization index takes values 0, 1 or 2 if either one of head or spouse (1) , both (2) or none (0) of them is hospitalized during previous calendar year.

The sample consists of households with heads between ages 25-65. The health variables are constructed using head and spouse health conditions. Income, consumption and wealth variables are at the household level. I trimmed the data if food consumption grows or shrinks more than 400%. I also dropped observations if a household has a negative checking/saving account or negative stocks, which is possibly due to the imputation of wealth variables. All nominal variables are deflated to 2010 dollars using CPI-U. Food variables are deflated using food CPI and healthcare expenditure variables are deflated using medical CPI.

Table 1.1: **Descriptive Statistics**

	Wealth Quintiles					
	1^{st}	2^{nd}	3^{rd}	4^{th}	5^{th}	Total
Net Wealth	-22.2	23.0	85.7	228.8	1,311.4	325.3
Disposable Income	27.0	31.6	41.9	53.4	96.8	50.2
Total Consumption	36.3	39.3	46.4	53.6	70.9	49.3
Food Consumption	6.9	7.6	8.4	9.3	10.9	8.6
Health Expenditure	3.7	4.2	4.8	5.9	8.3	5.4
Age	37.4	38.8	42.7	46.6	50.4	43.2
Education	13.4	13.1	13.5	14.1	15.0	13.8
Household Size	2.7	2.8	3.0	2.9	2.9	2.9
Observations	5,930	5,925	5,927	5,927	5,927	29,636

Wealth, income and consumption are in thousand \$s. Mean of corresponding variable for each wealth quintile.

1.4.4 Euler equation tests

Test for nondurable consumption

Euler equation tests are based on the existence of Lagrange multiplier, $\mu_{i,t}$, in the error term, which creates an omitted variable bias. Under the null hypothesis that the liquidity constraints do not exist, the parameter estimates should be similar across wealth groups. Under the alternative hypothesis that the liquidity constraints exist and binding for some groups, the parameter estimates differ across groups. More specifically, the error term for the households for which the constraints are binding ($\mu_{i,t} > 0$), would be correlated with income which otherwise should have no effect on consumption growth, hence the parameters on income that is added as an extra regressor will be biased and will show up significantly different from zero.

Any other bias that might be occurring due to, for example, omitted variables, higher order terms that enter the error term after log-linearization or mis-measurement of consumption data can also invalidate the identifying assumptions. However, there is no reason to believe that such sort of bias will vary between quintiles. Hence, any difference in parameter estimates between quintiles must be coming from binding liquidity constraints. Having settled with this test, the second step is to assess how distinct the impact of binding liquidity constraints on the health-care spending compared to non-health consumption, in particular, to food consumption.

[Zeldes, 1989] divides the sample into two groups based on wealth to income ratio and shows the distinct response of these groups to the changes in income. The low wealth group has a significant bias on extra regressor, while high wealth group has no effect. On the other hand, [Runkle, 1991] divides samples based on homeownership and whether annuitized value of the household's asset income less than two month's income. He does not find any significant difference between the groups. I divide my sample based on net worth first into two groups and then continue with a finer division with five groups. For wealth quintiles division, it can be expected that the constraints are not binding for 4^{th} and 5^{th} wealth quintiles, and binding for 1^{st}, 2^{nd} and 3^{rd} quintiles with the degree to which it binds being more severe for the lowest wealth groups.

Test for healthcare expenditure

I extend the test by [Zeldes, 1989] and [Runkle, 1991] to the case of the health capital model. The extension of the test for health expenditures comes from the Euler equation for health stock (1.8). The unconstrained Euler equation for health may not hold due to (i) binding liquidity constraints today, i.e. $\mu_{i,t} > 0$, similar to non-durable consumption Euler equation (1.7) and (ii) expectations about future binding constraints, i.e. $\mathbb{E}_t[\mu_{i,t+1}] > 0$. The deviation (ii) arises due to the recursive nature of health capital. Then, the test is extended considering 4 possible cases, with some abuse of notation:

- **Case 1:** $\mu_{i,t} > 0$ and $\mathbb{E}_t[\mu_{i,t+1}] = 0$

  Liquidity constraint at time t is binding, however there is no expectation about future binding constraints.

- **Case 2:** $\mu_{i,t} = 0$ and $\mathbb{E}_t[\mu_{i,t+1}] > 0$

  Liquidity constraint is not binding at t, however it is expected to bind at t+1.

- **Case 3:** $\mu_{i,t} > 0$ and $\mathbb{E}_t[\mu_{i,t+1}] > 0$

  Liquidity constraint at time t is binding and it is expected to bind at time t+1.

- **Case 4:** $\mu_{i,t} = 0$ and $\mathbb{E}_t[\mu_{i,t+1}] = 0$

  Liquidity constraint at t is not binding and is not expected to bind at t+1.

Note that the expectation for $\mu_{i,t+1}$ is unlikely to be zero. $\mu_{i,t+1}$ has a weakly positive support, it can take zero or a positive value assuming that the households cannot be constrained from saving. If there is even a very small probability for the constraint to bind in the future, the expectation will be a small positive number. So, in the above notation, $\mathbb{E}_t[\mu_{i,t+1}] = 0$ is used in place of $\mathbb{E}_t[\mu_{i,t+1}] = \epsilon$ for some small $\epsilon > 0$, and consequently, $\mathbb{E}_t[\mu_{i,t+1}] > 0$ indicates a large positive expectation.

Case 1 is the same as Runkle-Zeldes test for nondurable consumption. The Lagrange multiplier for binding constraint at t, $\mu_{i,t}$, is positively correlated with the income that is added as an extra regressor to the empirical model. However, it is negatively correlated with consumption growth. This shows up as a negative bias on the income variable. In this case, a negative coefficient on income is expected.

Case 2 has quite different implications for the bias on income. The Lagrange multiplier for binding constraint at t+1, $\mu_{i,t+1}$, is negatively correlated with consumption growth.

The household cannot increase consumption if she expects not to have enough resources for the next period. This can be because the resources are enough for the time t to cover the health spending, hence the constraint is not binding contemporaneously, but the resources are not enough to cover prolonged costs beyond what is already being spent at the time t. Moreover, $\mathbb{E}_t[\mu_{i,t+1}]$ is negatively correlated with expected income at t+1. The income may not be changing between t and t+1 so that $\mathbb{E}_t[\mu_{i,t+1}]$ is also negatively correlated with income at t, or it may be temporarily high at t than what is expected at t+1 which further increases negative correlation. Overall, both negative correlations induce a positive bias on the extra income regressor in the model, hence, a positive coefficient is expected in case 2.

Case 3 is the combination of Case 1 and Case 2. When the liquidity constraint is binding at t and is expected to bind at t+1, there is both a positive bias and a negative bias on income variable. These opposing biases may cancel out, or one of them may dominate. In this case, any situation for coefficient estimate on income is possible.

Case 4 is again same as Runkle-Zeldes test for unconstrained households. The liquidity constraint is not binding at t and is not expected to bind at t+1 since the household has enough resources to cover her expenditures. Hence, the extra regressor income is expected to have an insignificant coefficient since it is not predicted to have an impact on consumption growth by the PIH/LCH theory.

Figure (1.1) shows the illustration of how the multipliers associated with liquidity constraints at t and t+1 might affect the coefficients of log income in the tests. Panel [a] illustrates Case 1 discussed above and panel [b] illustrates Case 2.

Figure 1.1: **Direction of bias in expenditure growth**

(+)

$$\Delta d_{i,t+1} = \beta_0 + \beta_1 X_{i,t} + \beta_2 r_{i,t+1} + \beta_3 y_{i,t} + \epsilon_{i,t}$$

(−)

$$\boxed{\beta_3 < 0} \qquad \mu_{i,t}$$

[a] Case 1: direction of bias due to binding constraint at t

(−)

$$\Delta d_{i,t+1} = \beta_0 + \beta_1 X_{i,t} + \beta_2 r_{i,t+1} + \beta_3 y_{i,t} + \epsilon_{i,t}$$

(−)

$$\boxed{\beta_3 > 0} \qquad \mathbb{E}_t[\mu_{i,t+1}]$$

[b] Case 2: direction of bias due to expected binding constraint at t+1

Notes: The figure plots illustration of direction of bias for binding liquidity constraints. $\Delta d_{i,t+1}$ is the expenditure growth, $y_{i,t}$ is the log income at t which is the variable of interest for liquidity constraint tests. $\mu_{i,t}$ is the Lagrange multiplier for constraint at t and $\mathbb{E}_t[\mu_{i,t+1}]$ is the expectation of Lagrange multiplier for the constraint at t+1. Lagrange multipliers are omitted in the regression. β_3 takes zero when the constraints are not binding, i.e. when multipliers are zero. When liquidity constraints are binding, multipliers are positive and correlated with both income and expenditure growth and enter into the error term. This creates omitted variable bias for β_3.

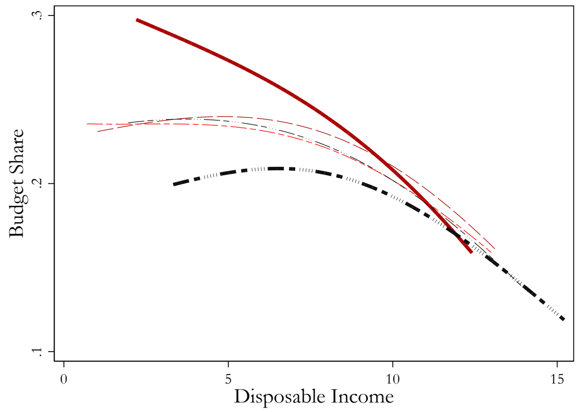
1.5 Empirical Findings

In order to motivate the divergent behavior of healthcare expenditures between heterogeneous agents compared to other consumption, I plot the Engel curves, share of consumption category in total consumption as a function of disposable income, for healthcare expenditures, non-health consumption and food consumption for each wealth quintiles. The sample is the same as the one used in the empirical analysis. The Engel curves are drawn using raw consumption shares and plotted against disposable income for each wealth quintile.

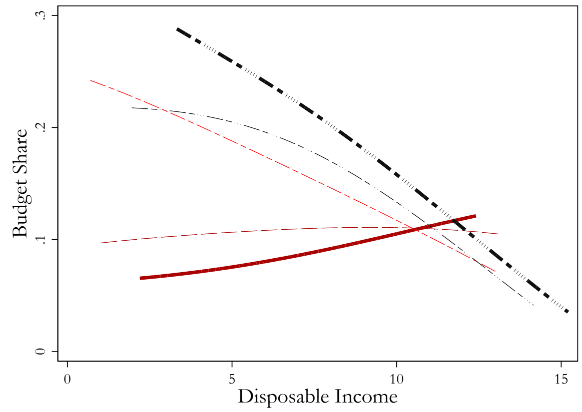
First observation is that the budget share of healthcare expenditures are very low for low wealth households, less than 10% for most households in 1st and 2nd quintiles. The share of food consumption is as high as 25-30% for very poor families. Second, the share of food consumption falls with the income for all wealth quintiles. This shows that food is a necessity for everyone. However, the behavior of healthcare expenditure differs between asset-rich and asset-poor households. While for high wealth households, it is a necessity, health care is inelastic or even slightly luxury for low wealth households as its share increases with income for the most constrained. These figures provide a first motivation for why healthcare expenditure has a differential interaction with income changes. [19]

[19] In Appendix B, I also plot Engel curves for housing, education, and transportation. The plots are very interesting for these consumption categories as they become more luxury as the incomes rise for most households. However, it is not the goal of this paper and I leave it to future work with models incorporating these expenditures as well.

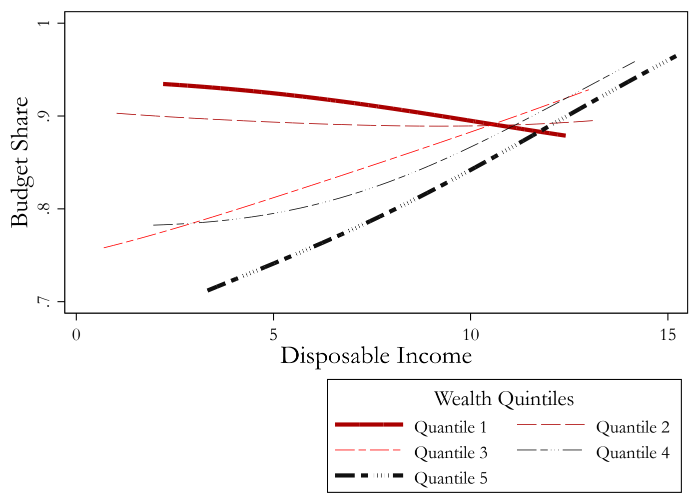
Figure 1.2: **Engel Curves: budget share as a function of disposable income**



[a] Food Expenditure Share



[b] Healthcare Expenditure Share



[c] Non-Health Expenditure Share

Notes: Engel Curves for Non-Health Expenditure, Healthcare Expenditure and Food Expenditure. The curves are expenditure shares log of consumption categories as a function of disposable income, fitted for each wealth quintile. The fits are nonparametric local linear polynomial regressions using Gaussian kernel weights and a bandwidth choice of 4. The healthcare expenditure is the sum of out-of-pocket health spending and health insurance payments of household. Food consumption includes food at home and food away from home. Non-health consumption includes food, housing, education, childcare, transportation spending of families. The data is from 1999-2015 waves of PSID, includes families with heads between 25-65 years old.

1.5.1 Results in levels

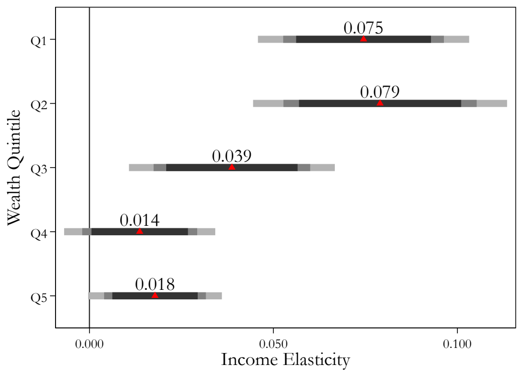
In order to give more motivation for the effect of liquidity constraints, I estimate the income elasticity of healthcare expenditures. The estimates show that the correlation between income and healthcare expenditure vary between low wealth and high wealth households.

Figure (1.3) plots the elasticity estimates for food consumption, healthcare spending and all non-health consumption and total consumption for each wealth quintile. The coefficients are plotted along with 99%, 95%, 90% confidence levels with fading colors.

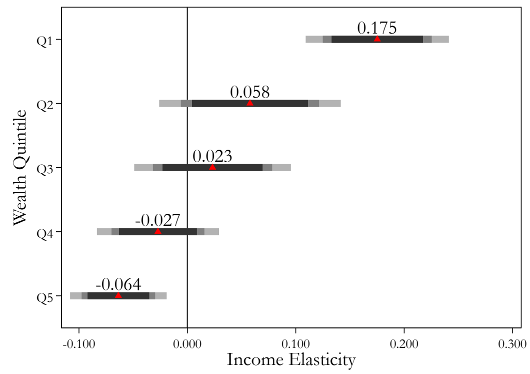
Overall, the elasticities for households in the lowest quintile are higher in magnitude for all consumption categories. In line with the theoretical and empirical findings in the literature, consumption moves with current income for constrained households. Food consumption elasticity varies between 8.2% and 2%. As is clear in panel b, the difference in elasticities of healthcare is much more stark between wealth quintiles. For the lowest quintile the elasticity is 12.5% whereas it is negative and significant for the highest quintiles with −9.5% and −9.7%.

Negative elasticity indicates that healthcare spending is an inferior consumption category. This is implausible. However, it is important to note that these estimates possibly suffer from endogeneity. The wealthier households can also be healthier and invest in preventive healthcare more when they have extra money and they can afford better insurance contracts as their income increase which makes them pay less out of pocket.

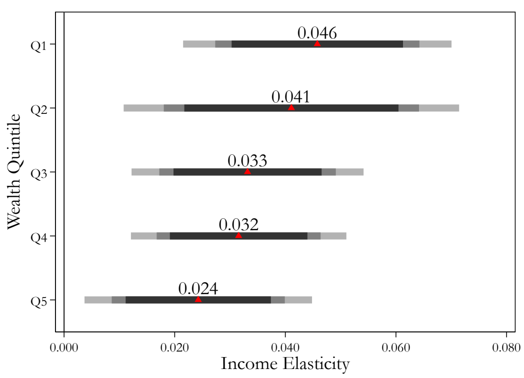
Figure 1.3: **Income elasticity of expenditures**



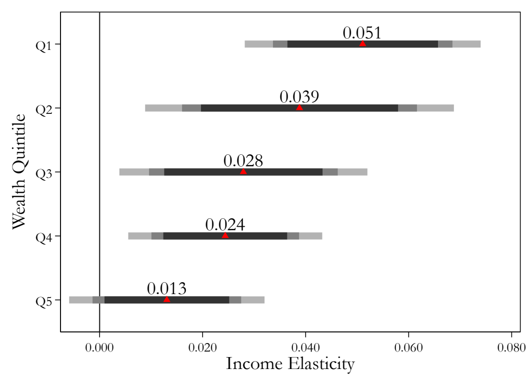
[a] Food Expenditure



[b] Healthcare Expenditure



[c] Non-health Expenditure



[d] Total Expenditure

Notes: The figure plots coefficients from regressing food consumption in panel a, healthcare spending in panel b and all non-health consumption in panel c and total consumption in panel d on log disposable income for each wealth quintiles Q1-Q5 with the upmost coefficient belonging to the first quintile. The confidence intervals are also plotted at 99%, 95%, 90% confidence levels with fading colors respectively. The regressions include all control variables as well as time and individual fixed effects.

Table 1.2: **Crowding-out effect of health status and hospitalization**

	Wealth Quintiles				
	1^{st}	2^{nd}	3^{rd}	4^{th}	5^{th}
	Dependent Variable: Food Expenditure				
Acute index	-0.039	0.044	-0.039	0.027	0.040*
	(0.043)	(0.038)	(0.036)	(0.029)	(0.021)
Chronic index	-0.032**	0.004	-0.005	-0.020	0.014
	(0.015)	(0.015)	(0.012)	(0.013)	(0.011)
Hospitalization	-0.055*	-0.032	-0.023	-0.061***	-0.006
	(0.028)	(0.023)	(0.023)	(0.020)	(0.017)
	Dependent Variable: Non-health Expenditure				
Acute index	0.019	0.046*	-0.011	-0.003	0.020
	(0.03)	(0.024)	(0.025)	(0.023)	(0.021)
Chronic index	-0.010	0.003	-0.006	-0.013	0.006
	(0.011)	(0.009)	(0.009)	(0.009)	(0.012)
Hospitalization	-0.041**	-0.012	-0.030*	0.009	-0.022
	(0.019)	(0.017)	(0.016)	(0.016)	(0.019)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Robust standard errors clustered at household level in parentheses. The table shows the coefficients of health indices and health shock from income elasticity regressions.

The elasticity regressions also reveal some crowding out the effect of health shocks and bad health into food and non-health consumption. Table (1.2) summarizes some findings of this effect. The detailed tables are presented in Appendix C.2. As seen in the table, a hospitalization shock reduces non-health consumption of the lowest quintile households significantly by 4.1% and of 3^{rd} quintile households by 3%. And a shock reduces food consumption of the lowest quintile by 5.4% and one additional chronic illness in the family reduces food consumption by 3.2%. The crowd out of hospitalization shock is also true for 4^{th} quintile households which is possibly due to more luxury food such as dining in a restaurant. Indeed, all quintiles have a negative effect of a health shock on their food spending though not all are statistically significant. In this regard, [Mohanan, 2013] reports small negative crowd out of health shocks on consumption of housing, festivals and more on education but the estimates are insignificant. He finds a significant impact of shocks on household indebtedness using a quasi-experimental design in India. I am not giving any causal interpretation to my results, however, they give a motivation for the importance of health shocks in household budget allocation.

1.5.2 Results in growths

I begin by presenting the results for sample split based on median net worth. I add $\ln Y_{i,t}$ as an extra regressor to the equation that proxy for the binding constraints. If the PIH holds, then the variations in expected after-tax real rate of return must be explaining the variations in consumption growth rates, no other variable that is already in the household's information set must have explanatory power. The results of binding liquidity constraints test are reported in Table 1.3. Column (1) gives a significant explanatory power for income for food consumption growth for low wealth households. As expected, the sign of the coefficient is negative, which is a clear indication of the binding liquidity constraints for this group.

Columns (3) and (4) show the results for healthcare expenditures. The coefficient on income variable is significantly negative for low wealth households, again it's an indication of a strong effect of binding liquidity constraints. These results correspond to Case 1 and Case 3 in the test described above. Since it is more reasonable to think that low wealth households with binding constraints would form expectations that the constraint will be binding in the next period as well, I consider Case 3 as the more plausible scenario. In this case, the negative results indicate that the binding constraint at the current period has more impact than any expectations in determining health expenditure growth. On the other hand, the results imply a very different pattern for high wealth households. The coefficient is positive and statistically significant. This corresponds to Case 2 of the test. That is, the liquidity constraints are not binding in the current period, however, these households hold expectations about future binding constraints. Note that this does not mean that the constraints are expected to bind for all expenditures nor that the households cannot afford healthcare next period. The results indicate that these households hold expectations that they may not afford more healthcare expenditure beyond the level what they are already spending in the current period, which limits their spending in the current period compared to what they could actually spend. However, as income rises, they can afford more healthcare expenditure in the next period.

Columns (5) and (6) show the results for total consumption. The results are interesting in this case, indicating a binding constraint for all households. However, since this category consists of all consumption items that is recorded in PSID, that are food, housing, transportation, education, childcare and healthcare expenditures, it is hard to interpret the findings. The housing, transportation and education categories for high wealth households possibly include more luxury type expenditures.

The expectations about future binding constraints cannot be proxied with given data, hence, I cannot further test the model including expectations.

An interesting point that is worth discussing is the estimate of intertemporal elasticity of substitution from the Euler equations. The IES is positive using food consumption, however, it is negative for healthcare expenditures though it is not significantly estimated. [Hall, 1988] also reports negative IES using aggregate data. Negative IES implies a convex utility function which cannot be the interpretation in this case since it is the service flow from health capital that enters into the utility function, not the healthcare expenditures in current period. [Hall, 1988] also draws the conclusion that the IES is not strongly positive but avoids a nonconcave utility interpretation. For IES to be negative, the substitution effect from a change in interest rates must be dominating the income effect. For example, when interest rates rise, consumers want to increase consumption due to the income effect, but also increase savings by the substitution effect. In this case, for food consumption the income effect is more operative. However, for healthcare, the fact that substitution effect dominates income effect means that although higher income makes households relatively rich for food, they do not feel rich enough to spend extra income on healthcare. Instead, they increase savings which they possibly want to use for food or other consumption in the future that bring higher marginal utility than the marginal utility of healthcare expenditures today. This situation shows the secondary role given to healthcare spending as it is relatively more luxury and it arises due to the fact that health capital enters into the utility.

Table 1.3: **Instrumental Variable Estimation of Consumption Growth**

	Food Consumption		Healthcare Expenditure		Total Consumption	
	Low Wealth (1)	High Wealth (2)	Low Wealth (3)	High Wealth (4)	Low Wealth (5)	High Wealth (6)
Ex-post rate	0.144	0.059	-0.299	-1.870	0.124	-0.520
	(0.130)	(1.043)	(0.427)	(2.778)	(0.161)	(1.013)
Current income	-0.077***	-0.010	-0.070**	0.063**	-0.038***	-0.014**
	(0.012)	(0.008)	(0.031)	(0.032)	(0.01)	(0.007)
Acute index	0.049	0.029*	0.019	0.433*	0.066**	-0.012
	(0.039)	(0.017)	(0.201)	(0.239)	(0.027)	(0.016)
Chronic index	0.01	0.012	0.043	0.143	0.005	0.0001
	(0.014)	(0.01)	(0.104)	(0.089)	(0.011)	(0.009)
Δ Acute index	0.061*	0.045***	-0.05	-0.015	0.062***	0.008
	(0.034)	(0.016)	(0.077)	(0.044)	(0.023)	(0.014)
Δ Chronic index	0.011	0.017**	0.042	0.043**	0.014*	0.005
	(0.011)	(0.008)	(0.027)	(0.02)	(0.008)	(0.007)
Hospitalization	-0.004	0.029	-0.223	-0.313*	-0.004	0.019
	(0.029)	(0.018)	(0.238)	(0.187)	(0.021)	(0.017)
Δ Hospitalization	-0.016	0.002	0.101**	0.153***	0.006	0.031**
	(0.021)	(0.014)	(0.051)	(0.040)	(0.015)	(0.013)
Household size	-0.055***	-0.053***	-0.009	-0.025	-0.058***	-0.013*
	(0.009)	(0.008)	(0.027)	(0.026)	(0.007)	(0.007)
Education	0.019**	-0.012	0.003	0.022	0.002	-0.002
	(0.01)	(0.009)	(0.031)	(0.036)	(0.007)	(0.009)
Constant	0.581	0.411	3.189	-0.907	0.763	1.267
	(1.168)	(1.029)	(3.134)	(4.152)	(0.859)	(1.117)
Age polynomial	✓	✓	✓	✓	✓	✓
Household FE	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓
N	12449	14726	12449	14726	12449	14726
R^2	0.011	0.006	0.008	0.002	0.033	0.009
Within R^2	0.023	0.014	0.021	0.01	0.043	0.024

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Robust standard errors clustered at household level in parentheses. The regressions include household specific rate of return, taste shifters as well as time and individual fixed effects. Instrument set consists of time t-1 values of the variables which are head and spouse marginal tax rates, log disposable income and average hours per week of head. A total of 21 instruments are used.

I then proceed with a finer division in order to analyze the severity of the binding constraints. Figure (1.4) shows the results for the instrumental variable regression of the liquidity constraint test for wealth quintiles.

The Euler equation test results are summarized in Figure 1.4.[a]-[c]. The figures plot the estimated coefficient on log income with 99%, 95%, and 90% level confidence intervals for each wealth quintile regressions. Figure 1.4.[a] shows the results for food consumption, Figure 1.4.[b] shows the results for out-of-pocket healthcare expenditures and Figure 1.4.[c] shows the results for total consumption.

The sign of the coefficient in food consumption is negative for 1^{st} , 2^{nd} and 3^{rd} quintiles. This is in line with the predictions of the permanent income hypothesis that if the liquidity constraints are not binding the changes in income should not be affecting consumption growth since they can be smoothed out. However, when the constraints are binding, the households cannot smooth consumption in case of an income fall, the unconstrained Euler equation is violated for these groups. Hence, an income fall will induce current consumption to be low and it is expected to grow. The inverse of this, when there is temporary income rise in the current period, the household can always save and smooth away consumption, hence there shouldn't be any change in consumption growth. This explains the negative and significant coefficient for liquidity-constrained households in this group.

In the case of healthcare expenditures, except the households in 1^{st} quintile, the coefficient on income variable is positive, indicating a positive bias and significant for the 3^{rd} and 5^{th} quintiles.

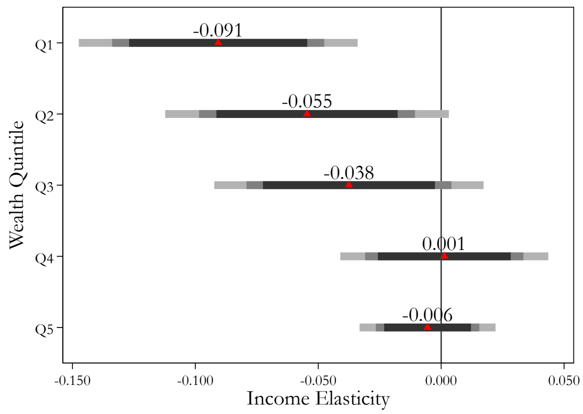
The households in 1^{st} quintile are likely to be the group in Case 3. The liquidity constraint is binding at time t which shows up as a negative bias in income variable for food consumption. Since they are very poor households, it is likely that they also expect the constraints will bind at time t+1. However, if the households are expecting the constraint to bind in period t+1, then the healthcare expenditure model predicts an ambiguity of the direction of bias. The 1^{st} quintile have a significant negative bias in healthcare expenditure growth indicating that the negative bias arising from time t constraints is so severe that it is dominating any positive bias by expectations about binding constraints in the next period.

The 2nd and 3rd quintiles likely correspond to Case 3 again. The binding constraints at t translate into a negative bias in food consumption test. Expectations about future binding constraints are also strong for these quintiles so there is a positive coefficient for healthcare. In the case nth3 quintile the result is significant.

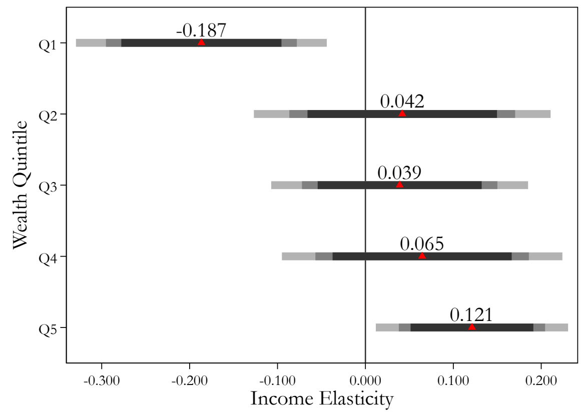
The households in 4th and 5th quintiles can be thought of the group in Case 2. The liquidity constraint is not binding at t, hence the income variable in food consumption regression does not show any bias. However, the coefficient in healthcare expenditures regression is positive, significant for 5th quintile. This indicates an expectation that the constraint might bind at time t+1.

The group in 1st, 2nd and 3rd quintiles are relatively asset-poor households that do not have enough resources for consumption and especially for healthcare expenditures. This is amplified by the unexpected nature of healthcare expenditures. There is not much 'consumption smoothing' for health-care spending as the households need to spend in the period when a negative shock hits. The difference is when the liquidity constraints are not binding, an extra income can translate into better healthcare in the current period (as the results in levels show) as well as better healthcare in the subsequent periods as the healthcare needs may be persistent and the health bills are paid over time. The households in 4th and 5th quintiles are relatively wealthy, they have enough resources for healthcare costs but may not have enough to increase these expenditures beyond the level what they are already spending.

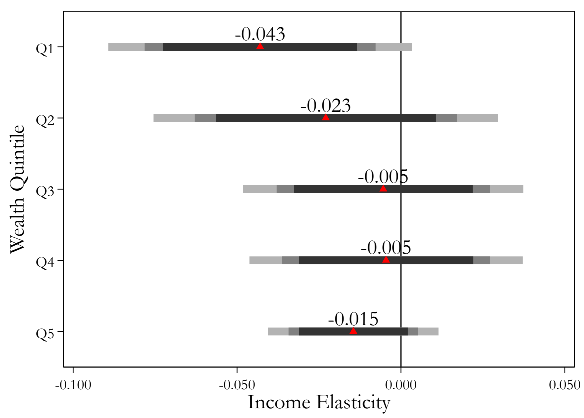
Figure 1.4: **Income elasticity of expenditure growth**



[a] Food Expenditure



[b] Healthcare Expenditure



[c] Total Expenditure

Notes: The figure plots coefficients from regressing growth of food consumption in panel a, growth of healthcare spending in panel b and growth of total consumption in panel c on disposable income for each wealth quintiles Q1-Q5 with the upmost coefficient belonging to the first quintile. The confidence intervals are also plotted at 99%, 95%, 90% confidence levels with fading colors respectively. The instrumental variable regressions include household specific rate of return, taste shifters as well as time and individual fixed effects. Instrument set consists of time t-1 values of the variables which are head and spouse marginal tax rates, log disposable income and average hours per week of head. Robust standard errors are clustered at household level.

1.5.3 Econometric Considerations

Measurement Error

The measurement error in consumption is of particular concern in empirical estimations using consumption data. For example [Runkle, 1991] finds an estimate around 76% of the variation in PSID food consumption that can be attributable to the measurement error, [Alan and Browning, 2010] finds a higher estimate of 86 % variance of noise. [20] In linearized Euler equations, the concern is alleviated by assuming a multiplicative measurement error which then enters into the residual term additively. In this regard, I follow the literature and assume that consumption is measured with a multiplicative error term $\kappa_{i,t}$. Let $C^a_{i,t}$ be actual consumption and the observed consumption data is $C_{i,t} = C^a_{i,t} * \kappa_{i,t}$. The Euler equations hold for actual level of consumption. Substituting $C^a_{i,t} = \frac{C_{i,t}}{\kappa_{i,t}}$ into $\Delta \ln C^a_{i,t+1} = \ln C^a_{i,t+1} - \ln C^a_{i,t} = \ln(\frac{C_{i,t+1}}{\kappa_{i,t+1}}) - \ln(\frac{C_{i,t}}{\kappa_{i,t}}) = \Delta \ln C_{i,t+1} - \Delta \ln \kappa_{i,t+1}$ and rearranging, the equation (1.21) can be written as;

$$\Delta \ln C_{i,t+1} = \frac{1}{\phi}\{\ln(1 + \mu'_{i,t}) + \ln \beta_i + \ln(1 + r_{i,t+1}) - \ln(1 + e'_{i,t+1}) + \Delta\Theta_{i,t+1}\} + \Delta \ln \kappa_{i,t+1}$$

The classical measurement error enters into the equation as an additive term due to log-linearization. I assume that the measurement error is stationary and independent of other regressors including lagged masurement error and expectation error as in [Alan et al., 2009]. As long as the error term is not correlated with the instruments, the classical measurement error is not a concern in linearized models. [21] Moreover, measurement error

[20] [Runkle, 1991] assumes no household fixed effects, no measurement error in $r_{i,t}$ and no random shocks to utility. Therefore his estimate can be considered as an upper bound for measurement error in consumption.

[21] As a supportive evidence for this assumption, [Alan and Browning, 2010] finds no heterogeneity in measurement error between less educated and more educated groups.

introduces an MA(1) structures to the residuals. To address these concerns, I use time t-1 values of variables as instruments. For consumption growth to be a valid instrument it must be lagged at least twice. Nevertheless, any lagged consumption growth is not used in any regressions. Similar arguments apply for measurement error in healthcare expenditures and again t-1 variables are used as instruments.

Log-linearization

Another concern arises due to log-linear approximations to dynamic Euler equations. [Ludvigson and Paxson, 2001] and [Carroll, 2001] show using simulation methods that the higher order terms omitted in linear approximations may create substantial bias in estimating the structural parameters of interest such as the coefficient of relative risk aversion, the coefficient of relative prudence and intertemporal elasticity of substitution. [Ludvigson and Paxson, 2001] uses a second order approximation to test precautionary savings motive. Their regressions of consumption growth on consumption growth squared produce prudence parameter that is biased down due to omitted third and higher moments. Instrumental variables correct some of this bias but not all since the typical instruments used in the literature are correlated with the higher order moments of the consumption growth. The approximation bias is more pronounced for households with low cash on hand relative to income as the consumption growth and variance of consumption growth are both higher for them due to their inability to smooth consumption. Hence, they appear to be less prudent because of the higher downward approximation bias. [Carroll, 2001] also verifies that the linear approximations to Euler equations yield poor estimates of structural parameters due to omitted higher order terms that are endogenous with respect to first-order terms. These papers show that the structural parameters are most of the time downward biased. They do not show how the approximation bias can invalidate the liquidity constraints test.

For the current analysis following the literature, I assumed that higher order moments that enter the approximation error in Taylor expansion are orthogonal to the information set at time t. For the liquidity constraint test, if the extra regressor is correlated with the omitted terms then the test coefficient might be showing some of these terms. In a first-order approximation, a second order term, consumption growth squared, is omitted. If low income today is associated with more consumption variance, then these terms are negatively correlated.

However, all the analysis in this paper is *relative* in the sense that I am comparing healthcare spending with food consumption in a first layer, and response of heterogeneous agents in wealth in the second layer. So if the approximation bias is interacting with the bias due to liquidity constraints for food consumption, the argument should also apply for healthcare expenditures. If we accept that in food consumption the test coefficients are downward biased due to approximation bias for all wealth groups, it is interesting to see the positive test coefficient for healthcare expenditures for high wealth group while a significant negative coefficient for low wealth group. It is implausible to think that the approximation bias is changing non-monotonically with wealth level. Based on this argument, I am assuming that the omitted higher order conditional moments are not differentially biasing healthcare expenditures between wealth groups compared to food consumption.

Misspecification

Incorporating Health Shocks Health shocks can be incorporated into the model in two ways. One way which is the one that empirical analysis implicitly assumes is to consider them as shocks to marginal utility. Then, the extension is straightforward via the taste shifter. Note that I assumed the taste shifter takes the following form:

$$\Theta_{i,t} = g_{i,t}(age_{i,t}, edu_{i,t}, size_{i,t}, race_{i,t}, marital_{i,t}, HI^a_{i,t}, HI^c_{i,t}, H^s_{i,t}) + \zeta_i + \chi_t + \nu_{i,t}$$

Taste shifter enters into the Euler equations as difference $\Delta\Theta_{i,t+1}$. Here, $H^s_{i,t}$ is a direct proxy for health shocks that ended in hospitalization. Moreover, the change in illness indexes $\Delta HI^a_{i,t}$ and $\Delta HI^c_{i,t}$ in $\Delta\Theta_{i,t+1}$ are also health shocks to the households. I use both levels and changes of health indexes and hospitalization shock as controls in empirical analysis.

An alternative way of incorporating health shocks is as an additive shock term to the health capital accumulation.

$$H_{i,t} = (1-\delta^h)H_{i,t-1} + d_{i,t} + \varepsilon^h_{i,t}$$

In this case, the idiosyncratic health shock can be considered as an medical expense shock and can be combined with health expenditure in period t by defining $\tilde{d}_{i,t} = d_{i,t} + \varepsilon^h_{i,t}$ and writing health capital process as:

$$H_{i,t} = (1-\delta^h)H_{i,t-1} + \tilde{d}_{i,t}$$

Then all the derivations apply with $\tilde{d}_{i,t}$ instead of $d_{i,t}$.

These approaches are extensively used in macro-health literature. [De Nardi et al., 2010] model healthcare related uncertainty in two ways, both as an uncertainty to health status that has a stationary Markov process which effects marginal utility of consumption, as well as a medical expense uncertainty. Similarly, [Pashchenko and Porapakkarm, 2013] incorporate medical expenses as a shock into the budget constraint and [Conesa et al., 2018] model health status as a finite state Markov process and medical expenses as a function of age and health status that determines the out-of-pocket spending of households.

Labor supply margin Another issue arises due to misspecification of the instantaneous utility function. I assumed away any complementarities between food consumption, health capital and leisure in order to simplify the model. However, the labor supply is also determined in equilibrium and affect the consumption decision as discussed in [Attanasio, 1999]. Although it is not explicitly modeled, I add average weekly hours of head, $L_{i,t}$, as an explanatory variable. In my preferred specification, I avoid using hours as a regressor due to correlation with extra omitted terms in healthcare expenditure equation. However, the results are similar in this specification and presented in Table (1.4) and Figure (1.5).

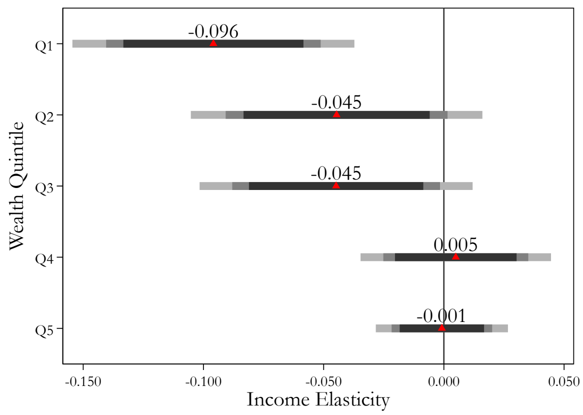
Table 1.4: **Instrumental Variable Estimation of Consumption Growth**

	Food Consumption		Healthcare Expenditures		Total Consumption	
	Low Wealth (1)	High Wealth (2)	Low Wealth (3)	High Wealth (4)	Low Wealth (5)	High Wealth (6)
Ex-post rate	0.144	-0.016	-0.304	-1.932	0.124	-0.596
	(0.130)	(1.018)	(0.430)	(2.758)	(0.161)	(0.991)
Current income	-0.077***	-0.005	-0.076**	0.059*	-0.039***	-0.013*
	(0.013)	(0.007)	(0.033)	(0.031)	(0.01)	(0.007)
Acute index	0.049	0.028	0.022	0.434*	0.067**	-0.013
	(0.04)	(0.017)	(0.20)	(0.24)	(0.027)	(0.016)
Chronic index	0.009	0.009	0.046	0.143	0.005	-0.0006
	(0.0143)	(0.009)	(0.104)	(0.088)	(0.011)	(0.009)
Δ Acute index	0.061*	0.045***	-0.049	-0.016	0.062***	0.007
	(0.034)	(0.016)	(0.077)	(0.044)	(0.023)	(0.014)
Δ Chronic index	0.011	0.016**	0.043	0.044**	0.014*	0.005
	(0.011)	(0.008)	(0.027)	(0.02)	(0.008)	(0.007)
Hospitalization	-0.0035	0.03	-0.226	-0.316*	-0.005	0.019
	(0.03)	(0.018)	(0.238)	(0.187)	(0.021)	(0.017)
Δ Hospitalization	-0.016	0.001	0.100**	0.152***	0.006	0.031**
	(0.021)	(0.014)	(0.051)	(0.04)	(0.015)	(0.013)
Household Size	-0.054***	-0.053***	-0.009	-0.025	-0.058***	-0.013*
	(0.009)	(0.008)	(0.027)	(0.026)	(0.008)	(0.007)
Education	0.0193**	-0.012	0.003	0.022	0.002	-0.002
	(0.01)	(0.009)	(0.031)	(0.036)	(0.007)	(0.009)
Hours	-0.0001	-0.002***	0.002	0.002	0.0003	-0.0004
	(0.0008)	(0.0005)	(0.0019)	(0.0016)	(0.0006)	(0.0005)
Constant	0.579	0.386	3.271	-0.896	0.776	1.269
	(1.168)	(1.033)	(3.137)	(4.154)	(0.860)	(1.117)
Age polynomial	✓	✓	✓	✓	✓	✓
Household FE	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓
N	12449	14726	12449	14726	12449	14726
R^2	0.011	0.005	0.008	0.002	0.033	0.009
Within R^2	0.023	0.014	0.021	0.010	0.043	0.022

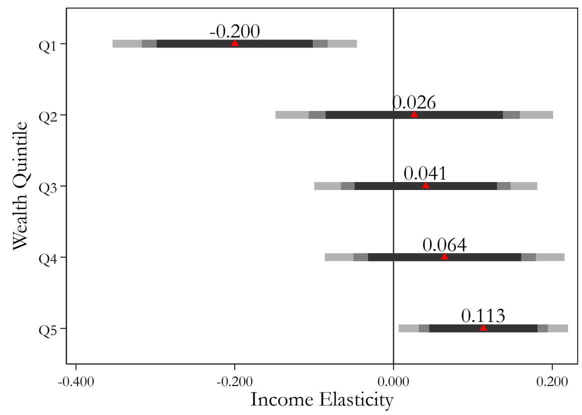
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Robust standard errors clustered at household level in parentheses. The regressions include household specific rate of return, taste shifters as well as time and individual fixed effects. Instrument set consists of time t-1 values of the variables which are head and spouse marginal tax rates, log disposable income and average hours per week of head. A total of 21 instruments are used.

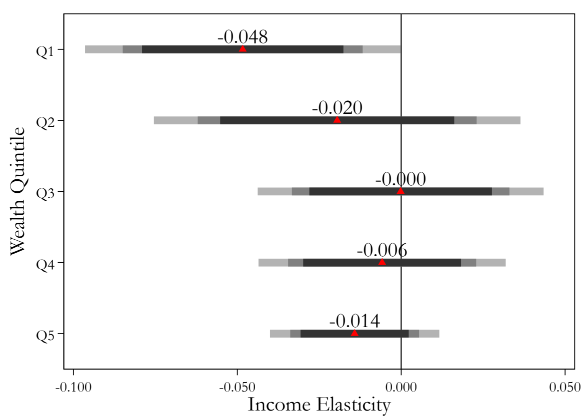
Figure 1.5: **Income elasticity of expenditure growth**



[a] Food Consumption



[b] Healthcare Expenditures



[c] Total Consumption

Notes: The figure plots coefficients from regressing growth of food consumption in panel a, growth of healthcare spending in panel b and growth of total consumption in panel c on disposable income for each wealth quintiles Q1-Q5 with the upmost coefficient belonging to the first quintile. The confidence intervals are also plotted at 99%, 95%, 90% confidence levels with fading colors respectively. The IV regressions include household specific rate of return, taste shifters as well as time and individual fixed effects. Instrument set consists of time t-1 values of the variables which are head and spouse marginal tax rates, log disposable income and average hours per week of head. Robust standard errors are clustered at household level.

1.6 Conclusion

This paper investigates the differential effect of binding liquidity constraint on healthcare expenditures compared to other consumption categories. I start by showing theoretical implications of the health capital model for the healthcare expenditures and compare it with nondurable consumption goods. In particular, I incorporate health capital in the instantaneous felicity function which has a recursive accumulation with investment in the health stock à la [Grossman, 1972]. I incorporate potentially binding liquidity constraints in the Euler equations and show the dynamics for healthcare expenditure. It is well known that the Euler equation for nondurable consumption deviates from optimal level by the binding liquidity constraints in the current period. I show that the optimal healthcare expenditure deviates from unconstrained case by two additive terms, one is the liquidity constraint in the current period similar to nondurable consumption Euler equation, and the other is the expectations about one period ahead constraints discounted by time preference and health depreciation rate unlike the nondurable case.

Then, I carry the theoretical findings into the data using the Panel Study of Income Dynamics from 1999 to 2015. I extend the liquidity constraint test by [Zeldes, 1989] and [Runkle, 1991] for the health capital model by incorporating the expectations about one period ahead binding constraints. In the standard test for nondurable consumption growth, the unobserved binding liquidity constraints lead to an omitted variable bias for an extra regressor such as current income. In the extended test for healthcare expenditure growth, there are two terms that might create omitted variable bias that are the binding constraints in the current period and expectations about binding constraints one period ahead. I show that contemporaneous binding constraints induce a negative bias on the income variable which is predicted to have no impact by PIH, whereas expectation about one period ahead binding constraints would create a positive bias. The resulting bias depends on the strength of these two opposing effects.

I apply the test separately for food consumption and healthcare spending for each wealth group. According to the test, the 1st, 2nd, and 3rd quintiles have a negative and significant bias and 4th and 5th quintiles have an insignificant coefficient for food consumption which is the most commonly used nondurable consumption in the literature. For healthcare expenditure, the lowest quintile has a negative significant bias which means that the current binding constraints are severe for this group and dominates any other effect by expected binding constraints. The higher quintiles have a positive coefficient, significant for 5th, which means that the expectations about one period ahead binding constraints dominate any effect of current binding constraints.

My analysis shows a differential impact of liquidity constraints on healthcare expenditures. The results raise questions regarding public policy. The healthcare policy interventions should be taken differently from food or other types of nondurable consumption policies and incorporate the fact that the one period ahead expectations also play an important role for the healthcare spending behaviors.

Chapter 2

Local Shocks and Healthcare Elasticities

2.1 Introduction

Estimating income elasticity of consumption has been a topic of interest for a vast literature. In general, the response of consumption to income changes has been elaborated using a variety of tools and datasets. The tools include estimating elasticities using demand systems, estimating marginal propensity to consume out of income shocks using quasi-experimental research designs, covariance restrictions or structural models. Among the consumption elasticities, healthcare expenditure elasticity stands as a very controversial one due to the inconclusiveness in the estimates, in particular whether it is above one or below one.

Estimating income elasticity of healthcare expenditure is important in many ways. The relevant policy involvements can be made once the relationship between health spending and income is well understood. In this regard the argument goes as: if the health spending is a necessity, then it is desirable to have greater public involvement in healthcare. On the other hand, if it is a luxury good, then it must be left to market forces for optimal allocation [1].

However, there are only a few studies that attempt to estimate income elasticity of health spending in micro level. The reason for this scarcity is that income is endogenous. Most individual and household level studies reveal elasticities that are only simple associations between healthcare expenditures and income. The estimates are downward biased since they do not control for unobservable factors such as health status which is correlated with both health spending and income. This issue can be an explanation for why the micro level elasticities are near zero.

This paper aims at estimating causal effect of income changes on household out-of-pocket healthcare spending. To my knowledge, this is the first paper that estimates the income elasticity of out-of-pocket healthcare expenditures at household level. The closest paper to mine is by [Tsai, 2015] who estimates income elasticities of out-of-pocket total medical costs, medical service expenses, and prescription drug expenses for the elderly population. I estimate the income elasticity of out-of-pocket health expenditures for families of working age households.

My strategy in tackling this issue is to exploit cross-regional and time series variation of employment that affected household incomes differentially across regions with varying industry mix of local economy. I use a shift-share instrumental variable design à la [Bartik, 1991] to mitigate the endogeneity concerns by exploiting variation due to local labor market exposure to aggregate shocks. As is standard in Bartik instruments, my empirical strategy exploits the interaction between changes in national employment growth in industries (a.k.a. *shifters* in "shift-share" design) and the importance of the industry in the region as an instrument for household income. The importance of the industry in a given region is proxied by regional employment share of that industry (a.k.a. *shares*

[1] see [Culyer, 1988] and [Di Matteo, 2000].

in "shift-share" design). In the baseline specification, I approximate local economies by counties. I use metropolitan statistical area (MSA) level aggregation as an alternative approximation which gives similar results. The identifying assumption is that the interaction between industry employment shares and industry growth rates should have no affect on household out-of-pocket healthcare spending, except its effect through household income. Moreover, I control for health status in a family using health indices that are calculated by summing chronic and acute illnesses for household head and spouse. These indices allow me to eliminate an important part of the endogeneity that exists in most micro studies which creates downward biased estimates.

The controversial results for income elasticity estimation arise partly due to the the level of aggregation. It is well known that as the level of aggregation increase, the estimated elasticities become larger. Healthcare is considered as highly income elastic, a 'luxury' good, due to an income elasticity above unity using aggregate data, i.e. across countries or for a country over time. However, this is inconsistent with micro data where individuals with higher incomes have a lower share of health spending. [Newhouse, 1977] finds an elasticity around 1.15 and 1.31 in a cross-country study, similarly [Leu, 1986], [Parkin et al., 1987] and [Gerdtham et al., 1992] find elasticities as high as 1.39 among OECD countries. In the intermediate level unit of analysis, [Freeman, 2003] finds elasticities around 0.817-0.844 among US states for the period 1966-1998. Similarly, [Moscone and Tosetti, 2010] analyze income elasticity of personal healthcare expenditure at state level and find elasticities less than one for most US states, and above one for only 4 states. [Acemoğlu et al., 2013] finds an elasticity around 0.7 in economic subregions (ESRs) comprised of U.S. counties level by exploiting the differential exposure of local areas to the shocks in oil prices. However, they use hospital spending as the healthcare expenditure measure. Similarly, [Di Matteo and Di Matteo, 1998] also finds a similar estimate of 0.77 in Canadian provinces. [2]

Another reason for controversial results is that the measure of healthcare expenditures vary between studies. Aggregate data, both cross-country or time series, incorporate all healthcare spending in a country. The changes in healthcare incorporate the technological advancements in the health industry over time, or technological and institutional differences across countries. Therefore, these studies are not comparable with micro studies, as the elasticities have different interpretations. Among the few micro studies, [Phelps, 2016] reports elasticities between 0 and 0.2. On the other hand, [Tsai, 2015] finds an income elasticity of 0.81 - 1.03 among the elderly population by exploiting the changes in Social Security legislation. These are the highest estimates among micro studies. [Getzen, 2000] reports summary of many elasticity estimates and shows that estimates are close to zero in studies that use individual or household level data. In micro level, data limitations as well as identification difficulties make the estimation even more inconsistent. Therefore, the income elasticity of health expenditure studies did not reach a consensus for the range of the elasticity. Most studies find an inelastic demand for healthcare in micro studies, and sometimes even report negative elasticities.

I find healthcare expenditure elasticities around 3.14 and 3.59 using household level healthcare expenditure data. These numbers mean that a 10% change in household disposable income leads to around 31 - 36% change in household out-of-pocket healthcare spending. The magnitudes are large and point that healthcare spending is very income elastic. The elasticities above one indicate that household out-of-pocket expenditure is a luxury good. These are very large numbers compared to the literature. However, my elasticities are not directly comparable with the elasticities stated in the literature since the estimates in the literature usually refer to total healthcare spending whereas I use out-of-pocket healthcare expenditures including insurance premiums paid by a family.

[2] [Liu and Chollet, 2006] provide a comprehensive review on various estimates of healthcare elasticities.

Yet, my question is important on its own because the economic burden of households' need for healthcare can be understood with the amount they are paying. The behavioral response of households to economic conditions for their health care is largely related to its effect on their budget. Moreover, I use healthcare spending by a family controlling the household size. This measure of health spending is more relevant for measuring income elasticities than individual level spending measures since consumption decisions are made at household level. I include households where household head is at working ages. The reason is that Bartik instrument proxies for local labor market conditions which is expected to have direct effects on incomes of working population rather than the retired population.

Using the same strategy for other consumption elasticities, I find an average elasticity of total household consumption in the ranges between 0.4 to 0.53 and food consumption elasticities between 0.11 to 0.2 though the latter is not significantly estimated. Overall, I conclude that the consumption bundle that a typical household has consists of necessities. In this regard, healthcare expenditure is quite different than an average consumption bundle in budget allocation decision of U.S. households.

Further, I look at the heterogeneity in healthcare expenditure elasticities with respect to wealth. I find that low wealth households have a larger elasticities that are around 3.5 - 3.7. On the other hand, high wealth households have elasticities around 2.3 to 2.9. Despite the large difference between wealth groups, the elasticities are above one for all households. Moreover, I divide the sample into US Census regions and estimate elasticities separately for each region. The high income elasticity of healthcare expenditure is observed for all regions, Midwest and West have the highest elasticities.

2.2 Empirical Strategy

The empirical model I consider is the following linear relationship between consumption growth and income growth:

$$\Delta \ln C_{i,c,t} = \beta_0 + \beta_1 \Delta \ln y_{i,c,t} + X'_{i,c,t}\beta_3 + \lambda_s + \epsilon_{i,c,t} \tag{2.1}$$

where $\Delta \ln C_{i,c,t}$ is log consumption growth of household i in location c from time t to t+1, $\Delta \ln y_{i,c,t}$ is log income growth of household i in location c from time t to t+1, $X_{i,c,t}$ is household level controls including size of the household, a quadratic in age, education, sex, race and marital status of head of the household, λ_s controls for the state of residence. This equation is the causal relationship between consumption growth and income growth that we are after.

Estimating above equation with OLS is likely to result in biased estimates due to endogeneity of income. If there are factors that are correlated with both consumption and income growth other than the control variables and state fixed effects, then β_1 will be biased. For example, consumption-labor complementarities such as work-related expenditures can create correlation between income and consumption.

For this reason, I use an instrument for income growth which plausibly isolates household level supply shocks to labor supply from demand shocks. I instrument for household income growth with local area employment using industry-level employment data from QCEW. Then, household income growth is estimated as:

$$\Delta \ln y_{i,c,t} = \theta_0 + \theta_1 \hat{E}_{c,t} + X'_{i,c,t}\theta_2 + \eta_s + u_{i,c,t} \tag{2.2}$$

This second equation is the first stage of 2SLS estimation where $\Delta \hat{E}_{c,t}$ is the Bartik measure of employment growth in location c from time t to t+1.

Bartik instrument is introduced to economic literature by Timothy [Bartik, 1991] as a measure of projected employment growth in a regional economy. The measure assumes that each industry in a region grows at its national level that is called "national shift", and weighs these growth rates by the industry's share in the regional economy which is called "regional share". This shift-share design plausibly isolates exogenous growth in employment from local endogenous factors.

The second stage in the above specification is given as;

$$\Delta \ln C_{i,c,t} = \alpha_0 + \alpha_1 \Delta \ln \hat{y}_{i,c,t} + X'_{i,c,t}\alpha_2 + \gamma_s + \nu_{i,c,t} \tag{2.3}$$

Equation 3 is the main specification that will be estimated where $\Delta \ln \hat{y}_{i,c,t}$ is estimated using the first stage in equation 2. I estimate the model with state fixed effects which uses within-state variation to estimate the coefficients.

This specification exploits the variation across households within the same state and same demographic characteristics. Household level controls account for the factors that affect household consumption that are size of the household, a quadratic in age, education, sex, race and marital status of head of the household, acute and chronic health indices that are constructed as the sum of illnesses for head and spouse, and a measure of hospitalization shock for head and spouse. The identifying assumption in 2.3 is that unobservable household characteristics are orthogonal to the regional employment growth rate conditional on household observables and state.

For an alternative specification, I also include base-year industry characteristics of the regions, namely share of manufacturing in the region in 1998 and share of tradable sectors in the region in 1998. Fixing these shares to the base year prevents a mechanical correlation with the instrument.

$$\Delta \ln C_{i,c,t} = \alpha_0 + \alpha_1 \Delta \ln \hat{y}_{i,c,t} + X'_{i,c,t}\alpha_2 + Q'_{c,1998}\alpha_3 + \gamma_s + u_{i,c,t} \tag{2.4}$$

where $Q'_{c,1998}$ is the regional industry controls. The variation in this specification comes from differences in households within the same state and same demographic characteristics and in a region with same industry composition. Therefore, the identifying assumption in 4 is that unobservable household characteristics are orthogonal to the regional employment growth rate conditional on household observables, regional industry composition and the state of residence.

I estimate the model to find average income elasticity for various household expenditures. The main coefficient of interest is β_1 in the equation for structural relationship. The dependent variable, $\Delta \ln C_{i,c,t}$, refers to either annual household food consumption, total household consumption or household out-of-pocket healthcare expenditures including insurance premium payments. I approximate local labor markets with counties in my preferred specification. I provide results for MSAs in the appendix.

Further, I estimate the model separately for low net-worth and high net-worth households to investigate the heterogeneity in elasticities with respect to wealth. Recently, [Ganong et al., 2020] show that the elasticities and marginal propensity to consume with respect to income varies with wealth and race. They calculate elasticities for all consumption using bank transaction data. I look specifically at healthcare expenditures and its variation across wealth.

2.3 Instrument Construction

I follow [Broxterman and Larson, 2020] in constructing alternative shift-share instruments. In particular, I construct three instruments using several industry mixes for employment shares and growth rates.

In all instruments, I use employment in the private sector and I aggregate industries according to 3-digits NAICS classification. I exclude the focal area employment in constructing the national shifter. This practice of excluding own area is called ”leave-one-out” procedure and is aimed at reducing endogeneity of the instrument as the highly endogenous sectors to an area's economic activity are also the ones that have high shares in local employment. Hence, this leave-one-out procedure ensures that the instrument does not suffer from endogeneity by local employment supply shocks.

In the first instrument, I use all industries in a region except public administration. The instrument is constructed by exploiting variation in industry-level employment growth rates as follows:

$$Z^{all}_{c,t-1} = \sum_{j=1}^{J} \frac{e_{c,j,t-1}}{e_{c,t-1}} \left(\frac{E_{-c,j,t} - E_{-c,j,t-1}}{E_{-c,j,t-1}} \right) \tag{2.5}$$

where $e_{c,j,t}$ is employment for location c, in industry j at time t. $E_{-c,j,t}$ is the total national employment in industry j at time t excluding employment in location c. The share, $\frac{e_{c,j,t-1}}{e_{c,t-1}}$, is defined as the ratio of local employment in industry j to all local employment, so shares in each region sum to 1 by construction: $\sum_{j=1}^{J} \frac{e_{c,j,t}}{e_{c,t}} = 1 \quad \forall j,\ \forall t$. I follow many practices in the literature on shift-share instruments by fixing shares to initial year share. Hence, $\frac{e_{c,j,t-1}}{e_{c,t-1}}$ is not updated each year and is fixed to the year 1998 ratio, $\frac{e_{c,j,98}}{e_{c,98}}$, when my data starts.

The second instrument is constructed in a similar way but includes only tradable industries. This instrument considers only export-oriented industry employment. The export-oriented industry definition is based on basic (*economic base*) activity definition of [Moretti and Thulin, 2013] who consider mining and manufacturing industries as basic activities that are export-oriented and local service activities as *non-basic*. This instrument is constructed as:

$$Z^{trd}_{c,t-1} = \sum_{j=1}^{\tilde{J}} \frac{e_{c,j,t-1}}{e_{c,t-1}} \left(\frac{E_{-c,j,t} - E_{-c,j,t-1}}{E_{-c,j,t-1}} \right) \tag{2.6}$$

where $\tilde{J}$ is a subset of J that includes only tradable industries. [Broxterman and Larson, 2020] argue that the instruments constructed omitting employment in non-traded sectors empirically perform better than instruments constructed using all employment. They show that employment in non-traded sectors have low variation across areas and are endogenous. Therefore excluding those industries that produce for mostly local consumption improves instrument relevance and reduces potential endogeneity. However, since non-traded sectors usually have high share in local economy, there is a danger of losing explanatory power by excluding them.

The third instrument separates export-oriented employment based on location quotient employment measures instead of an a priori judgement of export-orienting sectors. This instrument is constructed as follows:

$$Z^{lq}_{c,t-1} = \sum_{j=1}^{\hat{J}} \frac{e^{lq}_{c,j,t-1}}{e^{lq}_{c,j,t}} \left(\frac{E_{-c,j,t} - E_{-c,j,t-1}}{E_{-c,j,t-1}} \right) \tag{2.7}$$

where $\hat{J}$ is a subset of J that includes only export-oriented industries based on location quotient measures and $e^{lq}_{c,j,t}$ is basic or export employment based on employment location quotient for location c, in industry j at time t.

Bureau of Economic Analysis defines location quotient as: *A location quotient (LQ) is an analytical statistic that measures a region's industrial specialization relative to a larger geographic unit.* So, an employment location quotient is computed as the ratio of an industry's share of regional employment to industry's share of national employment. An LQ value greater 1 indicates that the industry is more concentrated in the region compared to its national average. Following [Broxterman and Larson, 2020], I use [Brown et al., 1992]'s assumption that excess employment compared to national average produces goods and services for exporting. Consequently, export employment based on location quotient measure is calculated as:

$$e^{lq}_{c,j,t} = \begin{cases} \left(\frac{LQ_{c,j,t}-1}{LQ_{c,j,t}}\right) e_{c,j,t} & \text{if} \quad LQ_{c,j,t} > 1 \\ 0 & \text{otherwise} \end{cases} \tag{2.8}$$

where $LQ_{c,j,t}$ employment location quotient for location c, in industry j at time t, and calculated as $LQ_{c,j,t} = \dfrac{e_{c,j,t}/e_{c,t}}{E_{j,t}/E_t} \quad \forall c, \forall j, \forall t$.

2.4 Data

Data comes from from [Panel Study of Income Dynamics, 2015] (PSID) [3]. Starting from 1968, PSID collected data on demographics, employment, asset holdings, expenditures and health factors of 5,000 U.S. households over their life course and their children (SRC sample). Later, more samples added as to represent Latino population and lower

[3]Some of the data used in this analysis are derived from Restricted Data Files of the Panel Study of Income Dynamics, obtained under special contractual arrangements designed to protect the anonymity of respondents. These data are not available from the authors. Persons interested in obtaining PSID Restricted Data Files should contact PSIDHelp@umich.edu.

income levels (Latino and SEO sample). The survey initially collected food, childcare and housing expenditures, however, after 1999 more comprehensive expenditure categories are added. The empirical analysis in the present paper incorporates all households excluding SEO and Latino samples.

The consumption data uses the aggregated consumption variables imputed by the PSID staff in the main family files. These variables span food, housing, transportation, education, childcare and health-care expenditures and their subcategories. Healthcare expenditure consists of health insurance premiums paid by household and out-of-pocket health-care spending. The wealth variable used in this analysis is all assets net of debt, including home equity. Disposable income is calculated as family unit federal taxable income minus federal, state and social security taxes plus credits. Marginal tax rates and the variables in disposable income calculations are estimated using NBER's TAXSIM simulator.

I constructed health indices using the categorization employed by [Conley and Thompson, 2011], however the index construction serves a different purpose in the sense that I construct them as a measure of family health status rather than to identify health shocks. Instead, I use the hospitalization index as a proxy for a health shock. Specifically, acute illnesses consists of stroke, heart attack, and cancer. Chronic illnesses consist of diabetes, lung disease, heart disease, psychological problems, arthritis, asthma, memory loss, and learning disorder. The index is the sum of the existence of each illness for head and spouse combined. Acute and chronic health indices indicate the state of health in the family. Hospitalization index takes values 0, 1 or 2 if either one of head or spouse (1) , both (2) or none (0) of them is hospitalized during previous calendar year.

The sample consists of families where heads are in working ages between 25-65. The health variables are constructed using head and spouse health conditions. Income, consumption and wealth variables are at the household level. I trimmed the data if food consumption grows or shrinks more than 400%. I also dropped observations if a household has a negative checking/saving account or negative stocks, which is possibly due to the imputation of wealth variables. All nominal variables are deflated to 2010 dollars using CPI-U. Food variables are deflated using food CPI and healthcare expenditure variables are deflated using medical CPI.

The PSID data for each year refers to the previous year's household expenditures, income and wealth. Therefore, I construct the geography based instruments for years 1998 to 2014 biannually. The local employment and wages data are constructed using 3-digit NAICS industry level information for both MSAs and counties, and extracted from Quarterly Census of Employment and Wages (QCEW)[4]. There are 92 3-digit NAICS industries, 1168 counties and 547 MSAs in my data. I use counties as regions in aggregating industries in shift-share instrument in the main text. MSA-level estimation results are also provided in the appendix.

Figure 2.2 provides the spatial distribution of employment growth rates across U.S. counties for 3 time periods. In all time periods, there is substantial variation of employment growth rates across counties. Panel a provides growth rates from 1998 to 2000 and panel c provides the ones for 2012-2014. These two periods have similar magnitudes of growth which are dominantly positive. Panel b provides employment growth rates for 2008-2010 which is the Great Recession period. The growth rates are negative in these years, showing the destruction of the recession on labor markets in the United States.

Figure 2.1 provides the histograms of Bartik IV constructed using employment in all industries for the same time periods as in Figure 2.2. The histograms are plots of the inner product of baseline shares and employment growth rates. The magnitudes fall mostly in the range 0 to 0.1 for 1998-2000 and 2012-2014 periods. Again, we see negative

[4]NAICS system calls 3-digit industries as "subsector" and 4-digit industries as "industry". Here, I simply call the division as industry without making any distinction between definitions.

and more dispersed magnitudes for the Great Recession period. Histograms also provide evidence that there is a lot of variation of growth rates across space and across time.

The histograms for the Bartik instruments constructed using either tradable sector employment or LQ-based employment are shown in the appendix for the same time periods. The magnitudes and signs are similar to all employment instruments, however those alternative instruments have a more dispersed distribution. This shows that most of the variation comes from export-oriented industries calculated by a priori tradable sector or LQ-based industry definitions.

Table 2.1: **County Level Correlations of alternative instruments**

	All sectors	Tradable sectors	LQ sectors
All sectors	1		
Tradable sectors	0.8711	1	
LQ sectors	0.9081	0.8231	1
Observations	28,952	28,952	28,952

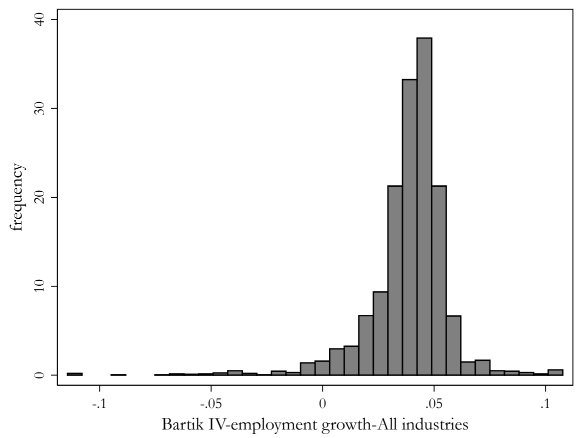
Notes: This table presents correlations between alternative constructions of Bartik instrument at county level. The dataset consists of 1168 counties across the US.

Table 2.2: **MSA Level Correlations of alternative instruments**

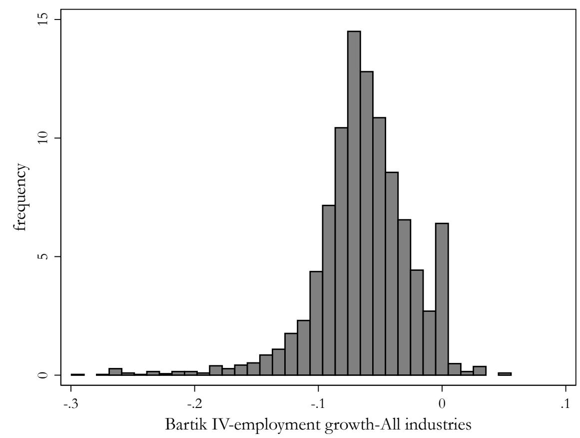
	All sectors	Tradable sectors	LQ sectors
All sectors	1		
Tradable sectors	0.9181	1	
LQ sectors	0.8739	0.8343	1
Observations	3,340	3,340	3,340

Notes: This table presents correlations between alternative constructions of Bartik instrument at MSA level. The dataset consists of 547 MSAs across the US.

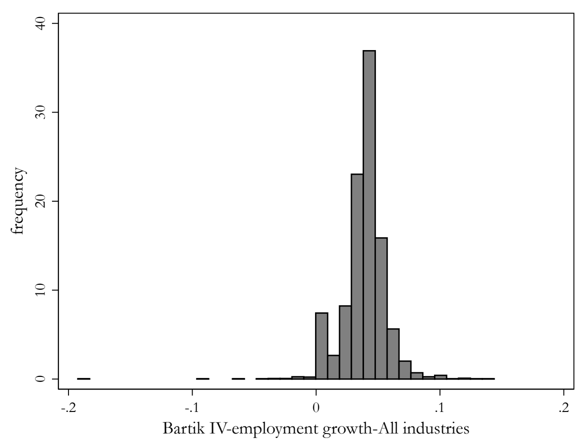
Figure 2.1: **Within-year distribution of Bartik IV for total employment growth rates**



[a] County Employment Growth 1998-2000



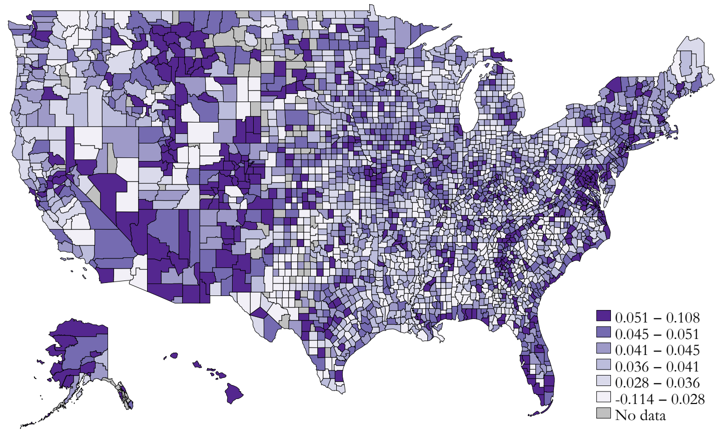
[b] County Employment Growth 2008-2010



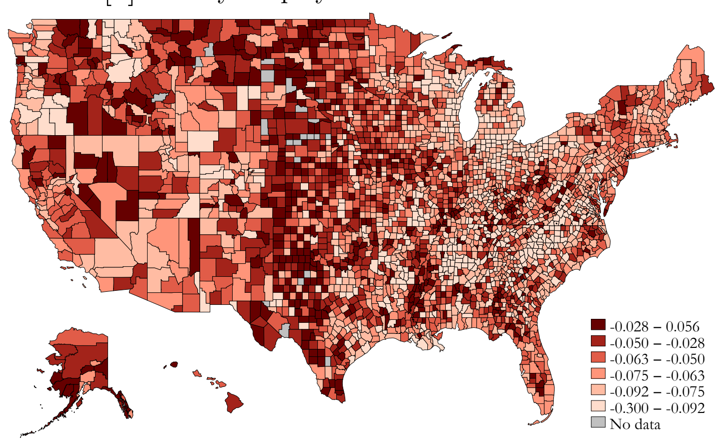
[c] County Employment Growth 2012-2014

Notes: The distribution of Bartik IV employment growth rates within each year. The IV is constructed using employment growth for all industries. The data is taken from Quarterly Census of Employment and Wages (QCEW).

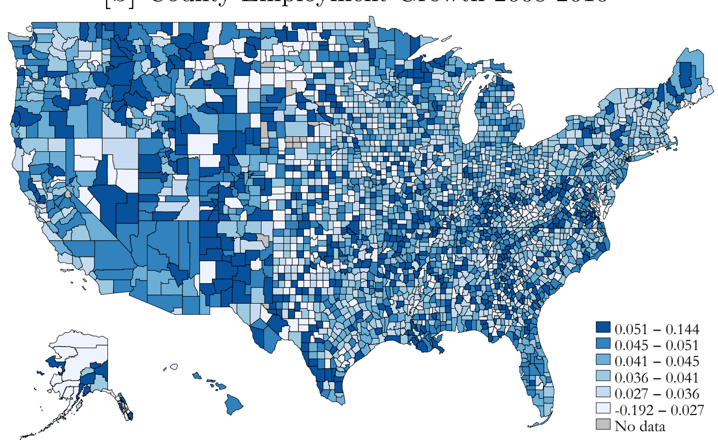
Figure 2.2: **Bartik IV of employment growth rates across time and space**



[a] County Employment Growth 1998-2000



[b] County Employment Growth 2008-2010



[c] County Employment Growth 2012-2014

Notes: Bartik IV distributions over U.S. counties. Bartik IV is constructed using employment growth for all industries. The data is taken from Quarterly Census of Employment and Wages (QCEW).

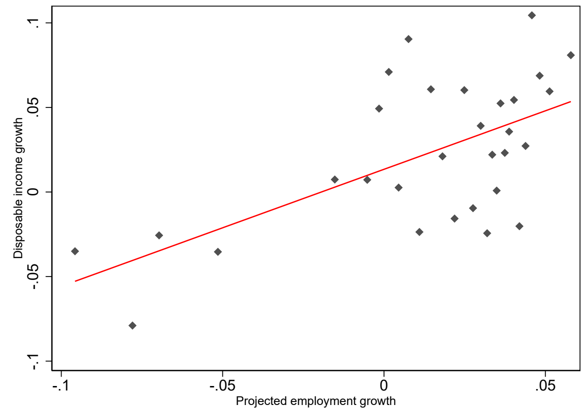
2.5 Results

2.5.1 Instrument Relevance

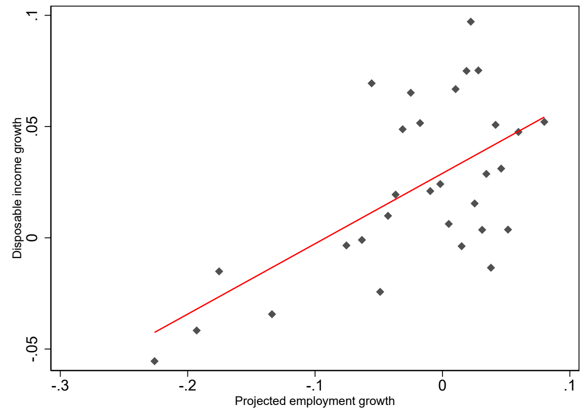
For the relevance of instruments, Figure 2.3 shows the residualized scatterplots of household disposable income growth and projected employment growth in the county that the households reside. Both variables are residuals after partialling out all the control variables. The figure shows that for all three Bartik instruments, there is positive association between the instrument and the instrumented variable. Figure 2.4 gives the residuals plotted separately for each wealth group. The positive association is observed for both groups. Overall the instruments are highly relevant for household disposable income growth which is also shown as high first stage F-tests in regression analysis. Similar results are obtained in MSA-level analysis which are shown in the appendix.

Additionally, I investigate another measure for local labor market conditions which is commonly used in constructing shift-share instruments in the literature. Namely, I use average weekly wage growth in a county from QCEW data to construct the shifter of the instrument. This instrument is not relevant and gives poor first stage results in county level. The residualized plots are provided in the appendix. This measure is subject to selection problems ,for instance, when labor markets are staggering, the average weekly wage might be increasing since the lowest wage earners are usually the first ones that lose their jobs. For this reason, I opt out using weekly wage as an instrument and continue with employment growth which is a more robust measure of labor market conditions.

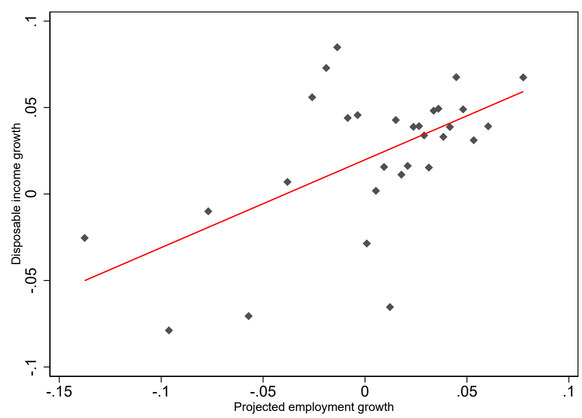
Figure 2.3: **First stage relationship**



[a] Residualized income growth and instrument of all industry employment



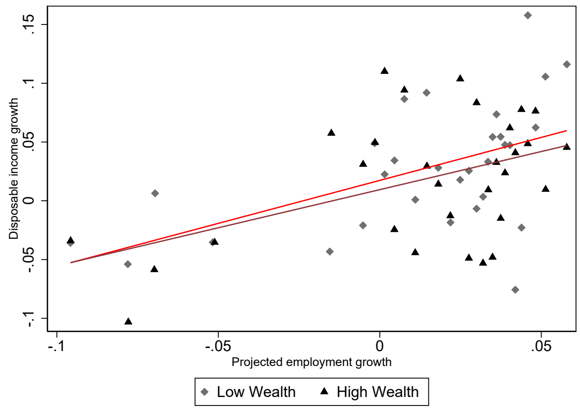
[b] Residualized income growth and instrument of tradable industry employment



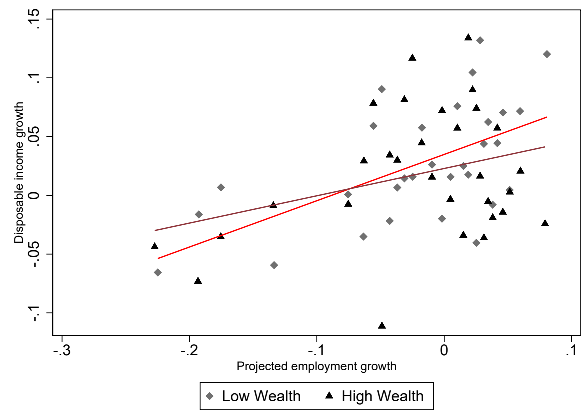
[c] Residualized income growth and instrument of LQ-based industry employment

Notes: Residual plots of projected county employment growth and household disposable income growth. Each dot is an average of 1,137 observations. The covariates in equation 4 are partialled out.

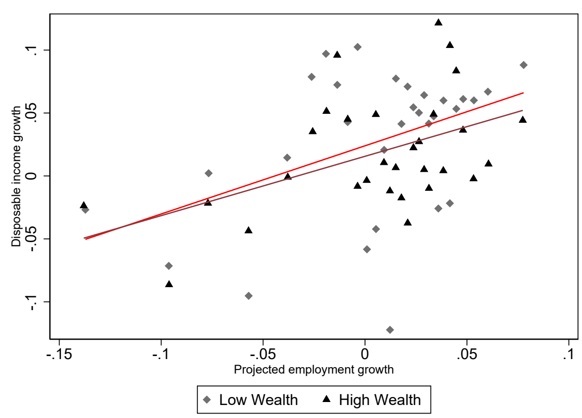
Figure 2.4: **First stage relationship across wealth**



[a] Residualized income growth and instrument of all industry employment



[b] Residualized income growth and instrument of tradable industry employment



[c] Residualized income growth and instrument of LQ-based industry employment

Notes: Residual plots of projected county employment growth and household disposable income growth. Each dot is an average of 571 observations for wealth group 1 and 566 observations for wealth group 2. The covariates in equation 4 are partialled out.

2.5.2 Outcome and Instrument Relation

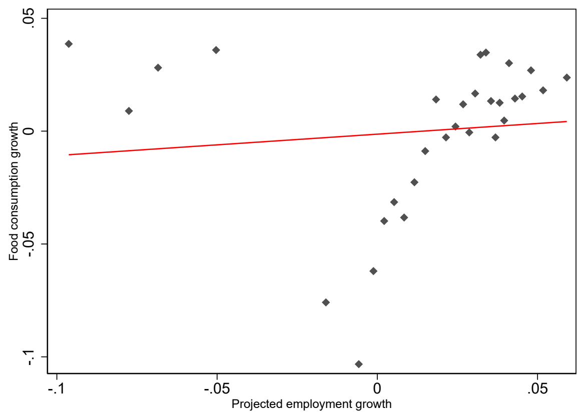
Figure 2.5, Figure 2.6 and Figure 2.7 provide the reduced form relationship between the instruments and food consumption, healthcare expenditure and total consumption, respectively.

Food consumption does not seem to have a strong correlation with the instrument when we consider all ranges of the employment growth. However, for the positive range the correlation is strong and positive.

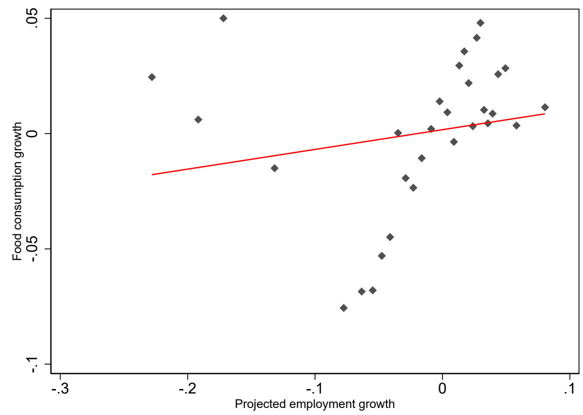
On the other hand, healthcare expenditure has a very strong positive correlation with the instruments as shown in Figure 2.6. This positive correlation seem to exist even only the positive range for employment growth is considered.

When total household consumption is considered as in Figure 2.7, the correlation is again positive in the reduced form relation, though not as strong as the healthcare-instrument relation.

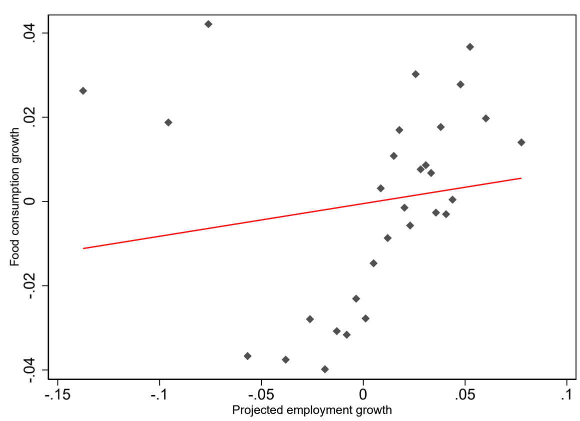
Figure 2.5: **Food consumption and instrument relation**



[a] Residualized food consumption growth and instrument of all industry employment



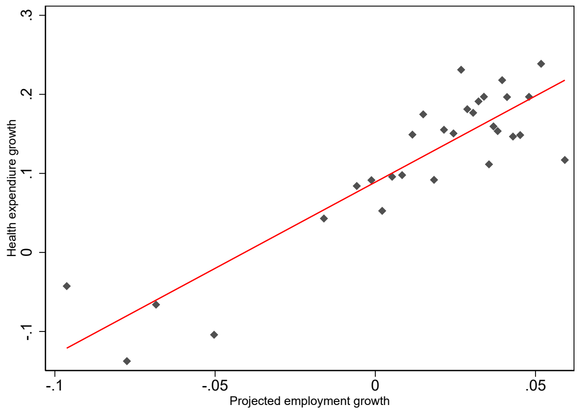
[b] Residualized food consumption growth and instrument of tradable industry employment



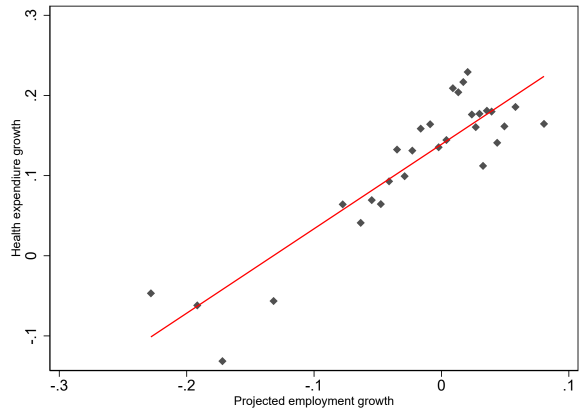
[c] Residualized food consumption growth and instrument of LQ-based industry employment

Notes: Residual plots of projected county employment growth and household food consumption growth. Each dot is an average of 1,117 observations. The covariates in equation 4 are partialled out.

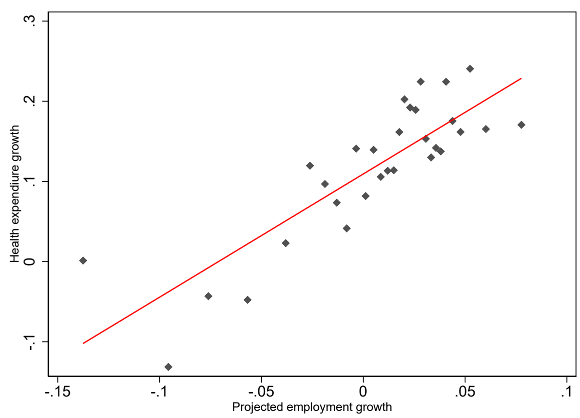
Figure 2.6: **Health spending and instrument relation**



[a] Residualized health spending growth and instrument of all industry employment



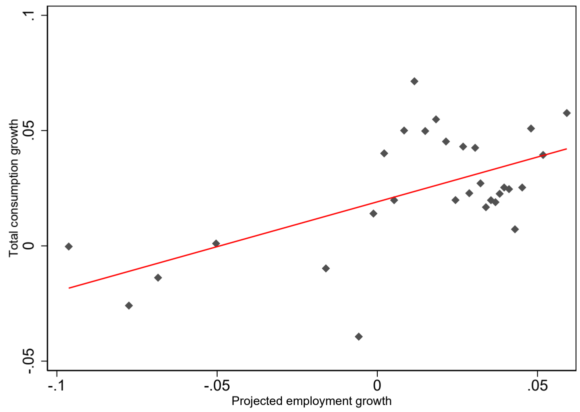
[b] Residualized health spending growth and instrument of tradable industry employment



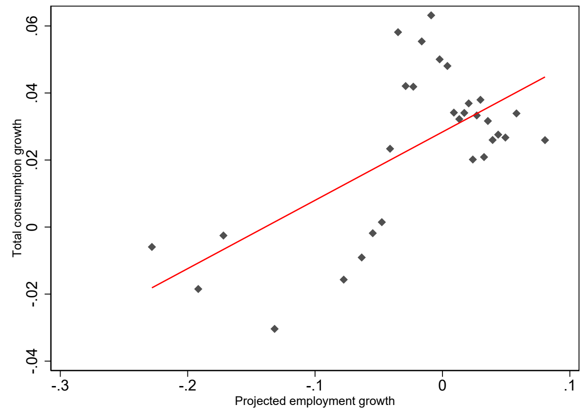
[c] Residualized health spending growth and instrument of LQ-based industry employment

Notes: Residual plots of projected county employment growth and household health spending growth. Each dot is an average of 1,117 observations. The covariates in equation 4 are partialled out.

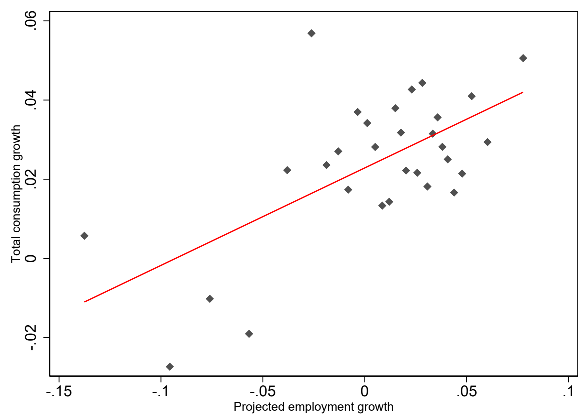
Figure 2.7: **Total expenditures and instrument relation**



[a] Residualized total expenditures growth and instrument of all industry employment



[b] Residualized total expenditures growth and instrument of tradable industry employment



[c] Residualized total expenditures growth and instrument of LQ-based industry employment

Notes: Residual plots of projected county employment growth and household total expenditures growth. Each dot is an average of 1,117 observations. The covariates in equation 4 are partialled out.

2.5.3 Average Income Elasticity of Consumption

I begin with showing OLS results. Table 2.3 shows correlation of log household income change and log consumption change. The healthcare expenditure has higher correlation to income changes compared to total consumption or food consumption. However, the correlations are much lower than one, 0.1. This is very similar to the income elasticity estimates in micro studies which are close to zero. OLS estimates are likely to be suffering from downward bias due to failing to control for many omitted variables that covary with both income and spending. For example, high income households tend to be healthier which reduces their healthcare expenditures accordingly. Moreover, high income households may have better insurance contracts which lowers their health costs in case of a medical need. Therefore, OLS estimates can at best be some correlations and can be informative qualitatively, such as comparing to other consumption-income correlations. For a quantitative understanding of income-spending relationship, an instrument is needed that can isolate the changes in income which are unrelated to omitted factors that also affect consumption growth.

Table 2.3: **OLS estimates of Income Elasticity of Expenditure**

	$\Delta Food$	$\Delta Healthcare$	$\Delta Total$	$\Delta Food$	$\Delta Healthcare$	$\Delta Total$
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta Household\ Income$	0.0510***	0.0958***	0.0448***	0.0502***	0.0946***	0.0446***
	(0.00387)	(0.00862)	(0.00321)	(0.00371)	(0.00895)	(0.00338)
$Manufacturing\ share$ 1998				-0.00425	-0.00996	0.0000661
				(0.00679)	(0.0213)	(0.00513)
$Tradable\ share$ 1998				0.0170	-0.0861	0.00608
				(0.0199)	(0.0551)	(0.0193)
$Constant$	1.089***	0.888***	1.032***	0.0867	0.773	0.462**
	(0.0329)	(0.0674)	(0.0230)	(0.205)	(0.569)	(0.209)
Household controls	✓	✓	✓	✓	✓	✓
State FE	✓	✓	✓	✓	✓	✓
Observations	34324	34324	34324	34001	34001	34001

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table presents estimates of the change in log income on the change in log expenditure for food, healthcare and total household consumption. Healthcare expenditure includes out-of-pocket health spending and insurance premiums paid by the household. Household level control variables comprise size of the household, a quadratic in age, education, sex, race and marital status of head of the household, acute health index, chronic health index and hospitalization index. State fixed effects are also included. Columns 4-6 adds industry characteristics in the region to the covariates, namely manufacturing industry share and tradable industry share. Region is approximated as U.S. counties. Robust standard errors are clustered at state level.

I continue with elasticity estimations using constructed Bartik instruments. I use all three Bartik instruments constructed using all or subcategory of industries for employment growth. Table 2.4 gives the results of 2SLS estimates of equations 2.3 and 2.4 with the Bartik instrument constructed as in equation 2.5 (employment in all sectors). Columns 1-3 are the estimates for specification 2.3 without using base-year industry controls. Columns 4-6 add base year industry composition control variables, manufacturing employment share and tradable sector employment share. Food consumption growth has a low elasticity around 0.1 which is not significantly differentiated from zero. Total household expenditure has an elasticity around 0.4, which means that a 10% change in disposable income leads to a 4% change in average household consumption. These elasticities indicate that an overall consumption bundle is composed of mostly income-inelastic good, i.e. necessities. On the other hand, healthcare expenditures have an elasticity around 3.1 in both specifications and it is very significantly estimated. A 10% change in disposable income leads to 31% change in household healthcare expenditures. The healthcare expenditure in the data consists of household out-of-pocket healthcare spendings plus the insurance premiums paid by the household. Elasticities higher than one indicate that the good is a luxury. In this regard, my PSID sample for 1999-2015 waves composes of households who have a high elasticity to changes in household income driven by the local area labor market conditions and for whom the healthcare spending can be regarded as luxury. Adding industry composition controls do not seem to have a significant impact on the results.

Table 2.5 and Table 2.6 show the results for estimations using Bartik instruments in equation 2.6 (tradable industries) and equation 2.7 (LQ-based industries). The results are similar in both cases. The income elasticity of health spending is 3.3 using tradable sectors to construct the instrument and the elasticity is 3.1 using location quotients for instrument construction. Overall, the estimated elasticities are very similar across alternative specification and they all point to a very high income sensitivity for out-of-pocket healthcare expenditures. The IV estimates are quite large compared to OLS estimates. The OLS estimates suffer from downward bias even when I control for health status in the family with the health indices I constructed for household heads and their spouses.

It is useful to give a sense of these elasticities in dollar terms. Average annual household disposable income in my sample is \$46,365 and the median absolute deviation of disposable income is \$18,778. The size of a median absolute deviation decline in annual disposable income will lead to a decline of \$9,032 in annual household consumption. The corresponding decline in healthcare expenditures would be \$57,686 which would effectively mean zero health spending since average healthcare expenditures are \$5,769.

Table 2.4: **2SLS estimates of Income Elasticity of Expenditure with Bartik IV all employment**

	$\Delta Food$	$\Delta Healthcare$	$\Delta Total$	$\Delta Food$	$\Delta Healthcare$	$\Delta Total$
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta Household\ Income$	0.111	3.142***	0.477***	0.114	3.072***	0.481***
	(0.112)	(0.593)	(0.120)	(0.111)	(0.571)	(0.118)
$Manufacturing\ share$ 1998				-0.0176	0.102	0.0419
				(0.0334)	(0.183)	(0.0454)
$Tradable\ share$ 1998				0.0246	-0.223	-0.0299
				(0.0321)	(0.157)	(0.0409)
$Constant$	0.0991	-2.497***	0.0479	0.0888	-2.387***	0.0483
	(0.230)	(0.787)	(0.231)	(0.228)	(0.754)	(0.227)
Household controls	✓	✓	✓	✓	✓	✓
State FE	✓	✓	✓	✓	✓	✓
Observations	34129	34129	34129	34056	34056	34056
First stage F-test	945.01	945.01	945.01	1511.83	1511.83	1511.83
First stage t-test on excluded IV	6.00	6.00	6.00	6.07	6.07	6.07

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table presents estimates of the change in log income on the change in log expenditure for food, healthcare and total household consumption using projected employment growth in the region as an instrument. Employment growth is constructed using employment in all industries. Region is approximated as U.S. counties. Healthcare expenditure includes out-of-pocket health spending and insurance premiums paid by the household. Household level control variables comprise size of the household, a quadratic in age, education, sex, race and marital status of head of the household, acute health index, chronic health index and hospitalization index. State fixed effects are also included. Columns 4-6 adds industry characteristics in the region to the covariates, namely manufacturing industry share and tradable industry share. Robust standard errors are clustered at state level.

Table 2.5: **2SLS estimates of Income Elasticity of Expenditure with Bartik IV tradable employment**

	$\Delta Food$	$\Delta Healthcare$	$\Delta Total$	$\Delta Food$	$\Delta Healthcare$	$\Delta Total$
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta Household\ Income$	0.195	3.293***	0.513***	0.198	3.357***	0.530***
	(0.123)	(0.721)	(0.139)	(0.129)	(0.757)	(0.146)
$Manufacturing\ share$ 1998				0.000499	0.0485	0.0122
				(0.0115)	(0.0668)	(0.0119)
$Tradable\ share$ 1998				0.00939	-0.212*	-0.0167
				(0.0219)	(0.122)	(0.0271)
$Constant$	0.0153	-2.647***	0.0125	0.00992	-2.653***	-0.000585
	(0.229)	(0.876)	(0.240)	(0.230)	(0.899)	(0.242)
Household controls	✓	✓	✓	✓	✓	✓
State FE	✓	✓	✓	✓	✓	✓
Observations	34129	34129	34129	33880	33880	33880
First stage F-test	923.69	923.69	923.69	971.90	971.90	971.90
First stage t-test on excluded IV	5.13	5.13	5.13	5.08	5.08	5.08

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table presents estimates of the change in log income on the change in log expenditure for food, healthcare and total household consumption using projected employment growth in the region as an instrument. Employment growth is constructed using employment in tradable industries. Region is approximated as U.S. counties. Healthcare expenditure includes out-of-pocket health spending and insurance premiums paid by the household. Household level control variables comprise size of the household, a quadratic in age, education, sex, race and marital status of head of the household, acute health index, chronic health index and hospitalization index. State fixed effects are also included. Columns 4-6 adds industry characteristics in the region to the covariates, namely manufacturing industry share and tradable industry share. Robust standard errors are clustered at state level.

Table 2.6: **2SLS estimates of Income Elasticity of Expenditure with Bartik IV LQ employment**

	$\Delta Food$	$\Delta Healthcare$	$\Delta Total$	$\Delta Food$	$\Delta Healthcare$	$\Delta Total$
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta Household\ Income$	0.127	3.084***	0.405***	0.131	3.015***	0.413***
	(0.120)	(0.629)	(0.113)	(0.122)	(0.609)	(0.114)
$Manufacturing\ share$ 1998				-0.00297	0.0361	0.00587
				(0.00770)	(0.0419)	(0.00737)
$Tradable\ share$ 1998				0.0136	-0.210**	-0.00948
				(0.0213)	(0.104)	(0.0244)
$Constant$	0.0825	-2.440***	0.120	0.0751	-2.315***	0.115
	(0.239)	(0.808)	(0.232)	(0.238)	(0.785)	(0.230)
Household controls	✓	✓	✓	✓	✓	✓
State FE	✓	✓	✓	✓	✓	✓
Observations	34129	34129	34129	34001	34001	34001
First stage F-test	891.25	891.25	891.25	101.62	101.62	101.62
First stage t-test on excluded IV	5.63	5.63	5.63	5.67	5.67	5.67

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table presents estimates of the change in log income on the change in log expenditure for food, healthcare and total household consumption using projected employment growth in the region as an instrument. Employment growth is constructed using employment in LQ-based industries. Region is approximated as U.S. counties. Healthcare expenditure includes out-of-pocket health spending and insurance premiums paid by the household. Household level control variables comprise size of the household, a quadratic in age, education, sex, race and marital status of head of the household, acute health index, chronic health index and hospitalization index. State fixed effects are also included. Columns 4-6 adds industry characteristics in the region to the covariates, namely manufacturing industry share and tradable industry share. Robust standard errors are clustered at state level.

2.5.4 Heterogeneity in Elasticities

Heterogeneity across wealth

Now, I turn to the heterogeneity in consumption elasticities. There is ample evidence that the elasticities vary with many demographic characteristics such as age, race, income and wealth. I look at the heterogeneity in expenditure elasticities with respect to wealth. I divide the sample into two groups with respect to the net worth of households.

Table 2.7 gives the OLS estimates separately for wealth groups. Again, the estimates are much lower than one for both groups. The correlations between health spending and income are 0.17 for low wealth and 0.01 for high wealth households. Low wealth households have higher correlation between consumption and disposable income for low wealth households compared to high wealth households.

Table 2.8 shows the elasticity estimates for expenditure using Bartik instrument constructed as in equation 2.4 with all industry employment. Table 2.9 and Table 2.10 show the estimates using Bartik instruments with tradable industry employment and LQ-based industry employment, respectively.

Total consumption elasticities are similar across wealth, 0.492 for low wealth households and 0.463 for high wealth households. In dollar terms, a decline of an average median deviation of household income of $18,778 will lead to a decline of $9,238 of total consumption for low wealth group, and $8,694 for high wealth group.

The health spending results indicate that low wealth households exhibit a higher elasticity of healthcare expenditure compared to high wealth households. The health spending elasticity estimates for low wealth group varies between 3.5 and 3.7, whereas high wealth group have elasticities around 2.3 and 2.9. On the other hand, total consumption elasticity is in general higher in high wealth group although the estimates are very close for both groups. It is likely that high wealth group has higher share of luxury goods in their consumption bundle. Therefore, the results for total consumption is not really comparable due to possibly different consumption mixes. The results are similar when baseline industry composition of regions is controlled for.

A related point about income elasticities is that high wealth households seem to have higher total consumption elasticity compared to low wealth households when income is instrumented for. This is again possibly a difference mix of consumption bundle which has higher luxury type spending for wealthier households.

Another observation is that dividing sample creates some precision loss in Table 2.8 such that the healthcare expenditure elasticity for low wealth group is not precisely estimated. This problem does not arise in Tables 2.9 and 2.10 when subcategories of industries are used in instrument construction. This is possibly because of the higher noise in all employment instrument as it is already shown in histograms that most variation across industries come from tradable/LQ-based industries. Again, the baseline industry composition does not seem to matter for consumption patterns of either wealth group.

Table 2.7: **OLS estimates of Income Elasticity of Expenditure**

	$\Delta Food\ Consumption$		$\Delta Healthcare\ Expenditures$		$\Delta Total\ Consumption$		$\Delta Food\ Consumption$		$\Delta Healthcare\ Expenditures$		$\Delta Total\ Consumption$	
	Low Wealth (1)	High Wealth (2)	Low Wealth (3)	High Wealth (4)	Low Wealth (5)	High Wealth (6)	Low Wealth (7)	High Wealth (8)	Low Wealth (9)	High Wealth (10)	Low Wealth (11)	High Wealth (12)
$\Delta Household\ Income$	0.0720***	0.0261***	0.167***	0.0131	0.0611***	0.0254***	0.0714***	0.0256***	0.165***	0.0130	0.0614***	0.0248***
	(0.00600)	(0.00520)	(0.0153)	(0.0138)	(0.00420)	(0.00448)	(0.00582)	(0.00526)	(0.0159)	(0.0138)	(0.00443)	(0.00454)
$Manufacturing\ share$ 1998							0.00202	-0.00990	-0.0421	0.0261	0.000856	0.00162
							(0.0148)	(0.00790)	(0.0285)	(0.0218)	(0.00929)	(0.00886)
$Tradable\ share$ 1998							0.0250	-0.00426	-0.0487	-0.152*	0.0195	-0.0271
							(0.0319)	(0.0251)	(0.0769)	(0.0860)	(0.0221)	(0.0330)
$Constant$	1.061***	-0.509***	1.170**	-0.289	1.846***	-0.204	1.121***	0.150**	1.096***	-0.173	1.015***	-0.0139
	(0.0734)	(0.0860)	(0.448)	(0.826)	(0.0444)	(0.213)	(0.0488)	(0.0635)	(0.151)	(0.144)	(0.0406)	(0.0615)
Household controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
State FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Observations	17229	17095	17229	17095	17229	17095	17084	16917	17084	16917	17084	16917

Robust standard errors are clustered at state level.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table presents estimates of the change in log income on the change in log expenditure for food, healthcare and total household consumption separately for low and high wealth households. The wealth variable used in this analysis is all assets net of debt, including home equity. Healthcare expenditure includes out-of-pocket health spending and insurance premiums paid by the household. Household level control variables comprise size of the household, a quadratic in age, education, sex, race and marital status of head of the household, acute health index, chronic health index and hospitalization index. State fixed effects are also included. Columns 7-12 adds industry characteristics in the region to the covariates, namely manufacturing industry share and tradable industry share. Region is approximated as U.S. counties. Robust standard errors are clustered at state level.

Table 2.8: **2SLS estimates of Income Elasticity of Expenditure with Bartik IV all employment**

	$\Delta Food\ Consumption$		$\Delta Healthcare\ Expenditures$		$\Delta Total\ Consumption$		$\Delta Food\ Consumption$		$\Delta Healthcare\ Expenditures$		$\Delta Total\ Consumption$	
	Low Wealth (1)	High Wealth (2)	Low Wealth (3)	High Wealth (4)	Low Wealth (5)	High Wealth (6)	Low Wealth (7)	High Wealth (8)	Low Wealth (9)	High Wealth (10)	Low Wealth (11)	High Wealth (12)
$\Delta Household\ Income$	0.0755	0.151	3.758	2.349*	0.489***	0.459***	0.0910	0.139	3.636	2.337*	0.492***	0.463***
	(0.154)	(0.148)	(1.176)	(0.634)	(0.166)	(0.149)	(0.151)	(0.151)	(1.124)	(0.637)	(0.164)	(0.149)
$Manufacturing\ share$ 1998							-0.00565	-0.0198	0.146	0.0768	0.0318	0.0674
							(0.0588)	(0.0466)	(0.356)	(0.282)	(0.0576)	(0.0695)
$Tradable\ share$ 1998							0.0320	0.00341	-0.421	-0.0520	-0.0304	-0.0481
							(0.0498)	(0.0467)	(0.327)	(0.242)	(0.0516)	(0.0592)
$Constant$	0.613***	-0.509***	-3.564**	-1.137	0.263	-0.184	0.582***	-0.503***	-3.317**	-1.139	0.262	-0.174
	(0.219)	(0.105)	(1.619)	(0.765)	(0.258)	(0.206)	(0.214)	(0.110)	(1.512)	(0.780)	(0.248)	(0.209)
Household controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
State FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Observations	17146	16983	17146	16983	17146	16983	17108	16948	17108	16948	17108	16948
First stage F-test	77.00	498.21	77.00	498.21	77.00	498.21	144.43	497.68	144.43	497.68	144.43	497.68
First stage t-test on excluded IV	3.66	3.08	3.66	3.08	3.66	3.08	3.79	3.04	3.79	3.04	3.79	3.04

Robust standard errors are clustered at state level.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table presents estimates of the change in log income on the change in log expenditure for food, healthcare and total household consumption separately for low and high wealth households using projected employment growth in the region as an instrument. Employment growth is constructed using employment in all industries. Region is approximated as U.S. counties. The wealth variable used in this analysis is all assets net of debt, including home equity. Healthcare expenditure includes out-of-pocket health spending and insurance premiums paid by the household. Household level control variables comprise size of the household, a quadratic in age, education, sex, race and marital status of head of the household, acute health index, chronic health index and hospitalization index. State fixed effects are also included. Columns 7-12 adds industry characteristics in the region to the covariates, namely manufacturing industry share and tradable industry share. Robust standard errors are clustered at state level.

Table 2.9: **2SLS estimates of Income Elasticity of Expenditure with Bartik IV tradable employment**

	$\Delta Food\ Consumption$		$\Delta Healthcare\ Expenditures$		$\Delta Total\ Consumption$		$\Delta Food\ Consumption$		$\Delta Healthcare\ Expenditures$		$\Delta Total\ Consumption$	
	Low Wealth	High Wealth	Low Wealth	High Wealth	Low Wealth	High Wealth	Low Wealth	High Wealth	Low Wealth	High Wealth	Low Wealth	High Wealth
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
$\Delta Household\ Income$	0.169	0.228	3.505***	2.955***	0.468***	0.598**	0.171	0.229	3.620***	2.970***	0.483***	0.615**
	(0.147)	(0.193)	(1.119)	(1.122)	(0.157)	(0.256)	(0.156)	(0.190)	(1.221)	(1.083)	(0.170)	(0.251)
$Manufacturing\ share$ 1998							0.00314	-0.00398	0.103	-0.00833	0.0129	0.00727
							(0.0226)	(0.0118)	(0.122)	(0.104)	(0.0206)	(0.0224)
$Tradable\ share$ 1998							0.0206	-0.00538	-0.443*	0.0512	-0.0269	0.00174
							(0.0351)	(0.0300)	(0.255)	(0.193)	(0.0401)	(0.0510)
$Constant$	0.493**	-0.550***	-3.238**	-1.460	0.291	-0.258	0.484**	-0.551***	-3.268**	-1.492	0.274	-0.266
	(0.213)	(0.116)	(1.510)	(0.903)	(0.237)	(0.229)	(0.218)	(0.119)	(1.575)	(0.925)	(0.243)	(0.237)
Household controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
State FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Observations	17146	16983	17146	16983	17146	16983	17035	16845	17035	16845	17035	16845
First stage F-test	75.40	475.99	75.40	475.99	75.40	475.99	136.74	4072.07	136.74	4072.07	136.74	4072.07
First stage t-test on excluded IV	3.69	2.14	3.69	2.14	3.69	2.14	3.51	2.25	3.51	2.25	3.51	2.25

Robust standard errors are clustered at state level.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table presents estimates of the change in log income on the change in log expenditure for food, healthcare and total household consumption separately for low and high wealth households using projected employment growth in the region as an instrument. Employment growth is constructed using employment in tradable industries. Region is approximated as U.S. counties. The wealth variable used in this analysis is all assets net of debt, including home equity. Healthcare expenditure includes out-of-pocket health spending and insurance premiums paid by the household. Household level control variables comprise size of the household, a quadratic in age, education, sex, race and marital status of head of the household, acute health index, chronic health index and hospitalization index. State fixed effects are also included. Columns 7-12 adds industry characteristics in the region to the covariates, namely manufacturing industry share and tradable industry share. Robust standard errors are clustered at state level.

Table 2.10: **2SLS estimates of Income Elasticity of Expenditure with Bartik IV LQ employment**

	$\Delta Food\ Consumption$		$\Delta Healthcare\ Expenditures$		$\Delta Total\ Consumption$		$\Delta Food\ Consumption$		$\Delta Healthcare\ Expenditures$		$\Delta Total\ Consumption$	
	Low Wealth (1)	High Wealth (2)	Low Wealth (3)	High Wealth (4)	Low Wealth (5)	High Wealth (6)	Low Wealth (7)	High Wealth (8)	Low Wealth (9)	High Wealth (10)	Low Wealth (11)	High Wealth (12)
$\Delta Household\ Income$	0.109	0.143	3.743***	2.314***	0.432**	0.379**	0.135	0.110	3.641	2.305	0.455	0.364**
	(0.152)	(0.173)	(1.239)	(0.672)	(0.171)	(0.154)	(0.159)	(0.184)	(1.219)	(0.663)	(0.177)	(0.158)
$Manufacturing\ share$ 1998							0.00439	-0.0107	0.0874	0.00457	0.0155	-0.00157
							(0.0165)	(0.00767)	(0.0819)	(0.0446)	(0.0144)	(0.00971)
$Tradable\ share$ 1998							0.0180	0.000614	-0.435*	-0.0199	-0.0242	-0.00753
							(0.0334)	(0.0255)	(0.246)	(0.143)	(0.0410)	(0.0406)
$Constant$	0.570***	-0.504***	-3.545**	-1.119	0.337	-0.142	0.530**	-0.487***	-3.292**	-1.113	0.312	-0.128
	(0.219)	(0.120)	(1.705)	(0.764)	(0.248)	(0.211)	(0.224)	(0.127)	(1.620)	(0.793)	(0.247)	(0.219)
Household controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
State FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Observations	17146	16983	17146	16983	17146	16983	17084	16917	17084	16917	17084	16917
First stage F-test	74.30	493.39	74.30	493.39	74.30	493.39	223.55	438.40	223.55	438.40	223.55	438.40
First stage t-test on excluded IV	3.41	2.78	3.41	2.78	3.41	2.78	3.41	2.80	3.41	2.80	3.41	2.80

Robust standard errors are clustered at state level.

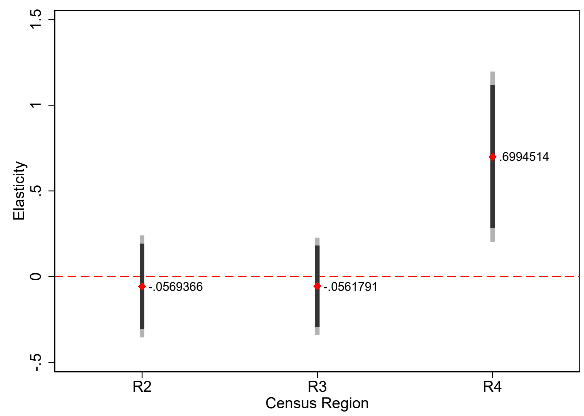
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table presents estimates of the change in log income on the change in log expenditure for food, healthcare and total household consumption separately for low and high wealth households using projected employment growth in the region as an instrument. Employment growth is constructed using employment in LQ-based industries. Region is approximated as U.S. counties. The wealth variable used in this analysis is all assets net of debt, including home equity. Healthcare expenditure includes out-of-pocket health spending and insurance premiums paid by the household. Household level control variables comprise size of the household, a quadratic in age, education, sex, race and marital status of head of the household, acute health index, chronic health index and hospitalization index. State fixed effects are also included. Columns 7-12 adds industry characteristics in the region to the covariates, namely manufacturing industry share and tradable industry share. Robust standard errors are clustered at state level.

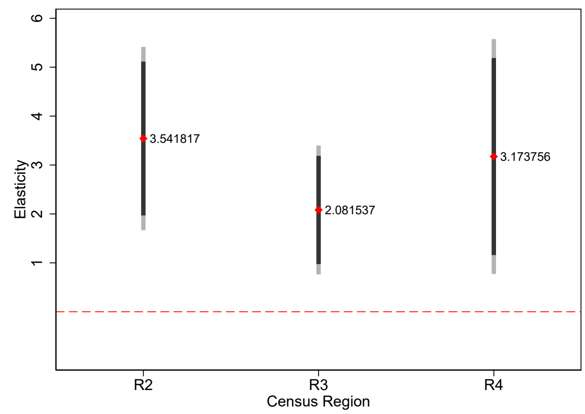
Heterogeneity across space

I estimate elasticities separately for each US Census regions. These regions may exhibit different dynamics since the labor markets and industries across regions vary. Therefore, it is more relevant to compare counties within a region where the industry structure is more similar. Figure 2.8 shows the coefficient estimates of instrumented disposable income on expenditures with 95% and 90% confidence intervals. Region 1, Northwest, results are omitted since the estimates are very noisy and have huge confidence intervals. The elasticities for remaining three regions indicate that there is significant heterogeneity across Census regions. The income elasticity of household out-of-pocket healthcare expenditure is 2.08 in South, 3.17 in West and 3.54 in Midwest. These numbers correspond to 21%, 32% and 35% change in health spending respectively when income changes by 10%. The elasticities are much greater than one in all regions. Therefore, the income-elastic nature of healthcare expenditure is not specific to a particular region. On the other hand, food consumption and total household consumption bundle seem to be income inelastic. For instance, in West of the US, where all elasticities are estimated very precisely and are larger than other regions, a 10% change in disposable income leads to around 7% change in food consumption and 6% change in total consumption.

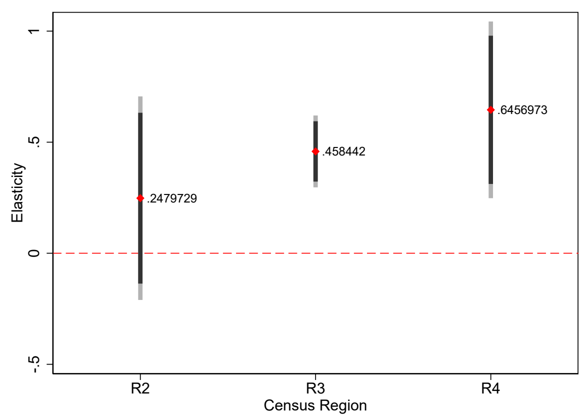
Figure 2.8: **Elasticity of Consumption for Census regions**



[a] Elasticity of Food Consumption



[b] Elasticity of Out-of-pocket Health Expenditures



[c] Elasticity of Total Consumption

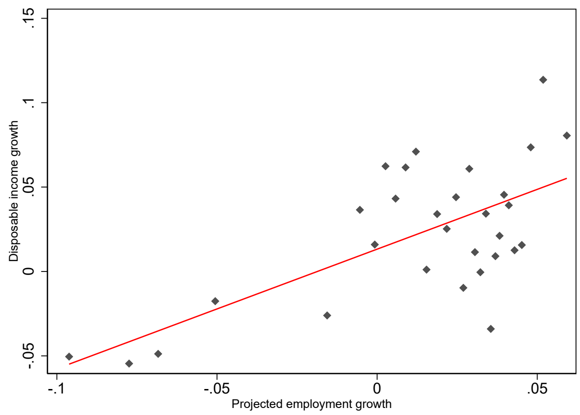
Notes: Second stage coefficients of income elasticity of consumption of 2SLS estimations where Bartik IV for all industries is used. R2:Midwest, R3:South, R4:West. Region1:Northeast is omitted because of high confidence intervals and noisy estimates.

2.6 Robustness

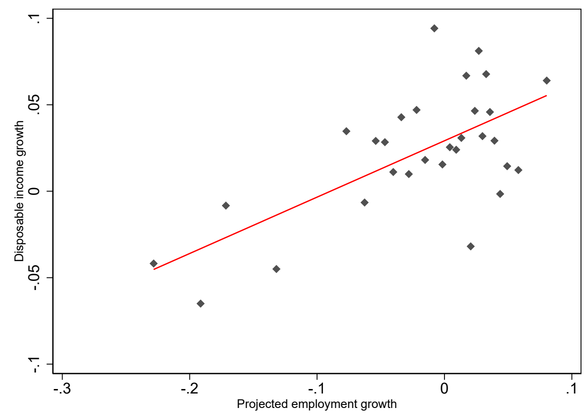
2.6.1 Insurance Status

Having an insurance affects how much households spend on their healthcare which is also correlated with income. Therefore, I add dummies for insurance status of the head of the household. Insurance dummies are controls for private insurance, public insurance and uninsured. I also add a dummy variable indicating whether insurance status has changed from previous time period. The outcomes are very similar in this specification. In particular, the income elasticity is 3.17 for health expenditures with insurance premium payments and 2.8 for out-of-pocket expenditures without premiums as shown in Table 2.11. Low wealth households have higher elasticities which are around 3.48 and 3.87 as shown Table 2.12, and high wealth households have elasticities around 2.06 and 2.36. Overall, the estimated elasticities are robust to the insurance status of the households.

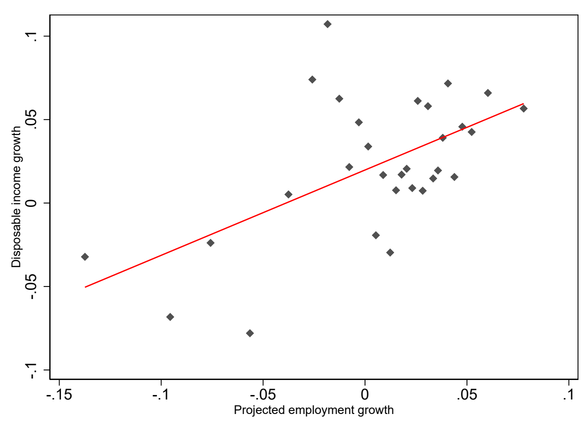
Figure 2.9: **First stage relationship**



[a] Residualized income growth and instrument of all industry employment



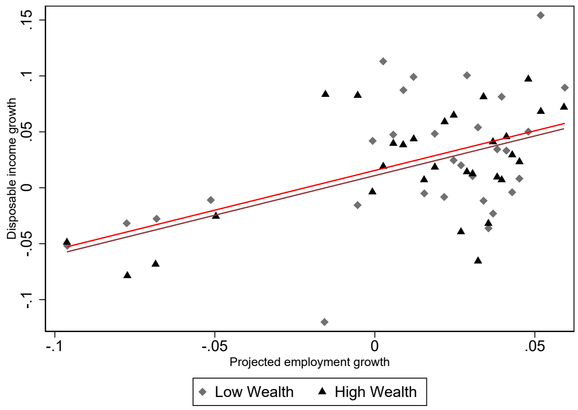
[b] Residualized income growth and instrument of tradable industry employment



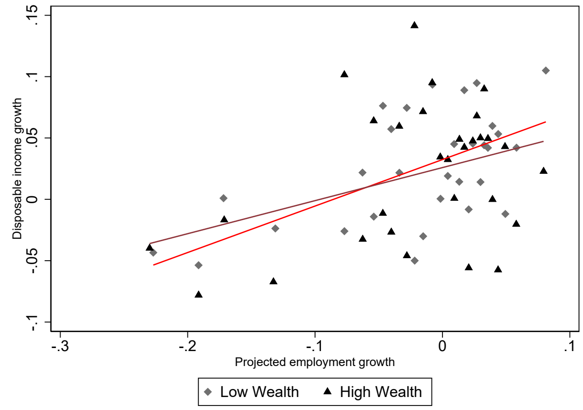
[c] Residualized income growth and instrument of LQ-based industry employment

Notes: Residual plots of projected county employment growth and household disposable income growth. Each dot is an average of 1,137 observations. The covariates in equation 4 and insurance status controls are partialed out.

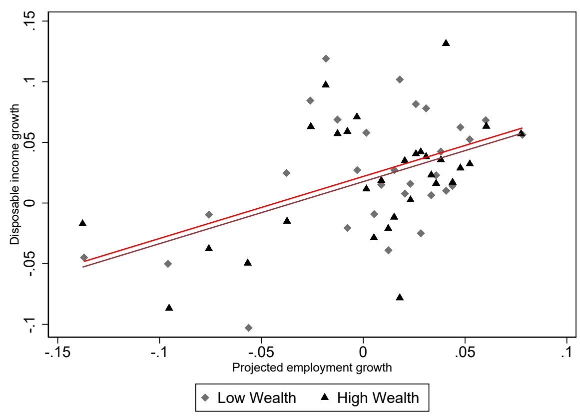
Figure 2.10: **First stage relationship across wealth**



[a] Residualized income growth and instrument of all industry employment



[b] Residualized income growth and instrument of tradable industry employment



[c] Residualized income growth and instrument of LQ-based industry employment

Notes: Residual plots of projected county employment growth and household disposable income growth. Each dot is an average of 571 observations for wealth group 1 and 566 observations for wealth group 2. The covariates in equation 4 and insurance status controls are partialled out.

Table 2.11: **2SLS estimates of Income Elasticity of Expenditure with Bartik IV all employment**

	$\Delta Food$	$\Delta Oop\ Health$	$\Delta Healthcare$	$\Delta Total$	$\Delta Food$	$\Delta Oop\ Health$	$\Delta Healthcare$	$\Delta Total$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta Household\ Income$	0.124	2.817***	3.173***	0.542***	0.127	2.741***	3.092***	0.544***
	(0.112)	(0.546)	(0.610)	(0.127)	(0.109)	(0.518)	(0.580)	(0.124)
$Insurance$ 1	0.0114	0.0155	-0.0547	0.0475*	0.0135	0.0156	-0.0538	0.0508**
	(0.0183)	(0.0980)	(0.110)	(0.0245)	(0.0184)	(0.0951)	(0.108)	(0.0252)
$Insurance$ 2	0.0304*	-0.206*	-0.309**	0.0245	0.0318**	-0.195*	-0.296**	0.0281
	(0.0164)	(0.115)	(0.129)	(0.0246)	(0.0158)	(0.112)	(0.126)	(0.0256)
$\Delta Insurance$	-0.00507	-0.0191	-0.0232	-0.0239***	-0.00454	-0.0180	-0.0218	-0.0234***
	(0.00655)	(0.0391)	(0.0434)	(0.00852)	(0.00662)	(0.0378)	(0.0421)	(0.00851)
$Manuf.\ share$ 1998					-0.0152	0.0608	0.0768	0.0361
					(0.0328)	(0.159)	(0.181)	(0.0455)
$Tradable\ share$ 1998					0.0235	-0.192	-0.215	-0.0291
					(0.0317)	(0.139)	(0.155)	(0.0410)
$Constant$	0.0772	-2.213***	-2.356***	0.00209	0.0664	-2.111***	-2.246***	0.00297
	(0.224)	(0.776)	(0.808)	(0.221)	(0.221)	(0.745)	(0.774)	(0.216)
Household controls	✓	✓	✓	✓	✓	✓	✓	✓
State FE	✓	✓	✓	✓	✓	✓	✓	✓
Observations	34127	34127	34127	34127	34054	34054	34054	34054
First stage F-test	1338.74	1338.74	1338.74	1338.74	2969.21	2969.21	2969.21	2969.21
First stage t-test on excluded IV	6.08	6.08	6.08	6.08	6.20	6.20	6.20	6.20

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table presents estimates of the change in log income on the change in log expenditure for food, healthcare and total household consumption using projected employment growth in the region as an instrument. Employment growth is constructed using employment in all industries. Region is approximated as U.S. counties. Healthcare expenditure includes out-of-pocket health spending and insurance premiums paid by the household. Oop Health is out-of-pocket healthcare expenditures excluding insurance premium payments. Insurance 1 is private insurance, Insurance 2 is public insurance. Omitted insurance category is uninsured or unknown. Δ Insurance is a dummy proxying for whether household head has changed insurance status. Household level control variables comprise size of the household, a quadratic in age, education, sex, race and marital status of head of the household, acute health index, chronic health index and hospitalization index. State fixed effects are also included. Columns 5-8 adds industry characteristics in the region to the covariates, namely manufacturing industry share and tradable industry share. Robust standard errors are clustered at state level.

Table 2.12: **2SLS estimates of Income Elasticity of Expenditure with Bartik IV all employment**

	$\Delta Food\ Consumption$		$\Delta Oop\ Health$		$\Delta Healthcare\ Expenditures$		$\Delta Total\ Consumption$		$\Delta Food\ Consumption$		$\Delta Oop\ Health$		$\Delta Healthcare\ Expenditures$		$\Delta Total\ Consumption$	
	Low Wealth (1)	High Wealth (2)	Low Wealth (3)	High Wealth (4)	Low Wealth (5)	High Wealth (6)	Low Wealth (7)	High Wealth (8)	Low Wealth (9)	High Wealth (10)	Low Wealth (11)	High Wealth (12)	Low Wealth (13)	High Wealth (14)	Low Wealth (15)	High Wealth (16)
$\Delta Household\ Income$	0.0893	0.165	3.475***	2.055***	3.868***	2.360***	0.555***	0.524***	0.108	0.152	3.335***	2.040***	3.720***	2.341***	0.554***	0.525***
	(0.162)	(0.139)	(1.167)	(0.512)	(1.298)	(0.576)	(0.189)	(0.148)	(0.157)	(0.141)	(1.094)	(0.508)	(1.219)	(0.573)	(0.184)	(0.146)
$Insurance$ 1	-0.00148	0.0472	0.0981	-0.0258	0.0353	-0.113	0.0531	0.0442	0.00229	0.0483	0.0951	-0.0336	0.0333	-0.122	0.0566	0.0453
	(0.0242)	(0.0321)	(0.176)	(0.0991)	(0.197)	(0.109)	(0.0352)	(0.0330)	(0.0241)	(0.0323)	(0.171)	(0.0999)	(0.191)	(0.110)	(0.0358)	(0.0332)
$Insurance$ 2	0.0338	0.0549*	-0.282	-0.175	-0.390**	-0.288**	0.0104	0.0335	0.0330	0.0577*	-0.248	-0.183	-0.352*	-0.296**	0.0150	0.0349
	(0.0242)	(0.0309)	(0.178)	(0.112)	(0.195)	(0.125)	(0.0285)	(0.0348)	(0.0234)	(0.0304)	(0.170)	(0.112)	(0.187)	(0.124)	(0.0296)	(0.0347)
$\Delta Insurance$	-0.00864	-0.00330	-0.0410	-0.0116	-0.0475	-0.0129	-0.0212**	-0.0261*	-0.00865	-0.00266	-0.0393	-0.0101	-0.0455	-0.0112	-0.0213**	-0.0250*
	(0.00855)	(0.00879)	(0.0658)	(0.0539)	(0.0730)	(0.0595)	(0.0108)	(0.0148)	(0.00861)	(0.00883)	(0.0637)	(0.0532)	(0.0706)	(0.0588)	(0.0108)	(0.0147)
$Manufacturing\ share$ 1998									0.000559	-0.0233	0.0730	0.0665	0.0988	0.0680	0.0261	0.0581
									(0.0577)	(0.0455)	(0.312)	(0.252)	(0.346)	(0.288)	(0.0589)	(0.0739)
$Tradable\ share$ 1998									0.0289	0.00616	-0.377	-0.0456	-0.418	-0.0489	-0.0344	-0.0398
									(0.0494)	(0.0463)	(0.296)	(0.213)	(0.327)	(0.247)	(0.0547)	(0.0619)
$Constant$	0.583***	-0.536***	-3.281**	-1.008	-3.496**	-0.997	0.183	-0.211	0.550**	-0.532***	-3.036**	-1.006	-3.235**	-0.994	0.184	-0.202
	(0.223)	(0.0941)	(1.594)	(0.816)	(1.764)	(0.795)	(0.290)	(0.186)	(0.216)	(0.0999)	(1.473)	(0.827)	(1.634)	(0.810)	(0.278)	(0.189)
Household controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
State FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
Observations	17144	16983	17144	16983	17144	16983	17144	16983	17106	16948	17106	16948	17106	16948	17106	16948
First stage F-test	596.97	1453.78	596.97	1453.78	596.97	1453.78	596.97	1453.78	$9.55 * 10^7$	10239.81	$9.55 * 10^7$	10239.81	$9.55 * 10^7$	10239.81	$9.55 * 10^7$	10239.81

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table presents estimates of the change in log income on the change in log expenditure for food, healthcare and total household consumption separately for low and high wealth households using projected employment growth in the region as an instrument. Employment growth is constructed using employment in all industries. Region is approximated as U.S. counties. The wealth variable used in this analysis is all assets net of debt, including home equity. Healthcare expenditure includes out-of-pocket health spending and insurance premiums paid by the household. Oop Health is out-of-pocket healthcare expenditures excluding insurance premium payments. Insurance 1 is private insurance, Insurance 2 is public insurance. Omitted insurance category is uninsured or unknown. Δ Insurance is a dummy proxying for whether household head has changed insurance status. Household level control variables comprise size of the household, a quadratic in age, education, sex, race and marital status of head of the household, acute health index, chronic health index and hospitalization index. State fixed effects are also included. Columns 9-16 adds industry characteristics in the region to the covariates, namely manufacturing industry share and tradable industry share. Robust standard errors are clustered at state level.

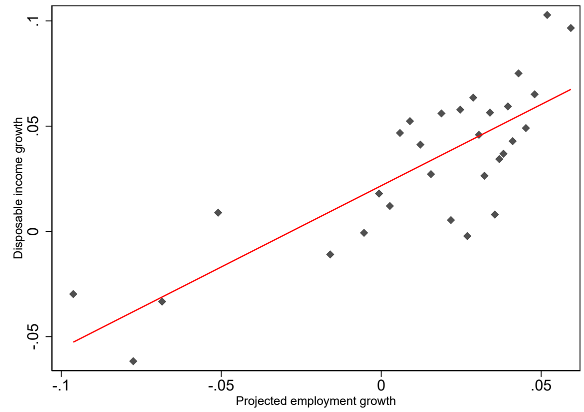
2.6.2 Extreme Income Changes

The extreme observations might be delivering the high healthcare elasticities estimated in the regressions. High income changes at household are possible but not widespread across households. The households that experience too high changes in income are likely the ones that also adjust their consumption accordingly. To test whether the results are driven by extreme changes in income, I trim sample based on income growth at 300 % , 200% and 100% levels. I continue with the robust analysis by also including insurance status controls in all regressions.

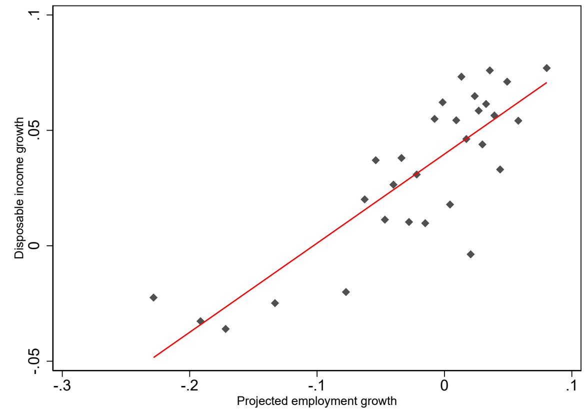
Sample Trim at 300%

First, I trim the sample such that I exclude observations in which the household income grew more than or declined less than 300%. This eliminates 495 and 557 observations respectively. Health elasticities decline in this case, 2.8 for health expenditures with insurance payments and 2.5 for only out-of-pocket expenditures. This result indicates that some extreme income changes also correspond to extreme sensitivity in health spending. It also warns against a possible measurement error in the survey data.

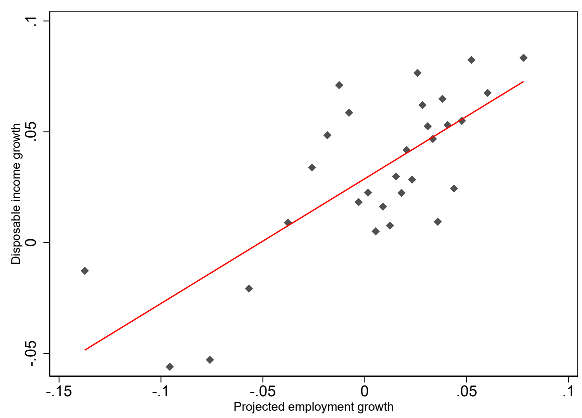
Figure 2.11: **First stage relationship for trimmed sample at 300%**



[a] Residualized income growth and instrument of all industry employment



[b] Residualized income growth and instrument of tradable industry employment



[c] Residualized income growth and instrument of LQ-based industry employment

Notes: Residual plots of projected county employment growth and household disposable income growth. Each dot is an average of 1,072 observations. The covariates in equation 4 and insurance status controls are partialed out.

Table 2.13: **2SLS estimates of Income Elasticity of Expenditure with Bartik IV all employment for trimmed sample at 300%**

	$\Delta Food$	$\Delta Oop\ Health$	$\Delta Healthcare$	$\Delta Total$	$\Delta Food$	$\Delta Oop\ Health$	$\Delta Healthcare$	$\Delta Total$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta Household\ Income$	0.105	2.523***	2.843***	0.475***	0.108	2.502***	2.824***	0.487***
	(0.0975)	(0.389)	(0.426)	(0.0697)	(0.0970)	(0.384)	(0.423)	(0.0710)
$Insurance$ 1	0.00495	-0.180***	-0.273***	0.0149	0.00612	-0.183***	-0.276***	0.0161
	(0.0126)	(0.0530)	(0.0579)	(0.0157)	(0.0126)	(0.0523)	(0.0571)	(0.0160)
$Insurance$ 2	0.0208	-0.249***	-0.353***	0.0169	0.0216	-0.252***	-0.356***	0.0171
	(0.0149)	(0.0590)	(0.0648)	(0.0164)	(0.0146)	(0.0580)	(0.0638)	(0.0169)
$\Delta Insurance$	-0.00404	-0.0540**	-0.0614**	-0.0288***	-0.00369	-0.0536**	-0.0609**	-0.0287***
	(0.00616)	(0.0225)	(0.0247)	(0.00561)	(0.00622)	(0.0224)	(0.0247)	(0.00566)
$Manuf.\ share$ 1998					-0.0183	0.172	0.202	0.0561
					(0.0326)	(0.140)	(0.159)	(0.0383)
$Tradable\ share$ 1998					0.0269	-0.206*	-0.228*	-0.0268
					(0.0299)	(0.123)	(0.138)	(0.0340)
$Constant$	0.115	-1.486**	-1.540***	0.137	0.106	-1.428**	-1.478**	0.133
	(0.210)	(0.595)	(0.593)	(0.176)	(0.209)	(0.596)	(0.593)	(0.176)
Household controls	✓	✓	✓	✓	✓	✓	✓	✓
State FE	✓	✓	✓	✓	✓	✓	✓	✓
Observations	33088	33088	33088	33088	33020	33020	33020	33020
First stage F-test	2634.87	2634.87	2634.87	2634.87	2969.21	2969.21	2969.21	2969.21

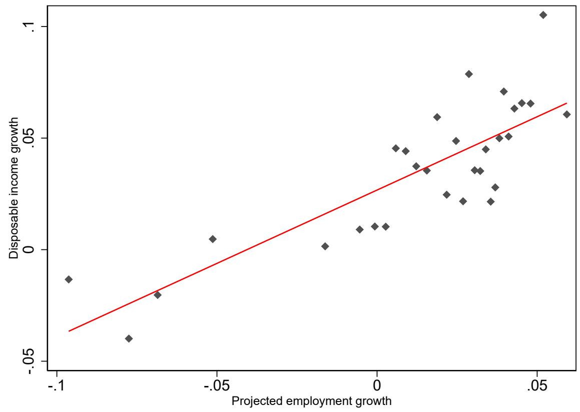
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table presents estimates of the change in log income on the change in log expenditure for food, healthcare and total household consumption using projected employment growth in the region as an instrument. Employment growth is constructed using employment in all industries. Region is approximated as U.S. counties. Healthcare expenditure includes out-of-pocket health spending and insurance premiums paid by the household. Oop Health is out-of-pocket healthcare expenditures excluding insurance premium payments. Insurance 1 is private insurance, Insurance 2 is public insurance. Omitted insurance category is uninsured or unknown. Δ Insurance is a dummy proxying for whether household head has changed insurance status. Household level control variables comprise size of the household, a quadratic in age, education, sex, race and marital status of head of the household, acute health index, chronic health index and hospitalization index. State fixed effects are also included. Columns 5-8 adds industry characteristics in the region to the covariates, namely manufacturing industry share and tradable industry share. Robust standard errors are clustered at state level.

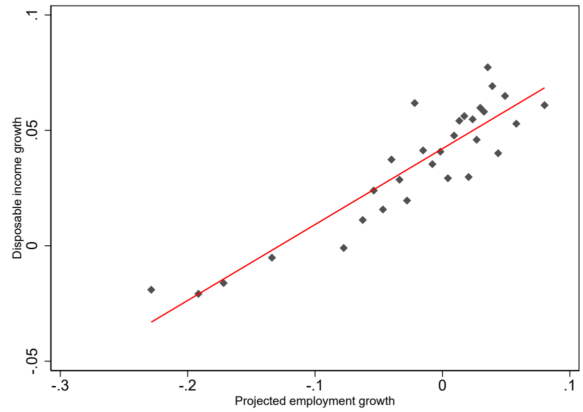
Sample Trim at 200%

I continue trimming the sample such that I exclude observations in which the household income grew more than or declined less than 200%. This eliminates 449 and 484 additional observations from 300% sample respectively. In this case the healthcare spending elasticities increase and become 3.4 for health expenditures with insurance payments and 3 for only out-of-pocket expenditures. The results are interesting in the sense that the extreme observations are actually reducing the elasticities and the high health spending elasticities are driven by relatively modest changes in income.

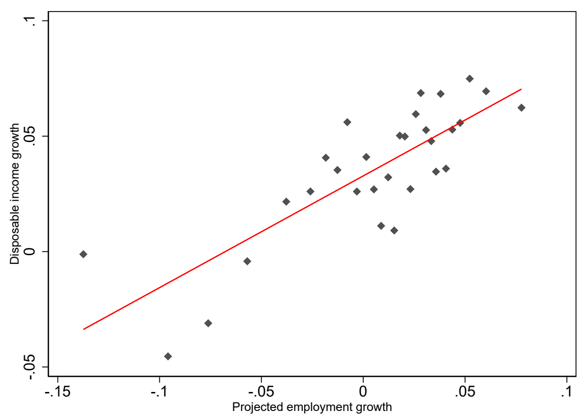
Figure 2.12: **First stage relationship for trimmed sample at 200%**



[a] Residualized income growth and instrument of all industry employment



[b] Residualized income growth and instrument of tradable industry employment



[c] Residualized income growth and instrument of LQ-based industry employment

Notes: Residual plots of projected county employment growth and household disposable income growth. Each dot is an average of 1,072 observations. The covariates in equation 4 and insurance status controls are partialed out.

Table 2.14: **2SLS estimates of Income Elasticity of Expenditure with Bartik IV all employment for trimmed sample at 200%**

	$\Delta Food$	$\Delta Oop\ Health$	$\Delta Healthcare$	$\Delta Total$	$\Delta Food$	$\Delta Oop\ Health$	$\Delta Healthcare$	$\Delta Total$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta Household\ Income$	0.127	3.029***	3.416***	0.546***	0.135	2.971***	3.356***	0.554***
	(0.128)	(0.417)	(0.451)	(0.0845)	(0.126)	(0.397)	(0.431)	(0.0798)
$Insurance$ 1	-0.00615	-0.214***	-0.307***	0.00699	-0.00497	-0.217***	-0.311***	0.00796
	(0.0118)	(0.0552)	(0.0601)	(0.0144)	(0.0117)	(0.0541)	(0.0590)	(0.0146)
$Insurance$ 2	-0.00177	-0.313***	-0.422***	-0.000410	-0.00153	-0.313***	-0.422***	-0.000279
	(0.0149)	(0.0614)	(0.0679)	(0.0157)	(0.0146)	(0.0610)	(0.0677)	(0.0161)
$\Delta Insurance$	-0.00502	-0.0642**	-0.0728**	-0.0290***	-0.00470	-0.0635**	-0.0720**	-0.0290***
	(0.00643)	(0.0263)	(0.0293)	(0.00573)	(0.00648)	(0.0261)	(0.0293)	(0.00579)
$Manuf.\ share$ 1998					-0.00741	0.0366	0.0459	0.0269
					(0.0327)	(0.133)	(0.150)	(0.0354)
$Tradable\ share$ 1998					0.0240	-0.135	-0.148	-0.0106
					(0.0290)	(0.119)	(0.134)	(0.0308)
$Constant$	0.0926	-1.842***	-1.940***	0.0734	0.0804	-1.769***	-1.863***	0.0688
	(0.214)	(0.630)	(0.632)	(0.169)	(0.212)	(0.620)	(0.621)	(0.169)
Household controls	✓	✓	✓	✓	✓	✓	✓	✓
State FE	✓	✓	✓	✓	✓	✓	✓	✓
Observations	32163	32163	32163	32163	32096	32096	32096	32096
First stage F-test	1710.27	1710.27	1710.27	1710.27	1887.29	1887.29	1887.29	1887.29

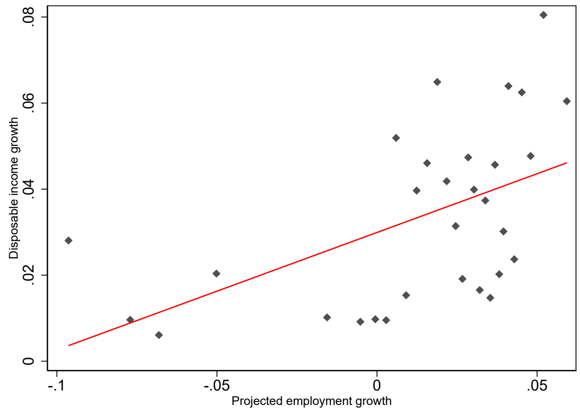
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table presents estimates of the change in log income on the change in log expenditure for food, healthcare and total household consumption using projected employment growth in the region as an instrument. Employment growth is constructed using employment in all industries. Region is approximated as U.S. counties. Healthcare expenditure includes out-of-pocket health spending and insurance premiums paid by the household. Oop Health is out-of-pocket healthcare expenditures excluding insurance premium payments. Insurance 1 is private insurance, Insurance 2 is public insurance. Omitted insurance category is uninsured or unknown. Δ Insurance is a dummy proxying for whether household head has changed insurance status. Household level control variables comprise size of the household, a quadratic in age, education, sex, race and marital status of head of the household, acute health index, chronic health index and hospitalization index. State fixed effects are also included. Columns 5-8 adds industry characteristics in the region to the covariates, namely manufacturing industry share and tradable industry share. Robust standard errors are clustered at state level.

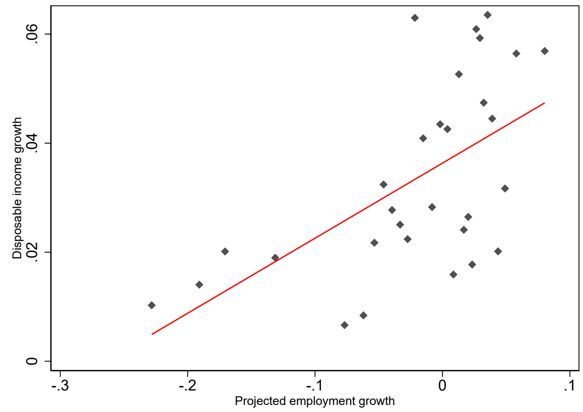
Sample Trim at 100%

Lastly, I trim the sample such that I exclude observations in which the household income grew more than or declined less than 100%. This eliminates 1652 and 1522 additional observations from 200% sample respectively. In this case the healthcare spending elasticities further increase and become as high as 8.3 for health expenditures with insurance payments and 7.3 for only out-of-pocket expenditures. This result provides a clear evidence that high elasticities are a result of high health spending changes to modest income changes. An explanation for this can be that some spending is unavoidable and not related to the magnitude of the change in income.

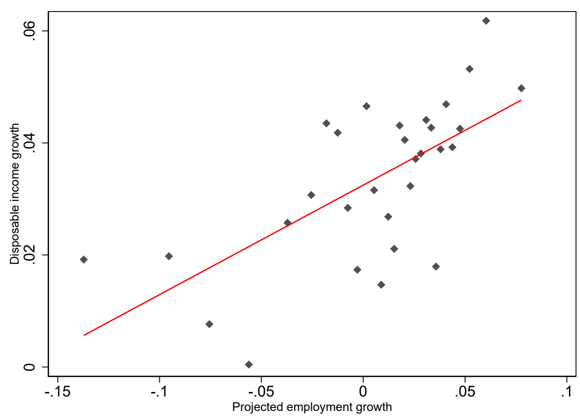
Figure 2.13: **First stage relationship for trimmed sample at 100%**



[a] Residualized income growth and instrument of all industry employment



[b] Residualized income growth and instrument of tradable industry employment



[c] Residualized income growth and instrument of LQ-based industry employment

Notes: Residual plots of projected county employment growth and household disposable income growth. Each dot is an average of 967 observations. The covariates in equation 4 and insurance status controls are partialed out.

Table 2.15: **2SLS estimates of Income Elasticity of Expenditure with Bartik IV all employment for trimmed sample at 100%**

	$\Delta Food$	$\Delta Oop\ Health$	$\Delta Healthcare$	$\Delta Total$	$\Delta Food$	$\Delta Oop\ Health$	$\Delta Healthcare$	$\Delta Total$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta Household\ Income$	0.139	7.346***	8.370***	1.303***	0.156	7.118***	8.117***	1.304***
	(0.280)	(1.837)	(2.081)	(0.351)	(0.273)	(1.694)	(1.919)	(0.326)
$Insurance$ 1	-0.00725	-0.334***	-0.442***	-0.0117	-0.00718	-0.341***	-0.449***	-0.0121
	(0.0111)	(0.0772)	(0.0852)	(0.0152)	(0.0111)	(0.0762)	(0.0839)	(0.0151)
$Insurance$ 2	-0.00652	-0.468***	-0.600***	-0.0213	-0.00719	-0.468***	-0.600***	-0.0218
	(0.0156)	(0.116)	(0.130)	(0.0154)	(0.0154)	(0.115)	(0.128)	(0.0153)
$\Delta Insurance$	-0.00620	-0.0514	-0.0596	-0.0291***	-0.00596	-0.0509	-0.0589	-0.0289***
	(0.00700)	(0.0365)	(0.0417)	(0.00757)	(0.00708)	(0.0364)	(0.0416)	(0.00767)
$Manuf.\ share$ 1998					0.00894	-0.0260	-0.0358	0.0242
					(0.0335)	(0.320)	(0.366)	(0.0572)
$Tradable\ share$ 1998					0.00667	-0.144	-0.152	-0.0231
					(0.0320)	(0.235)	(0.266)	(0.0503)
$Constant$	-0.0514	-2.046***	-2.257***	-0.0995	-0.0589	-1.959***	-2.162***	-0.0967
	(0.237)	(0.623)	(0.656)	(0.187)	(0.237)	(0.606)	(0.632)	(0.182)
Household controls	✓	✓	✓	✓	✓	✓	✓	✓
State FE	✓	✓	✓	✓	✓	✓	✓	✓
Observations	29007	29007	29007	29007	28946	28946	28946	28946
First stage F-test	1066.23	1066.23	1066.23	1066.23	765.52	765.52	765.52	765.52

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table presents estimates of the change in log income on the change in log expenditure for food, healthcare and total household consumption using projected employment growth in the region as an instrument. Employment growth is constructed using employment in all industries. Region is approximated as U.S. counties. Healthcare expenditure includes out-of-pocket health spending and insurance premiums paid by the household. Oop Health is out-of-pocket healthcare expenditures excluding insurance premium payments. Insurance 1 is private insurance, Insurance 2 is public insurance. Omitted insurance category is uninsured or unknown. Δ Insurance is a dummy proxying for whether household head has changed insurance status. Household level control variables comprise size of the household, a quadratic in age, education, sex, race and marital status of head of the household, acute health index, chronic health index and hospitalization index. State fixed effects are also included. Columns 5-8 adds industry characteristics in the region to the covariates, namely manufacturing industry share and tradable industry share. Robust standard errors are clustered at state level.

2.7 Conclusion

The studies that estimate causal effect of income changes on household out-of-pocket healthcare spending is scarce. Most studies that analyze relationship between income and healthcare expenditures are correlational since it is hard to find data for quasi-experimental variation in income.I aim to estimate causal effect of income changes on household out-of-pocket healthcare spending using an instrumental variable design à la [Bartik, 1991] to mitigate the endogeneity concerns by exploiting variation due to local labor market exposure to aggregate shocks. I exploit cross-regional and time series variation of employment that affected household incomes differentially across regions with varying industry mix of local economy. As is standard in Bartik instruments, my empirical strategy exploits the interaction between changes in national employment growth in industries (a.k.a. *shifters* in "shift-share" design) and the importance of the industry in the region as an instrument for household income. The importance of the industry in a given region is proxied by regional employment share of that industry (a.k.a. *shares* in "shift-share" design). In the baseline specification, I approximate local economies by counties. I use metropolitan statistical area (MSA) level aggregation as an alternative approximation which gives similar results. The identifying assumption is that the interaction between industry employment shares and industry growth rates should have no affect on household out-of-pocket healthcare spending, except its effect through household income.

I find healthcare expenditure elasticities around 3.14 and 3.59 using household level healthcare expenditure data. The elasticities above one indicate that household out-of-pocket expenditure is a luxury good. These are very large numbers compared to the literature. My elasticities are not directly comparable with the elasticities stated in the literature since the estimates in the literature usually refer to total healthcare spending.

However, my question is important on its own because the economic burden of households' need for healthcare can be understood with the amount they are paying. Moreover, the behavioral response of households to economic conditions for their health care is more related to its effect on their budget.

On the other hand, I find an average elasticity of total household consumption in the ranges between 0.4 to 0.53 and food consumption elasticities between 0.11 to 0.2 though the latter is not significantly estimated. Overall, the consumption bundle that a typical household has consists of necessities. In this regard, healthcare expenditure is quite different than average consumption bundle in budget allocation decision of U.S. households.

Moreover , I show that there is some heterogeneity in healthcare expenditure elasticities with respect to wealth which is not observed in other consumption items or average consumption bundle of households. I find that low wealth households have a larger elasticity around 3.5- 3.7. On the other hand, high wealth households have elasticities around 2.3 to 2.9. Despite the large difference between wealth groups, the elasticities are above one for all households.

These high elasticities are interpreted in the literature as health spending being a luxury good. I give a caution to this interpretation since it should be evaluated taking into account the dynamic structure of health accumulation. I believe this issue arises because of the stock-flow nature of health spending and health capital rather than health expenditures being a luxury good in utility function. The stock-flow adjustment creates large swings in healthcare expenditures as is shown in [Yıldız, 2019]. Therefore, the high elasticity results should be viewed in this lense.

Chapter 3

Wealth and Welfare over the Lifecycle and over the Business Cycle

3.1 Introduction

This chapter aims at presenting stylized facts of household portfolios and explores the income-portfolio allocation gradient of household wealth. Moreover, the paper presents stylized facts on household portfolios and household welfare over the business cycle for years 1999-2015.

Households save for consumption smoothing purposes, or to have precautionary savings for income and health uncertainty or due to retirement or bequest motives. The relation between income and household savings decisions is explored in many angles in macroeconomics and finance literatures. The income changes can be anticipated such as retirement. Therefore, many households save for their retirement. The income can also change unexpectedly during a household's working lives through layoffs, unemployment, disability etc. When there is income uncertainty, prudent agents tend to accumulate buffer stocks called precautionary savings. This savings incentive increase as the uncertainty in income process increases. Moreover, there are health shocks or other spending shocks can arise through the lifetime of households and these also provide an important motivation for savings.

Although the motivation for saving is well understood in the literature, it is much less clear how and why households hold a particular type of portfolio including variety of assets with different features. Some assets are more in liquid forms such that they have small or zero transaction cost both in terms of pecuniary or time. Some assets are riskier such that their return varies depending on the state of the economy. Some assets such as housing provide for sheltering needs for human beings, so are essential part of household portfolios. In this regard, the role of liquid and illiquid assets for saving purposes is different. Households usually accumulate liquid assets to buffer against negative income shocks such as unemployment or eligibility loss in a public support program or expense shocks such as unexpected health expenses, increased consumer expenses due to moving, repair etc. On the other hand, illiquid assets are accumulated for long-term goals such as retirement or children's higher education expenses etc.

This paper explores the relationship between household earnings and household asset allocation over the lifecycle and over the business cycle. What types of households hold a certain type of asset is an interesting question to explore. This question is addressed using two household surveys in the United States: Panel Study of Income Dynamics and Survey of Consumer Finances. These two sources provide similar information about assets and income relationship. However there is an important dimension that they differ: the share of liquid assets in household portfolio is increasing with income for some range in PSID whereas it is declining with income in SCF.

The chapter presents several features of household portfolios over the lifecycle and over the business cycle and the interaction of asset allocation with income. The stylized facts are summarized as:

Asset accumulation have an inverted-V shape over the lifecycle. This observation is not true when considering most liquid assets. Older households prefer holding their assets in liquid form such as in checking and savings accounts. On the other hand, home equity, other real estates, annuity/IRA accounts are sharply decumulated after the retirement age 65. The preference of old households for liquid assets is also observed in liquidity share in net wealth. The liquid to networth ratio has a U shape throughout the lifecycle with a large flat region in mid-ages. The share increases after retirement. On the other hand, home equity share in wealth declines after retirement. Debt is front-loaded in the lifecycle. Young households accumulate debt rapidly early in working life, then pay off their debt slowly throughout their remaining life.

As for the wealth-income gradient, there is a strong positive correlation with income and asset holdings for middle income households. The portfolio allocation behavior of households below and above log incomes 10 -11 greatly differ from the very low income households. Debt to income ratio, liquid assets to income ratio, debt share in networth, liquidity share in networth reverts correlation above log income 10, which corresponds approximately 22,000 $ annual household income. The findings in PSID and SCF are similar except for liquidity share and debt to income share for some subsample of households.

Income follows a hump-shape over the lifecycle. Consumption has a very similar correlation with income even after controlling for family size and composition which points to the lack of perfect consumption smoothing. An exception is the healthcare expenditure which is steadily increasing over the lifecycle with a level drop around the retirement age, possibly due to the eligibility of Medicare at age 65.

An interesting observation is the correlation of income with health status of families which is measured with two illness indices and a hospitalization index for the head and spouse of the household. Even after taking age effects out, income is strongly negatively correlated with the number of chronic illnesses in the family. However, the causation can be in both direction such that low income leads to worse self care and more illnesses on the one hand, and low health makes workers unproductive or unable to work on the other hand.

Besides income and consumption, an important measure of average household welfare in the economy is poverty rate among households. I use poverty thresholds provided by the U.S. Census Bureau to calculate *Income Poverty* rate in the PSID sample. Additionally, I construct the fraction of households that have savings below the poverty threshold and call it *Asset Poverty* rate. This latter rate measures whether households have enough assets worth of a year's income. For 1999-2015 time period, 35.57 % households have incomes below the poverty threshold and 46.99 % households do not have enough assets worth of a year's income. Only 11.48 % of households that experience income poverty have assets above asset poverty level. 24.1 % of households experience income poverty as well as asset poverty. Looking at the effect of Great Recession, poverty rates increase from 2007 to 2011. Also, the empirical findings indicate a clear drop in networth from 2007 to 2009 which is present across the distribution of wealth. According to the PSID sample, non-white households, female headed households and low educated households experienced the biggest downturn in their net wealth and liquid assets during the recession.

As noted in many studies in the literature, the findings show the shortcomings of mainstream economic models. For example, the fact that consumption follows income over the lifecycle points to the failure of Permanent Income Hypothesis which predicts a constant consumption stream over the lifecycle. Similarly, the fact that consumption drops in recessions when income and wealth drops shows that the markets are far from being complete.

Moreover, these findings are important in guiding economic models of household portfolios. Historically, economic models involve only one asset or recently two types of assets. Incorporating housing further improves the models in this dimension. However, household portfolios are more complicated than the two asset models and there is an established correlation of portfolio allocation with income and wealth. I show that the asset accumulation decision is much more heterogeneous than the simple economic models embody. The piecewise correlations provided in this chapter points to the important dimensions that the economic models should incorporate.

The findings about the heterogenous asset composition by age is particularly important in an aging society. The lifecycle profile of wealth informs in terms of the future demand for different kind of assets. One prominent feature of household portfolio allocation is the liquidation of household composition in old ages. This fact points to an increase in the demand for liquid assets as the society ages. Home equity and other real estate declines sharply with retirement. This points to a possible decrease in real estate demand.

Another important dimension is the demand for health in an aging society. The age profiles of consumption show that the healthcare spending is increasing with age even after Medicare eligibility at the age of 65. However, food consumption and overall consumption falls. These findings are informative about the demand for consumption in the future.

As for the wealth-income gradient, the high correlation of income with the type of assets points to possible pattern in asset demand in an economy with a growing income and wealth inequality. The income is positively correlated with the share of home equity in the household portfolios. Hence, as the income distribution gets more skewed, the demand for residential houses is expected to decrease relative to other assets.

Related Literature. This paper complements portfolio allocation literature in macroeconomics and household finance by providing recent features of household portfolio choices over the lifecycle and wealth and welfare changes over the business cycle.

Savings are the main tools that individuals can use to self-insure against fluctuations in their earnings, so to sustain a smooth consumption over time. Consumption smoothing over lifecycle is one of the key facts observed in data. Many studies show that, although the earnings and wealth vary, consumption is relatively smooth. According to Permanent Income Hypothesis(PIH) developed by [Friedman, 1957], an individual's consumption is determined by the present discounted value of lifetime income, not by income in each period. Similarly, Life-Cycle Hypothesis (LCH) by [Ando and Modigliani, 1963] states that individuals save in early periods of their lifetime based on their earnings in order to consume when they are retired so that they can maintain stable lifestyle over their lives.

Coexistence of different types of assets is not much addressed in economics literature. The literature on asset composition is recently developing, most portfolio models include only one or two assets. Similarly the literature on the relationship between different assets and income is still premature. [Poterba and Samwick, 2001] analyze the relationship between age and composition of household portfolios using data from Survey of Consumer Finances(SCF). They find significant differences in asset accumulation between households with different ages as well as cohorts. They conclude that analyzing household wealth as identical savings is not supported by the data. They argue that institutional factors, asset liquidity and investor tastes are important determinants of asset demand. Another comprehensive household survey, Panel Study of Income Dynamics (PSID), provides a unique panel dataset for various household level variables. Wealth and savings are analyzed in PSID sample by [Bosworth et al., 2008] for 1984-2005 period. [McCarthy, 2004] provide a literature review on household portfolio allocation by summarizing models and empirical facts from various countries. Similar to [Poterba and

Samwick, 2001] and [Bosworth et al., 2008], I empirically analyze savings and portfolio allocation of households using both SCF and PSID for recent time periods 1999-2015. Each dataset have their own advantages. PSID follows households over many periods, however it underrepresents high wealth households. In this regard, SCF draws high income households using tax records which provide more information about the upper tail of the income and wealth distribution.

There are a few empirical papers which focus on liquid assets and their importance in family wellbeing. These papers show the importance of liquid assets in confronting adversity after a negative income or expense shock. Despite that one of the main purpose of household savings is to cushion against negative shocks, many households lack enough resources to do so. [Mills and Amick, 2010] argue that holding a modest amount of liquid assets plays a buffer stock role which is significantly related to lowering material hardship. Similarly, [McKernan et al., 2009] find that material hardship after a negative life event is more pronounced for liquid-asset poor families. [Yıldız, 2019] shows that the lack of liquid resources may lead to very different intertemporal allocation of consumption for healthcare expenditures compared to nondurable goods. In this paper, I provide empirical evidence for the liquidity of household portfolios to understand the type of the households with more liquid assets in their portfolios.

The literature on the composition of household assets is growing recently. [Kaplan and Violante, 2014] and [Kaplan et al., 2014] incorporate two assets into their model, one which is illiquid in the sense that it can be used after paying a transaction cost. Although transaction cost assumption is sensible as most illiquid assets such as real estate necessitate some cost from value to liquidate, the main difficulty in liquidation is the uncertainty or time cost. [Bayer et al., 2019] are looking at the macroeconomic implications of income uncertainty with liquid and illiquid assets in a New Keynesian framework. They model the frictions as an uncertainty in capital markets where a fraction of households do not have the means to adjust their illiquid asset holdings every period. Similarly, [Aoki et al., 2019] constructs a life-cycle portfolio choice model and estimate the parameters to generate money, stock and bond holdings in SCF data. In order to generate money holdings, they use a shopping cost which is increasing with consumption and decreasing with money holdings.

Asset accumulation is crucial for the wellbeing of households since lack of enough resources creates economic difficulties in affording basic needs. In this dimension, poverty rate is used as an important indicator for overall household wellbeing in the economy. Lack of having enough income or enough assets drives households into economic hardship especially during recession times. Some households are even more vulnerable to negative economic environment. [Hoynes et al., 2006] show that non elderly poverty rate fails to decline even when wages and GDP per capita were increasing over the period 1959-2003. I show how poverty rate changes over the period 1999-2015 which includes one of the most severe economic downturn in US economic history, the Great Recession. I also show that non-white, low educated and female headed households are particularly vulnerable to the negative effects of recessions.

3.2 Data

There are two sources of household survey data. The first one which is the 1999-2015 waves of Panel Study of Income Dynamics (PSID). Starting from 1968, PSID collected data on demographics, employment, asset holdings, expenditures and health factors of 5,000 U.S. households over their life course and their children (SRC sample). Later, more samples added as to represent Latino population and lower income levels (Latino and SEO sample). The survey initially collected food, childcare and housing expenditures, however, after 1999 more comprehensive expenditure categories are added. The empirical analysis in the present paper incorporates all households excluding SEO and Latino samples.

The consumption data uses the aggregated consumption variables imputed by the PSID staff in the main family files. These variables span food, housing, transportation, education, childcare and health-care expenditures and their subcategories. Healthcare expenditure consists of health insurance premiums paid by household and out-of-pocket health-care spending. The wealth variable used in this analysis is all assets net of debt, including home equity. Disposable income is calculated as family unit federal taxable income minus federal, state and social security taxes plus credits. Marginal tax rates and the variables in disposable income calculations are estimated using NBER's TAXSIM simulator.

I constructed health indices using the categorization employed by [Conley and Thompson, 2011], however the index construction serves a different purpose in the sense that I construct them as a measure of family health status rather than to identify health shocks. Instead, I use the hospitalization index as a proxy for a health shock. Specifically, acute illnesses consists of stroke, heart attack, and cancer. Chronic illnesses consist of diabetes, lung disease, heart disease, psychological problems, arthritis, asthma, memory loss, and learning disorder. The index is the sum of the existence of each illness for head and spouse combined. Acute and chronic health indices indicate the state of health in the family. Hospitalization index takes values 0, 1 or 2 if either one of head or spouse (1) , both (2) or none (0) of them is hospitalized during previous calendar year.

The sample consists of families where heads are in working ages between 25-65. The health variables are constructed using head and spouse health conditions. Income, consumption and wealth variables are at the household level. I trimmed the data if food consumption grows or shrinks more than 400%. I also dropped observations if a household has a negative checking/saving account or negative stocks, which is possibly due to the imputation of wealth variables. All nominal variables are deflated to 2010 dollars using CPI-U. Food variables are deflated using food CPI and healthcare expenditure variables are deflated using medical CPI.

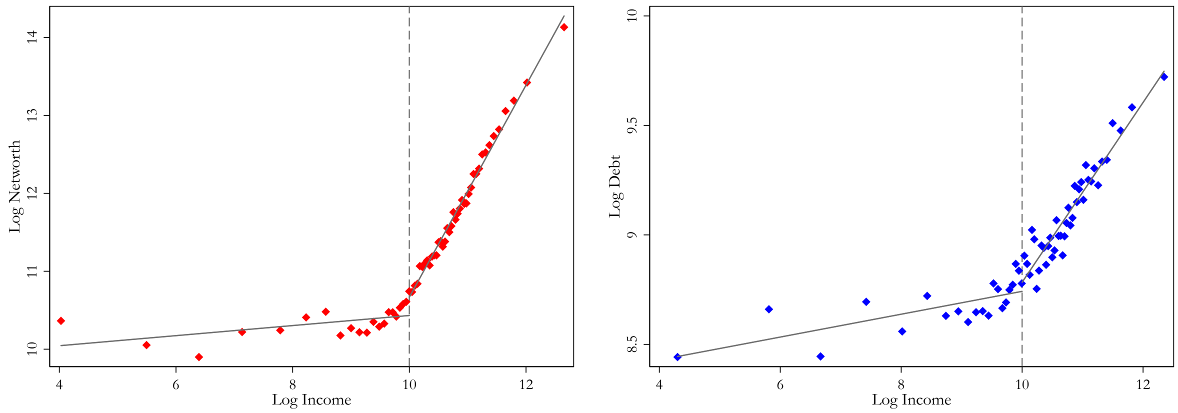
The second data source is 2010 Survey of Consumer Finances (SCF). SCF is are richer source of wealth data and I used it to explore wealth and income relationship in the paper. This survey is a triennial statistical survey of demographics, income and balance sheets of U.S. households. An information feature of SCF is that it draws high income households disproportionately using tax records. This makes SCF a good representation for the upper tail of the income distribution. Moreover, the survey has a rich set of questions on asset holdings and covers a variety of household types which makes it as an attractive source for portfolio allocation studies. In SCF analysis in the paper, liquid assets are defined as the sum of checking account, savings account, money market accounts(money market deposit accounts and money market mutual funds) and call accounts at brokerages. Income is total income before taxes and deductions which include wage income, business income, income from interest earning investments, sales of stocks, bonds and real estate, rent income and transfer income such as unemployment and child support.

3.3 Welfare over the Lifecycle

3.3.1 Wealth-Income Gradient in PSID

The income is highly correlated with the level of wealth for relatively high income earners. As can be assessed from Figure 3.1 and Figure 3.2, the correlation between income and networth or liquid assets and also between income and debt is very small for log income below around 10 which corresponds to an annual disposable income of 22026.47 \$. Then, there is a linear relation between log income and log net wealth and log debt above incomes around log 10. For home equity, the correlation seems to be slightly negative below income log 10.

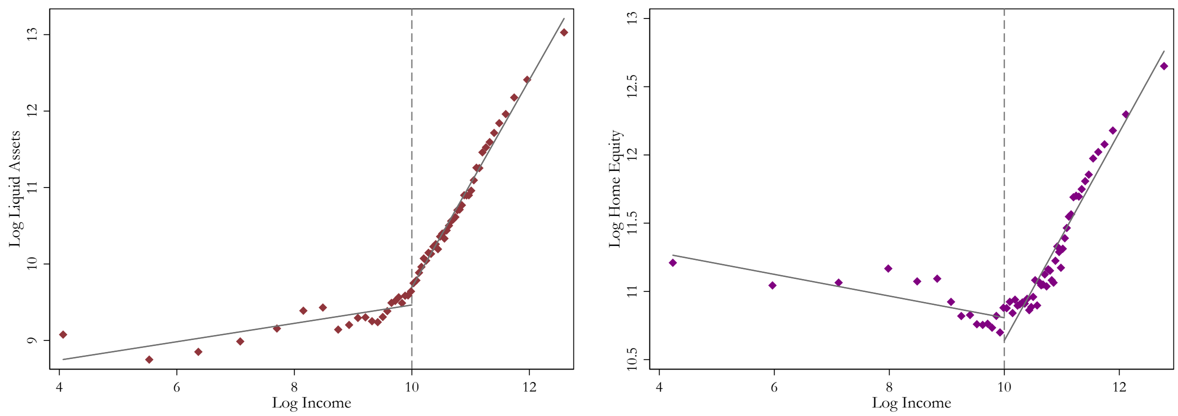
Figure 3.1: **Networth and Debt in PSID**



[a] Networth [b] Debt

Notes: The figure plots networth and debt against disposable income for households in 1999-2015 waves of PSID. Debt excludes residential mortgages and vehicle loans. Income is total income after taxes plus credits.

Figure 3.2: **Liquid assets and Home equity in PSID**

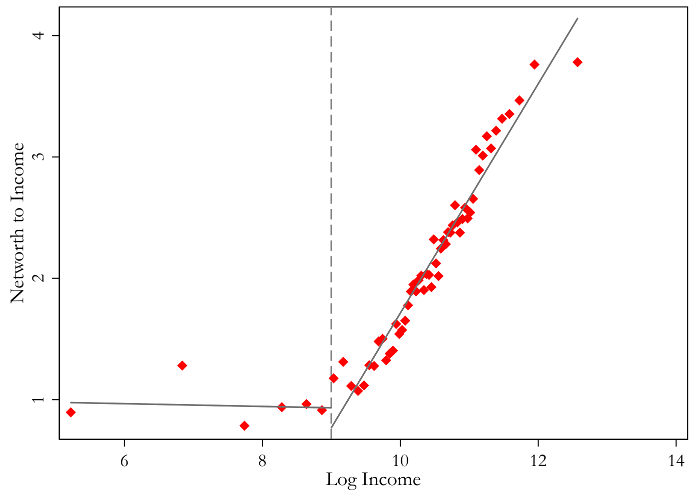


[a] Liquid assets [b] Home equity

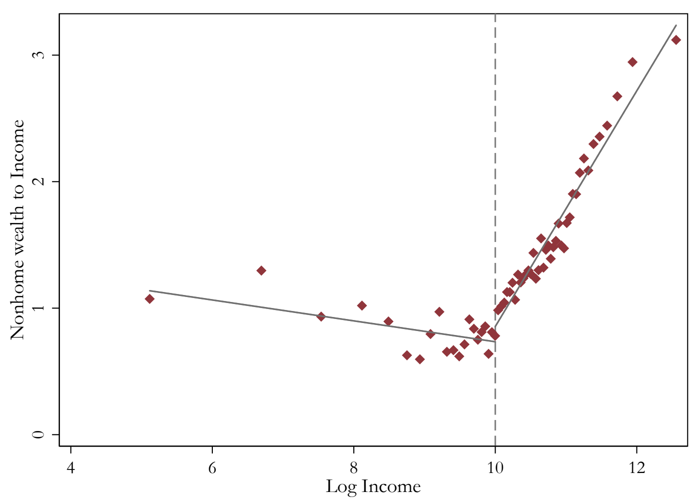
Notes: The figure plots liquid assets and home equity against disposable income for households in 1999-2015 waves of PSID. Liquid assets are defined very broadly for PSID data and are defined as the sum of checking/savings account, stocks, value of vehicles, other assets and annuity/IRA. Income is total income after taxes plus credits.

Similar patterns arise for net wealth to income (both including and excluding home equity) and log income correlation in figure 3.3. There is a positive correlation above around log income 9 which is around 8103.08 $. Figure 3.4 reveals an interesting reversal of the correlation between log income and debt to income ratio. For low income earners, the debt to income ratio has a positive association with income. This can be because low income households might be increasingly borrowing while expecting an increase in their incomes to smooth out the consumption. The association reverses at around log income 8. Note that this is actually a very low level of income and corresponds to around 2980.95 $ annual disposable income.

Figure 3.3: **Wealth to Income Ratio in PSID**



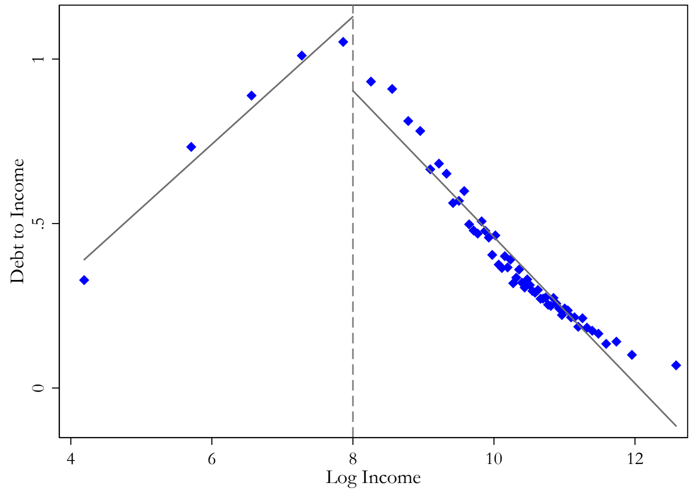
[a] Networth to income



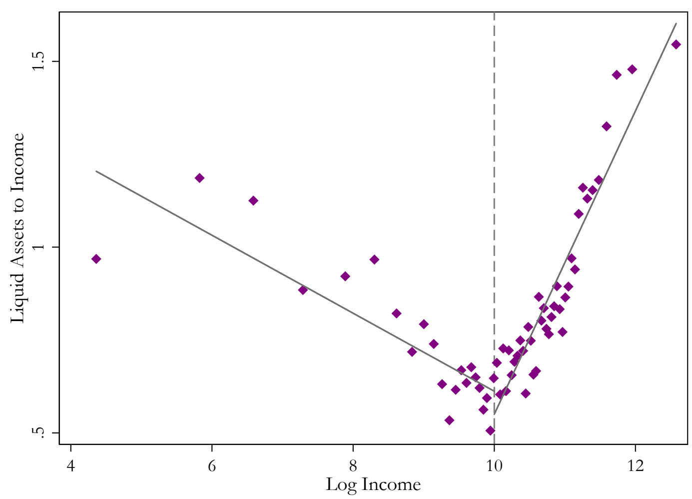
[b] Nonhousing net wealth to income

Notes: The figure plots networth to income ratio and nonhousing wealth to income ratio against disposable income for households in 1999-2015 waves of PSID. Income is total income after taxes plus credits.

Figure 3.4: **Debt to Income and Checking/Savings to Income Ratio in PSID**



[a] Debt to Income

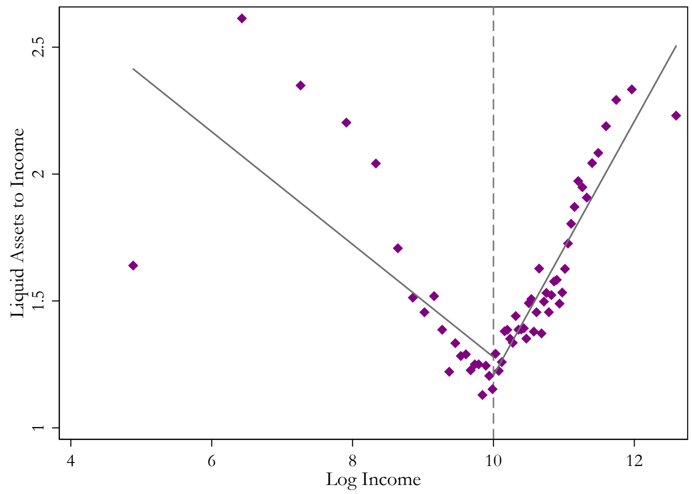


[b] Checking/Saving to Income

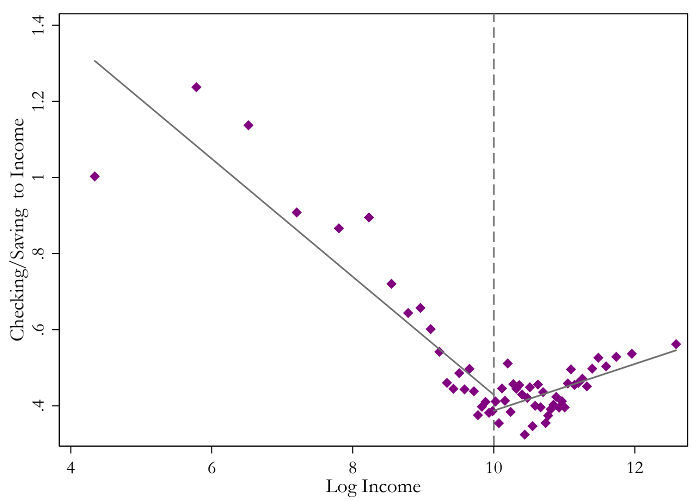
Notes: The figure plots debt to income ratio and checking/savings to income ratio against disposable income for households in 1999-2015 waves of PSID. Debt excludes residential mortgages and vehicle loans. Income is total income after taxes plus credits.

Liquid assets to income ratio also reverses the sign of the relationship above log 10 annual income. The reason can be a temporary income loss for some households who have some small savings. I used both narrow and broad definition of liquid assets as there is not a consensus in the literature for what constitutes as a liquid asset. Broad definition of liquid assets for PSID data is the sum of checking/savings account, stocks, value of vehicles, other assets and annuity/IRA. Narrow definition of liquid assets is the sum of checking/savings account, stocks, and other assets. In the narrowest definition for liquidity, checking and savings account are the truly liquid assets. Therefore, this negative relationship holds for assets excluding business value, real estate and home equity. Above log 10 income, the relationship becomes positive similar to networth to income ratio. All three definitions reveal similar patterns.

Figure 3.5: **Liquid assets to income in PSID**



[a] Liquid assets to income (broad)

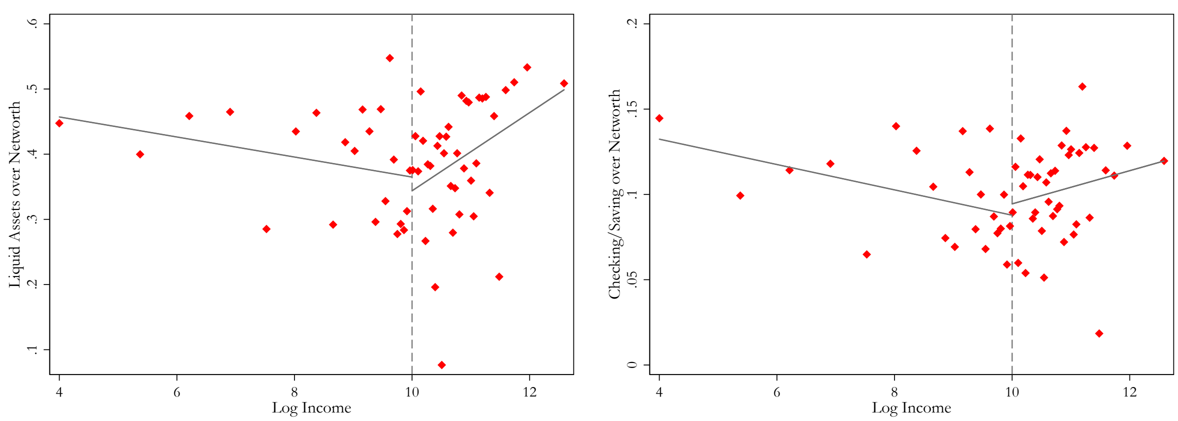


[b] Liquid assets to income (narrow)

Notes: The figure plots the ratio of liquid assets to income against disposable income for households in 1999-2015 waves of PSID. Broad definition of liquid assets for PSID data is the sum of checking/savings account, stocks, value of vehicles, other assets and annuity/IRA. Narrow definition of liquid assets is the sum of checking/savings account, stocks, and other assets. Income is total income after taxes plus credits.

Next, I look at the composition of wealth in US households. For the PSID sample, the share of liquid assets have a small positive correlation with income for relatively high income households as is given in Figure 3.6. Figure 3.7 plots the share of checking and savings account amount in net wealth. The relationship is stronger in this case. For very low income households, the share declines with income. Above log income 10, the correlation is positive. This result is interesting since it is known that high wealth households invest in either financial assets or real estate. However, it is important to note that PSID does not include households from upper distribution of income and wealth. Hence, the positive association is driven by middle income households.

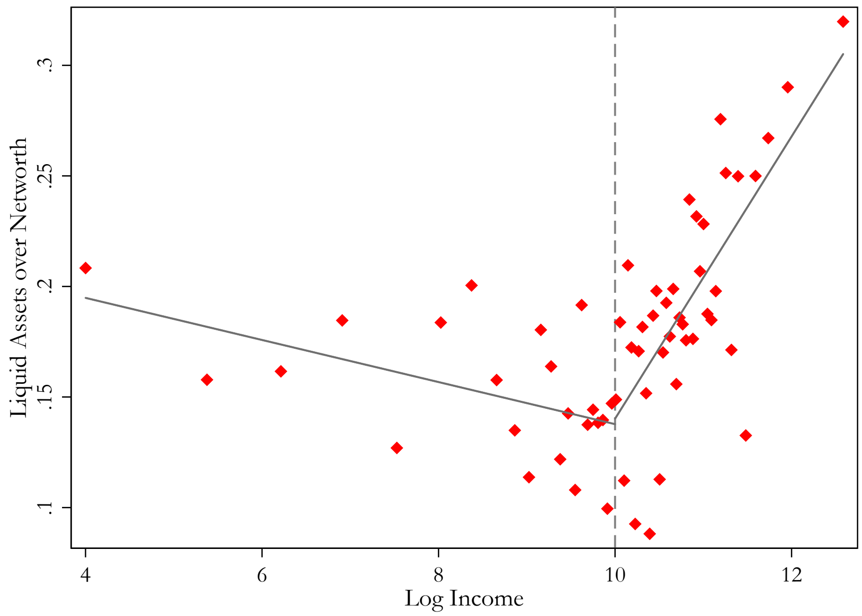
Figure 3.6: **Liquidity share in wealth in PSID**



[a] Liquid assets to networth (broad) [b] Liquid assets to networth (narrow)

Notes: The figure plots the ratio of liquid assets to networth against disposable income for households in 1999-2015 waves of PSID. Broad definition of liquid assets for PSID data is the sum of checking/savings account, stocks, value of vehicles, other assets and annuity/IRA. Narrow definition of liquid assets is the sum of checking/savings account, stocks, and other assets. Income is total income after taxes plus credits.

Figure 3.7: **Checking/Savings share in wealth in PSID**

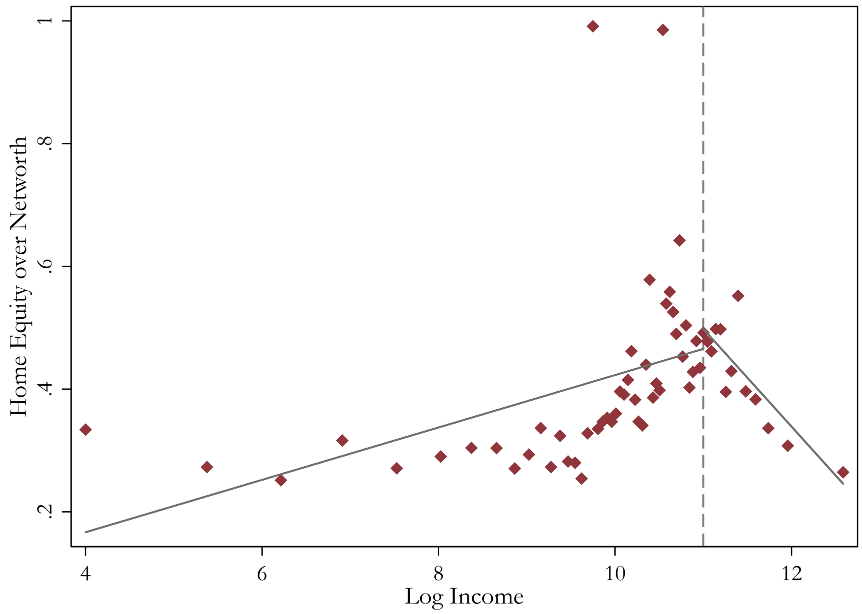


Checking/Savings to networth

Notes: The figure plots Checking/Savings account share in net wealth against disposable income for households in PSID. Income is total income after taxes plus credits.

Home equity share have a small positive correlation for low income earners until around log 11 (around 59874 $ annual disposable income) at which the relationship reverses. This result is not surprising as residential house is the main assets most middle income households have and its value and the ability to pay mortgage is highly correlated with income.

Figure 3.8: **Home equity share in wealth in PSID**



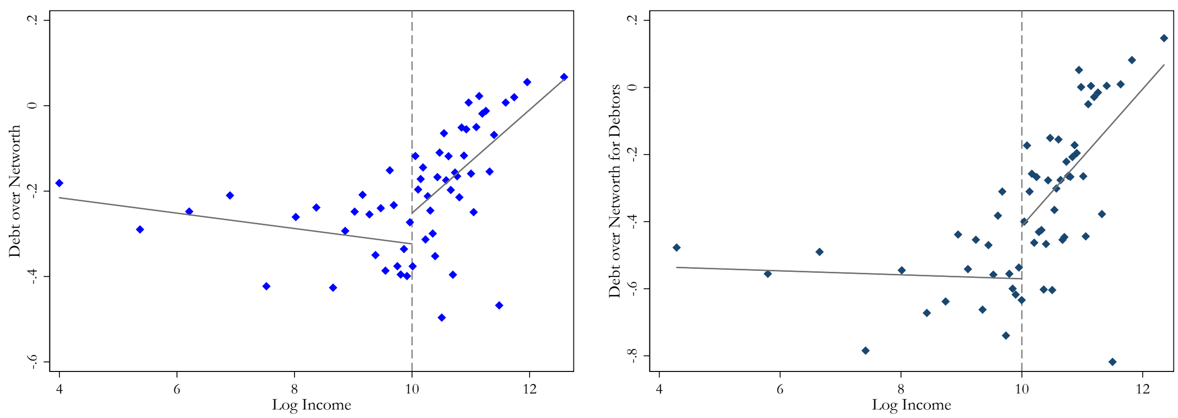
Home equity to networth

Notes: The figure plots home equity share in net wealth against disposable income for households in PSID. Income is total income after taxes plus credits.

The size of the debt relative to wealth is shown in Figure 3.9. The figure gives the plot of debt to networth against log income birth for all households, and for only debted households. There is a positive association above log income of 10. An important observation is that the ratio is negative for most households. This result is driven by the fact that some households have negative networth due to high debt relative to the value of their assets. Therefore, the ratio is very high for such households which drives the averages down. For high wealth households, the debt relative to their assets is very low that contributes low to simple arithmetic averages. Therefore Figure 3.9 mostly reflects the behavior of highly debted households (relative to their assets). High income means higher savings and higher wealth and lower debt which increase the ratio towards zero.

This relationship is clear when we only consider households with positive networth as in Figure 3.10. Higher income is associated with lower debt and higher wealth, this translates into lower debt to wealth ratio when the ratio is positive.

Figure 3.9: **Debt share in networth in PSID**

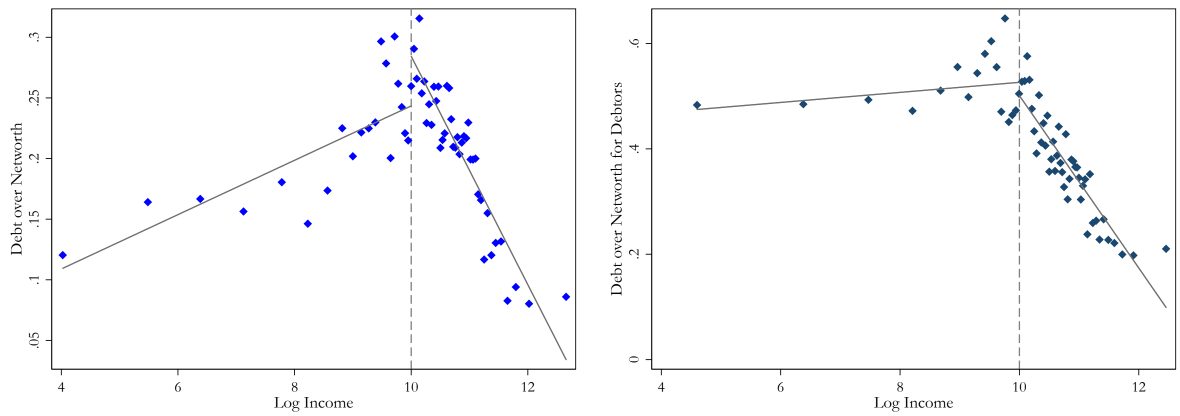


[a] Debt to networth ratio

[b] Debt to networth ratio for debtors

Notes: The figure plots debt to networth ratio against disposable income for households in 1999-2015 waves of PSID. Debt excludes residential mortgages and vehicle loans. Income is total income after taxes plus credits.

Figure 3.10: **Debt share in networth for positive networth households in PSID**



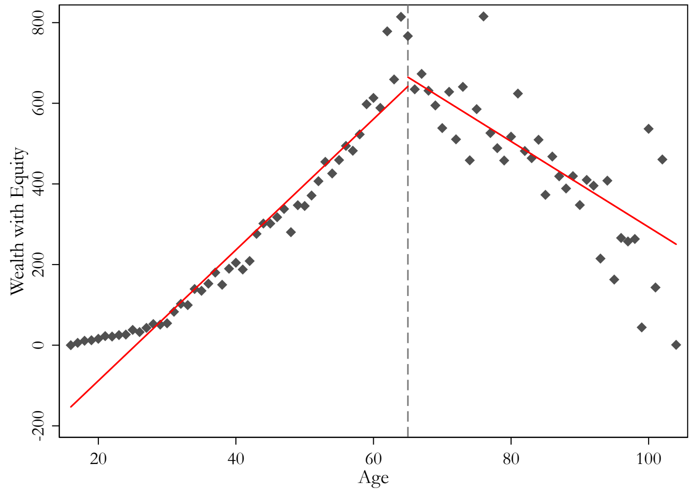
[a] Debt to networth ratio [b] Debt to networth ratio for debtors

Notes: The figure plots debt to networth ratio against disposable income for positive networth values for households in 1999-2015 waves of PSID. Debt excludes residential mortgages and vehicle loans. Income is total income after taxes plus credits.

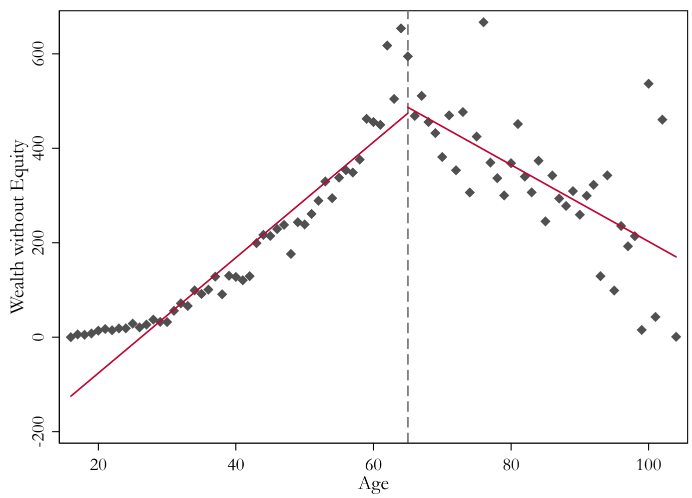
3.3.2 Age Profile in PSID

Household networth have an inverted V-shape over the lifecycle as is seen in Figures 3.11. However, this observation changes for more liquid assets. Households accumulate assets over their lifetimes until retirement and then starts decumulating. Figure 3.12 plots liquid assets based on two definitions. Broad definition of liquid assets for PSID data is the sum of checking/savings account, stocks, value of vehicles, other assets and annuity/IRA. Narrow definition of liquid assets is the sum of checking/savings account, stocks, and other assets. Figure 3.13 plots checking/saving account balance over the lifecycle as the most liquid asset type. As the assets become more liquid, the decline after retirement begins to reverse. These plots suggest that old households keep their wealth in liquid forms, they consume and possibly liquidate their illiquid assets at retirement.

Figure 3.11: **Net wealth over the lifecycle**



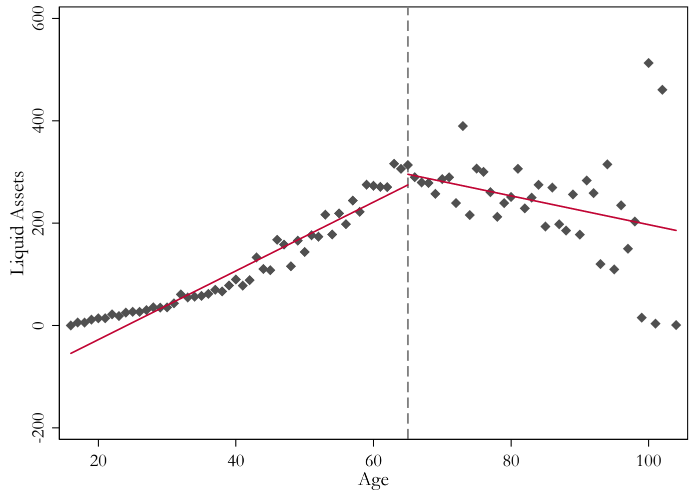
[a] Net wealth with home equity



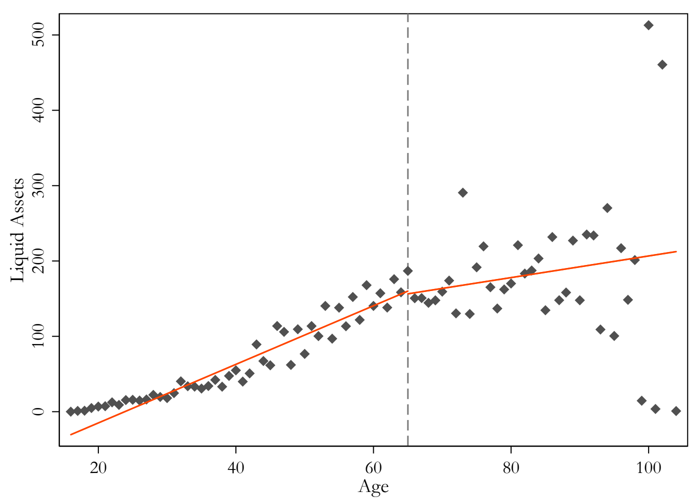
[b] Net wealth without home equity

Notes: The figure plots total household net wealth with and without home equity averaged over households against age of the head of the household. The data is a pooled sample of PSID for waves 1999-2015. The amounts are plotted in thousands 2010 dollars.

Figure 3.12: **Liquid assets over the lifecycle**



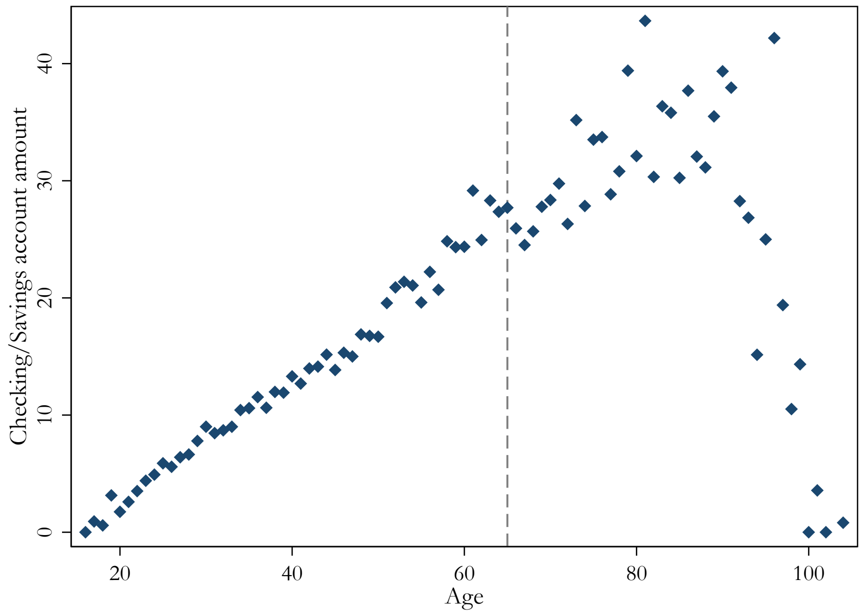
[a] Liquid Assets (broad)



[b] Liquid Assets (narrow)

Notes: The figure plots total household liquid assets averaged over households against age of the head of the household. The data is a pooled sample of PSID for waves 1999-2015. The amounts are plotted in thousands 2010 dollars. Broad definition of liquid assets for PSID data is the sum of checking/savings account, stocks, value of vehicles, other assets and annuity/IRA. Narrow definition of liquid assets is the sum of checking/savings account, stocks, and other assets.

Figure 3.13: **Ckecking and Savings Accounts over the lifecycle**

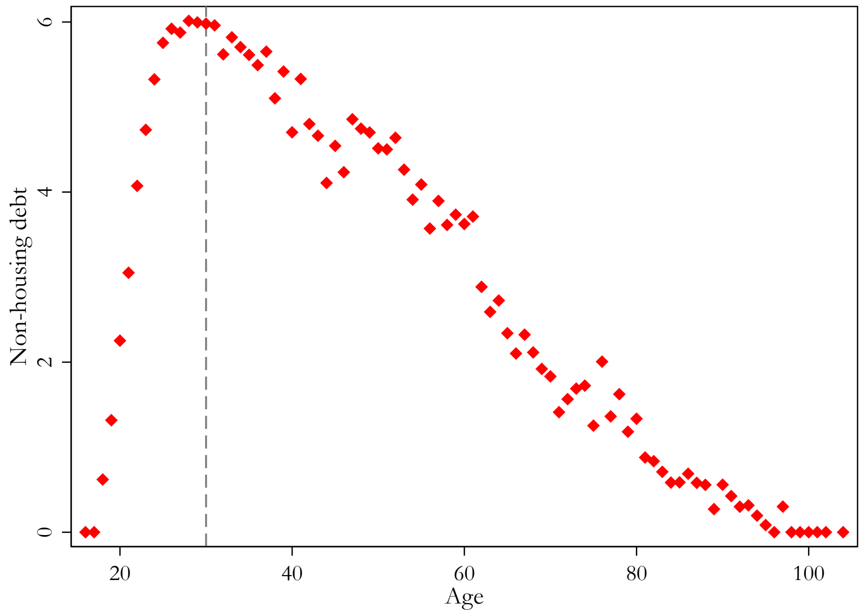


Ckecking/Saving Accounts

Notes: The figure plots household checking and savings account balance averaged over households against age of the head of the household. The data is a pooled sample of PSID for waves 1999-2015. The amounts are plotted in thousands 2010 dollars.

Figure 3.14 plots debt over the lifecycle. The figure clearly shows that debt is front loaded in household lifetime. Figures 3.15 - 3.17 plots disaggregated assets over the lifetime. The inverted V-shaped figure is seen in most asset types. Similar to above observations for liquid assets, the inverted shape does not hold for stocks or other assets that include bonds which are more liquid than farms and businesses, housing or vehicles.

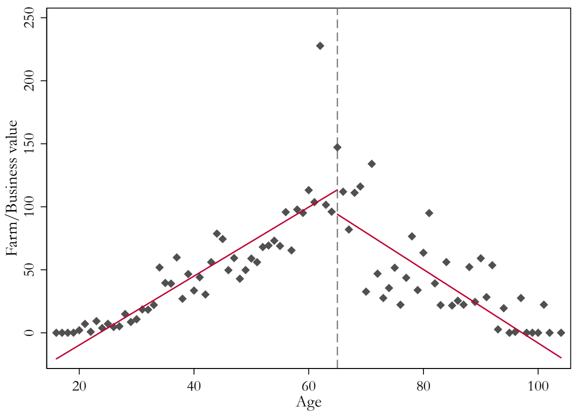
Figure 3.14: **Debt over the lifecycle**



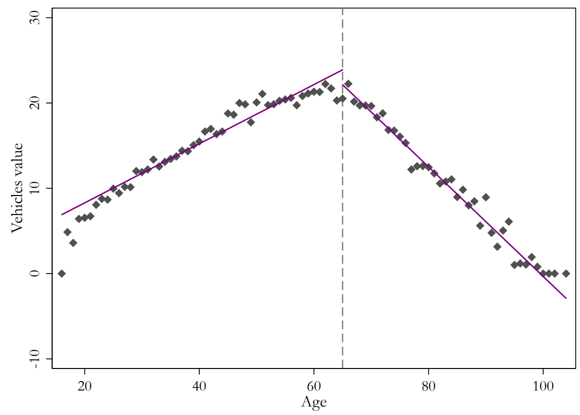
Debt excluding home mortgages and vehicle loans

Notes: The figure plots household all household debt other than mortgage and vehicle loans averaged over households against age of the head of the household. The data is a pooled sample of PSID for waves 1999-2015. The amounts are plotted in thousands 2010 dollars.

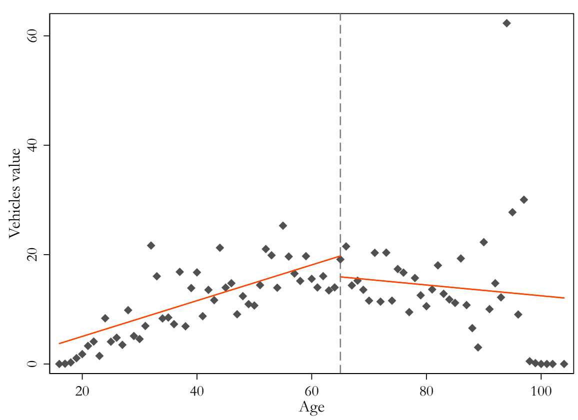
Figure 3.15: **Farm/Business value, vehicle value and value of other assets over the lifecycle**



[a] Farm and Business value



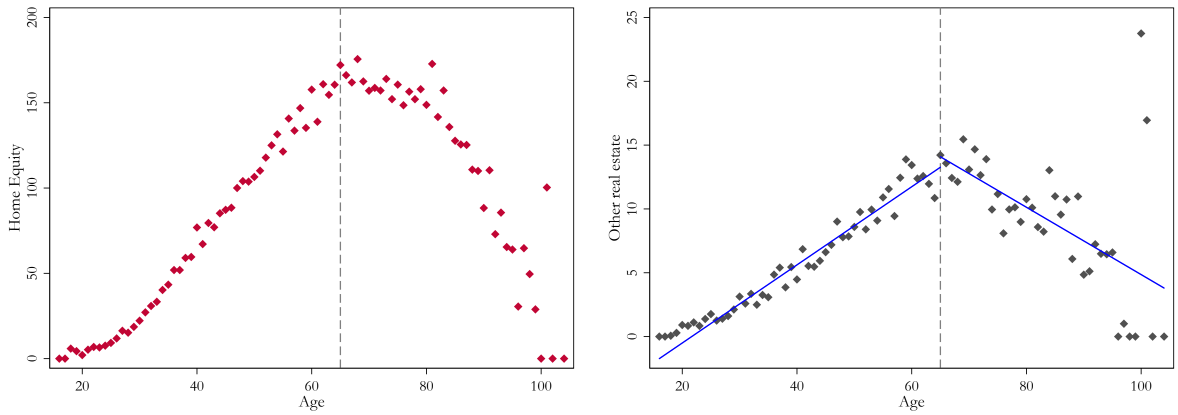
[b] Value of vehicles



[c] Value of other assets

Notes: The figure plots value of farm and business, value of vehicles and value to other assets owned by the household averaged over households against age of the head of the household. The data is a pooled sample of PSID for waves 1999-2015. The amounts are plotted in thousands 2010 dollars.

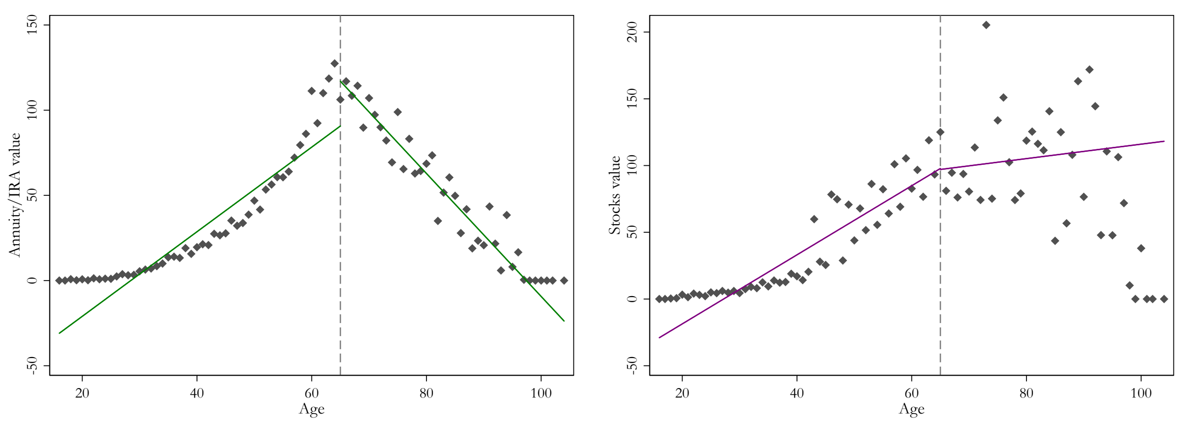
Figure 3.16: **Home equity and other real estate value over the lifecycle**



[a] Home equity [b] Other real estate

Notes: The figure plots value of home net of debt and other real estate owned by the household averaged over households against age of the head of the household. The data is a pooled sample of PSID for waves 1999-2015. The amounts are plotted in thousands 2010 dollars.

Figure 3.17: **Annuity/IRA and stocks over the lifecycle**

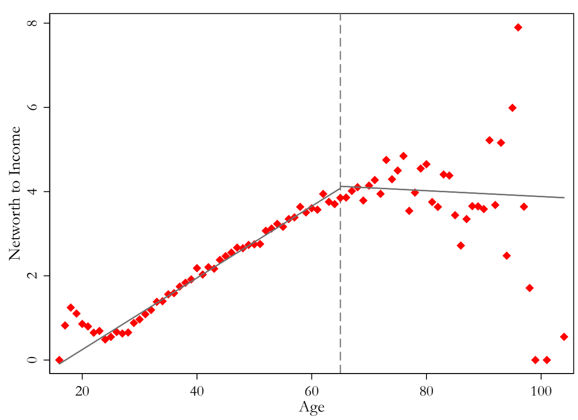


[a] Annuity/IRA accounts [b] Stocks

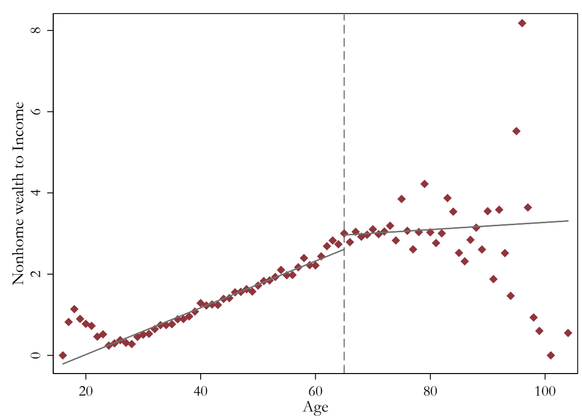
Notes: The figure plots value of annuity/IRA accounts and value of stocks owned by the household averaged over households against age of the head of the household. The data is a pooled sample of PSID for waves 1999-2015. The amounts are plotted in thousands 2010 dollars.

Figures 3.18 - 3.20 show how wealth grows relative to income during lifetime. Assets relative to income grows over life until retirement. This is not surprising since wealth is a stock variable while is flow variable. Even a constant savings rate will increase wealth to income ratio. At retirement the ratio is mostly constant except for relatively liquid assets. This again shows old households' tendency to keep wealth in liquid forms. On the other hand, debt to income ratio decline throughout life except for very young households until the age of 30. Households accumulate debt very rapidly early in life then start paying off around 30s.

Figure 3.18: **Wealth to Income Ratio over the lifecycle in PSID**



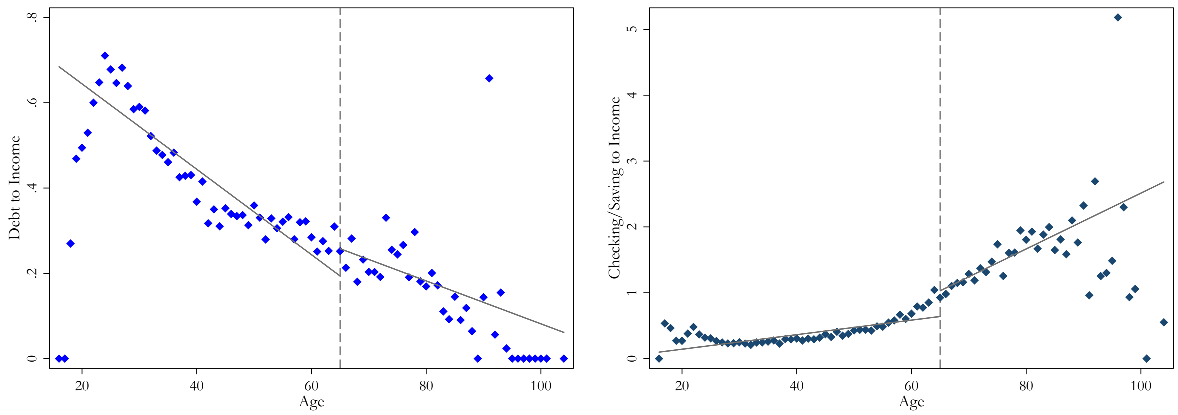
[a] networth to income



[b] Nonhousing net wealth to income

Notes: The figure plots networth to income ratio and nonhousing wealth to income ratio against age of the head of the household for households in 1999-2015 waves of PSID. Income is total income after taxes plus credits.

Figure 3.19: **Debt to Income Ratio and Checking/Savings to Income Ratio over the lifecycle in PSID**

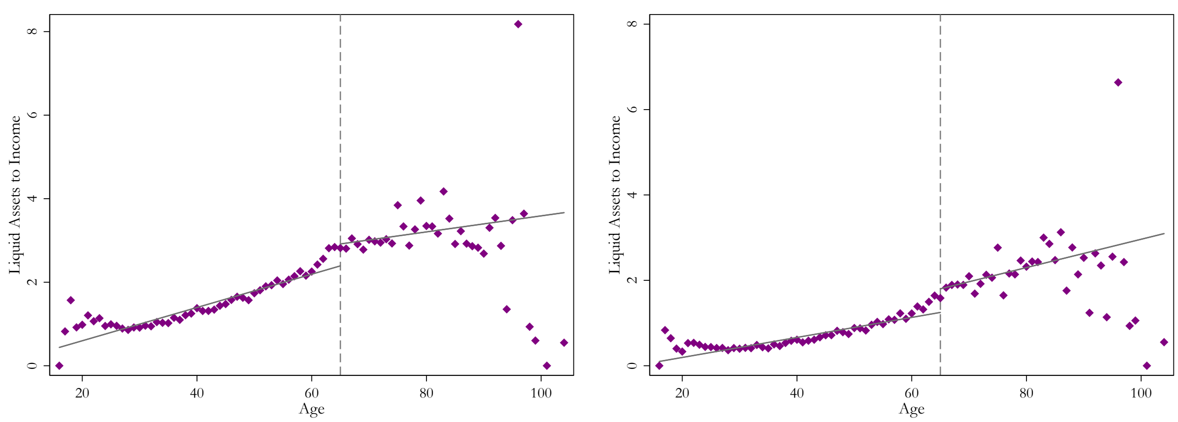


[a] Debt to Income

[b] Checking/Savings to Income

Notes: The figure plots debt to income ratio and checking/savings to income ratio against age of the head of the household for households in 1999-2015 waves of PSID. Debt excludes residential mortgages and vehicle loans. Income is total income after taxes plus credits.

Figure 3.20: **Liquid assets to Income in PSID**



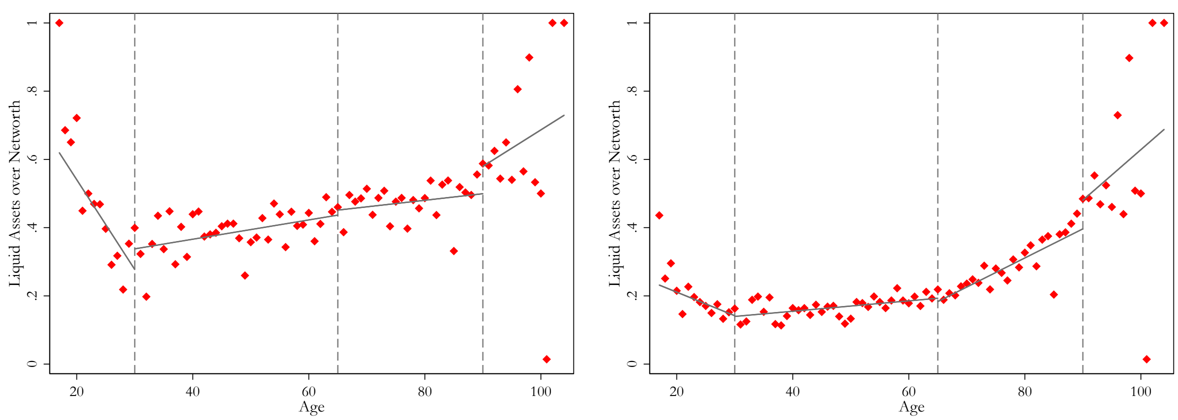
[a] Liquid assets to Income (broad)

[b] Liquid assets to Income (narrow)

Notes: The figure plots the ratio of liquid assets to income against age of the head of the household for households in 1999-2015 waves of PSID. Broad definition of liquid assets for PSID data is the sum of checking/savings account, stocks, value of vehicles, other assets and annuity/IRA. Narrow definition of liquid assets is the sum of checking/savings account, stocks, and other assets. Income is total income after taxes plus credits.

Figures 3.21 and 3.22 plots the share of liquid assets to networth over the lifecycle. The ratio is high in 20s, early in working life. Then it decline and is almost constant for middle aged. These are the ages while households invest in housing, real estate and businesses. The ratio is increasing after retirement which is consistent with the finding in previous graphs such that old households decumulate or deliquidate illiquid assets and keep liquid assets.

Figure 3.21: **Liquidity share in wealth over the lifecycle in PSID**

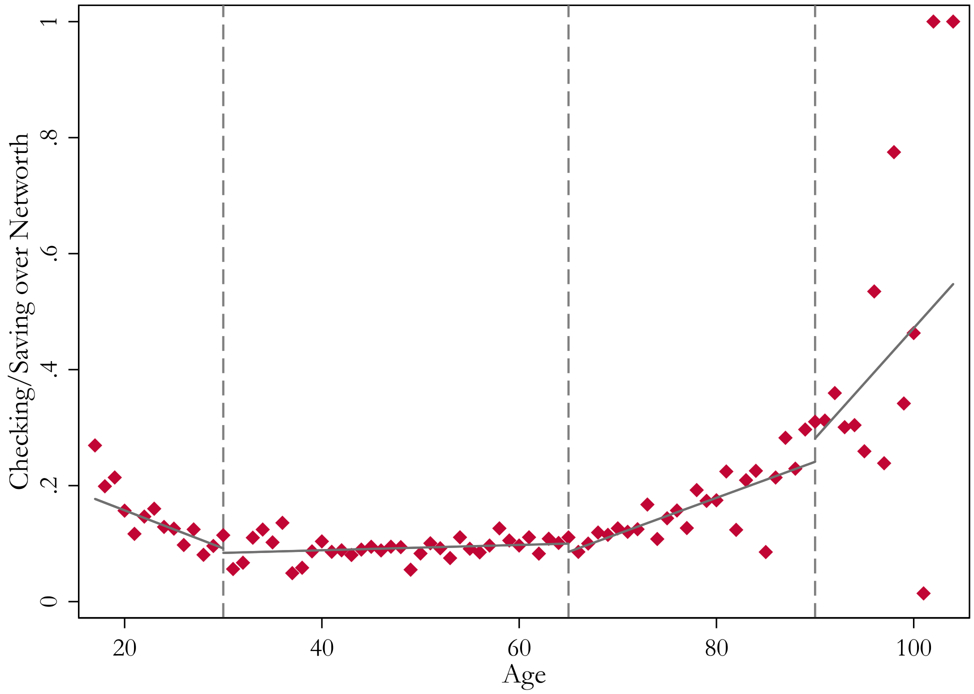


[a] Liquid assets to networth (broad)

[b] Liquid assets to networth (narrow)

Notes: The figure plots the ratio of liquid assets to networth against age of the head of the household for households in 1999-2015 waves of PSID. Broad definition of liquid assets for PSID data is the sum of checking/savings account, stocks, value of vehicles, other assets and annuity/IRA. Narrow definition of liquid assets is the sum of checking/savings account, stocks, and other assets. Income is total income after taxes plus credits.

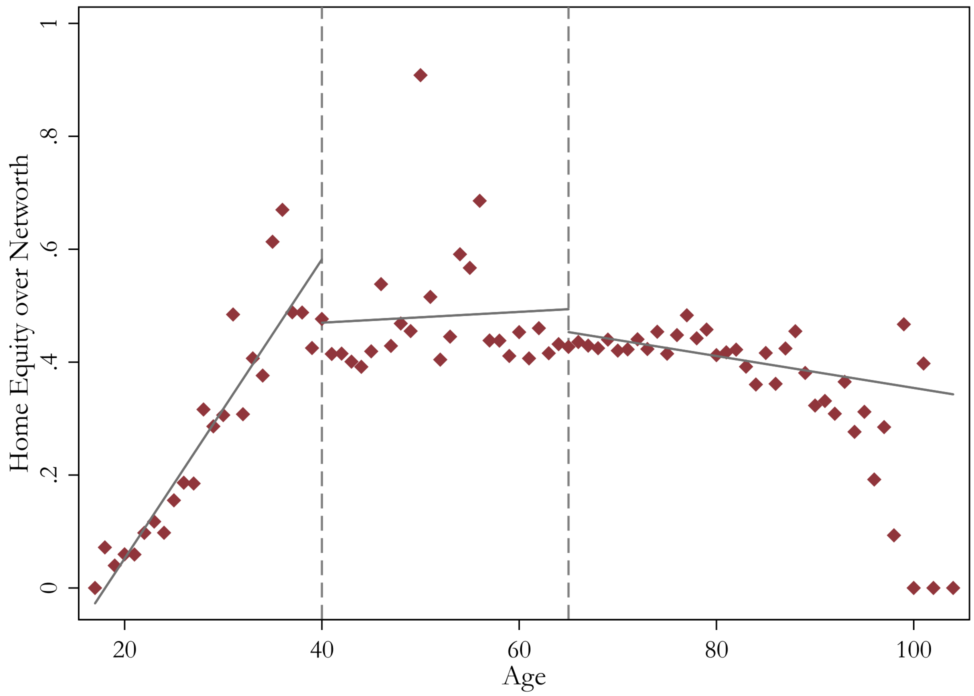
Figure 3.22: **Checking/Savings share in wealth over the lifecycle in PSID**



Checking/Savings to networth

Notes: The figure plots Checking/Savings account share in net wealth against age of the head of the household for households in PSID. Income is total income after taxes plus credits.

Figure 3.23: **Home equity share in wealth over the lifecycle in PSID**

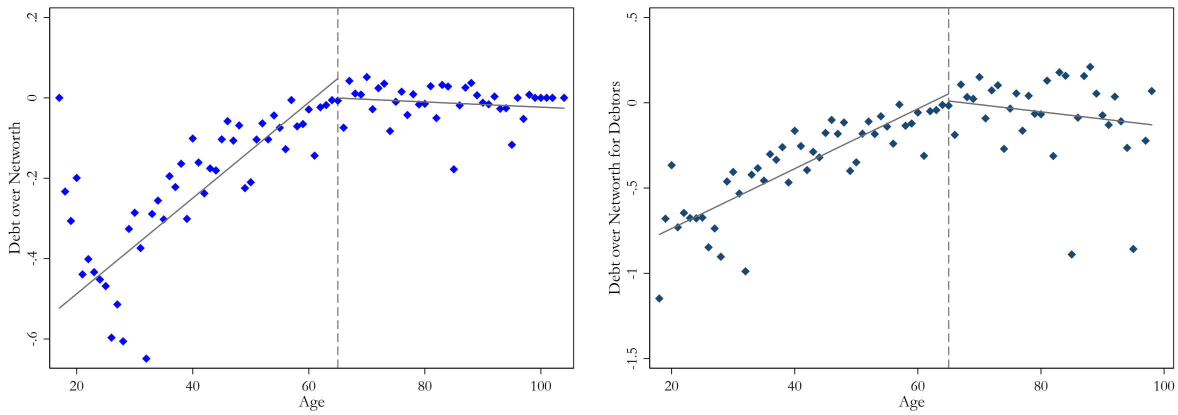


Home equity to networth

Notes: The figure plots home equity share in net wealth against age of the head of the household for households in PSID.

Home equity share increase sharply early in working life up until 40s as is shown in Figure 3.23. It is not surprising since most households' biggest invest is their houses. Figures 3.24 and Figure 3.25 plots debt share in networth for all households and also for households with positive networth. The reversal of figures for positive networth households is because of the statistical averaging of negative and positive values. Negative ratio for negative networth households are higher than positive values and dominates in simple averages. As households pay their debt over time, the negative average increase towards zero.

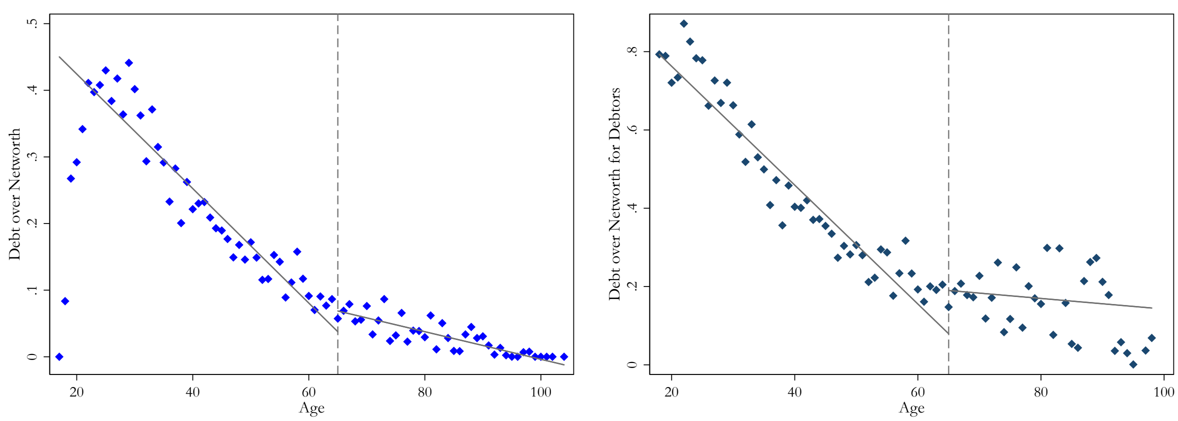
Figure 3.24: **Debt share in networth over the lifecycle in PSID**



[a] Debt to networth ratio [b] Debt to networth ratio for debtors

Notes: The figure plots debt to networth ratio against age of the head of the household for households in 1999-2015 waves of PSID. Debt excludes residential mortgages and vehicle loans.

Figure 3.25: **Debt share in networth for positive networth households over the lifecycle in PSID**



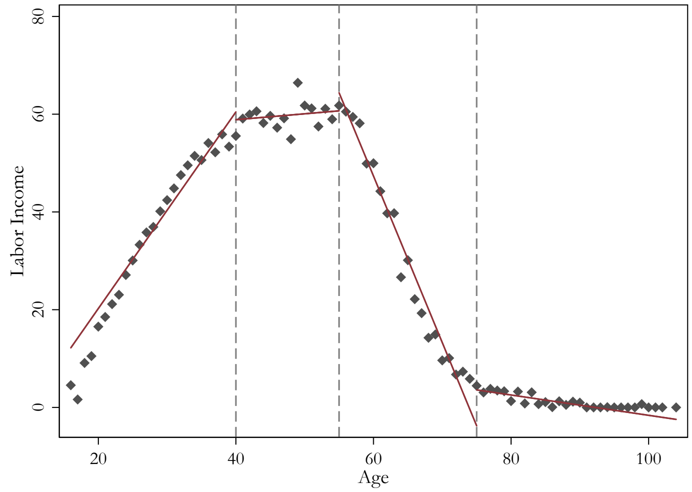
[a] Debt to networth ratio [b] Debt to networth ratio for debtors

Notes: The figure plots debt to networth ratio against age of the head of the household for positive networth values for households in 1999-2015 waves of PSID. Debt excludes residential mortgages and vehicle loans.

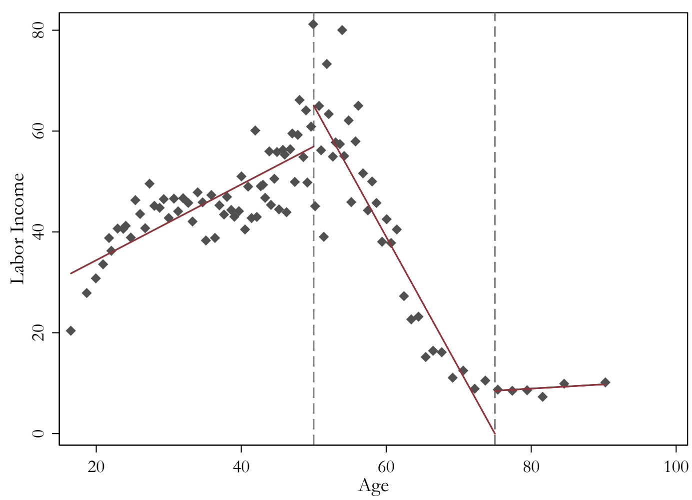
3.3.3 Income over the Lifecycle

Income has an hump shape over the lifecycle. Figures 3.26 - 3.28 plot the household labor, total family and disposable incomes respectively. Panel b in the figures are adjusted for the family size and the number of children. After the adjustment, the plots look more like inverted V shapes. In all the figures, the income peaks around the age of 50-55, then starts to decline. the reason for why income declines before retirement age 65 can be a composition effect. Some households might be retiring early, or working part time due to illnesses or disability arising later in working life. The curve flattens only after 75 which points to late retirement for some households.

Figure 3.26: **Household labor income over the lifecycle**



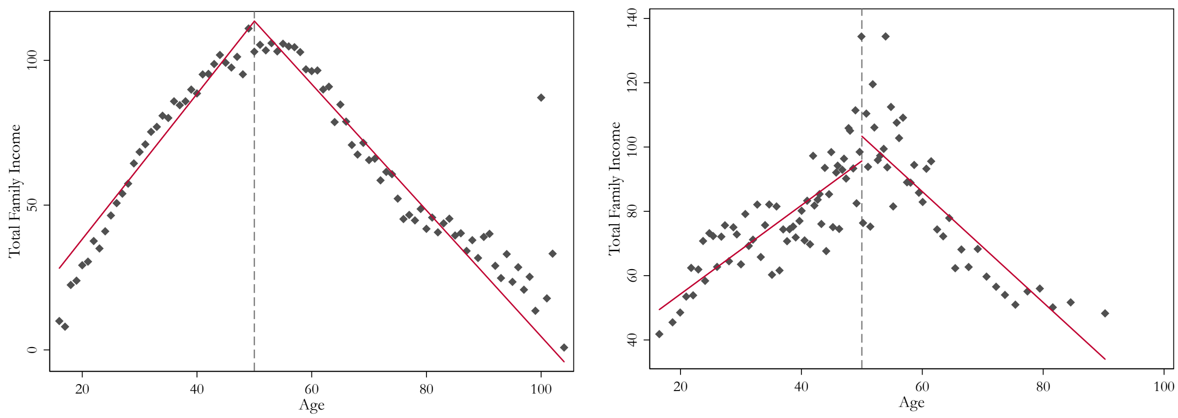
[a] Labor income



[b] Labor income adjusted for family size and composition

Notes: The figure plots total household labor income averaged over households by the age of the head. The data is a pooled sample of PSID for waves 1999-2015. The amounts are plotted in thousands 2010 dollars. Family size and the number of children are partialled out in the adjusted figure.

Figure 3.27: **Total family income over the lifecycle**

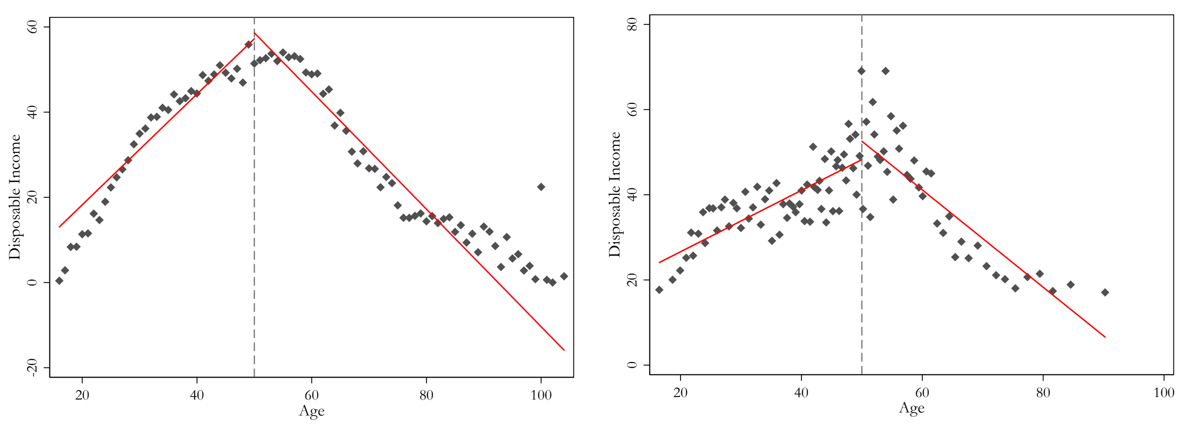


[a] Family income

[b] Family income adjusted for family size and composition

Notes: The figure plots total family income including labor and capital income averaged over households by the age of the head. The data is a pooled sample of PSID for waves 1999-2015. The amounts are plotted in thousands 2010 dollars. Family size and the number of children are partialled out in the adjusted figure.

Figure 3.28: **Disposable income over the lifecycle**



[a] Disposable income

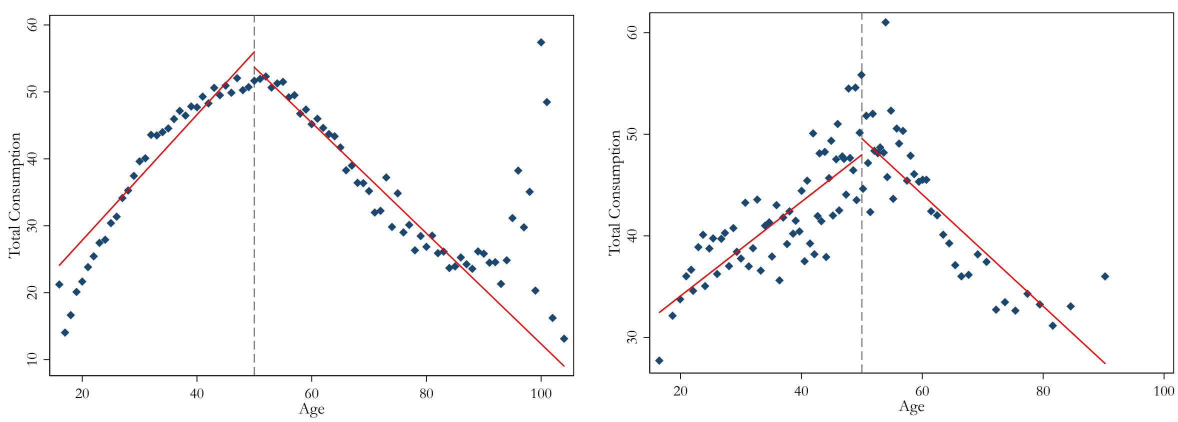
[b] Disposable income adjusted for family size and composition

Notes: The figure plots household income net of taxes paid and averaged over households by the age of the head. The data is a pooled sample of PSID for waves 1999-2015. The amounts are plotted in thousands 2010 dollars. Family size and the number of children are partialled out in the adjusted figure.

3.3.4 Consumption over the Lifecycle

The shape of consumption path throughout life is very similar to income except for healthcare expenditures. This suggests that households are not perfectly smoothing their consumption in their lifetime. For healthcare expenditures, households spend more on healthcare as they age even after retirement. This observation is true even after adjusting for family size and composition. At the retirement age 65, there is a level drop in the trend for health expenditures indicating the effect of Medicare eligibility at his age.

Figure 3.29: **Total consumption over the lifecycle**

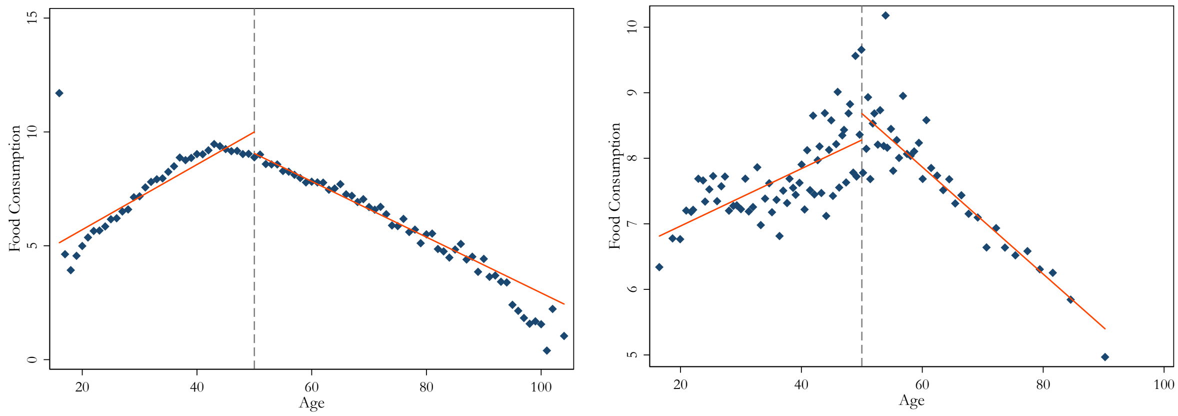


[a] Total consumption

[b] Total consumption adjusted for family size and composition

Notes: The figure plots total household consumption averaged over households by the age of the head. The data is a pooled sample of PSID for waves 1999-2015. The amounts are plotted in thousands 2010 dollars. Family size and the number of children are partialled out in the adjusted figure.

Figure 3.30: **Food Consumption over the lifecycle**

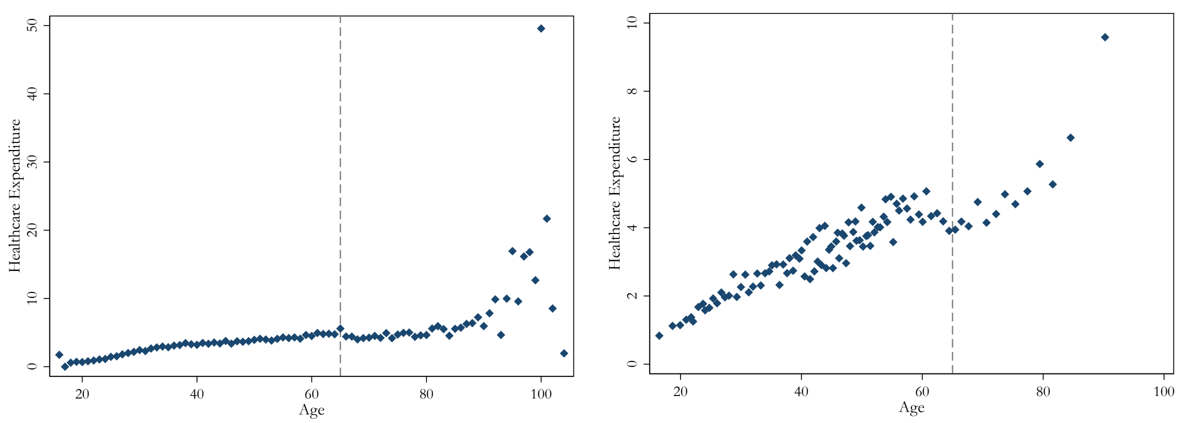


[a] Food consumption

[b] Food consumption adjusted for family size and composition

Notes: The figure plots household food consumption averaged over households by the age of the head. The data is a pooled sample of PSID for waves 1999-2015. The amounts are plotted in thousands 2010 dollars. Family size and the number of children are partialled out in the adjusted figure.

Figure 3.31: **Healthcare Expenditures over the lifecycle**

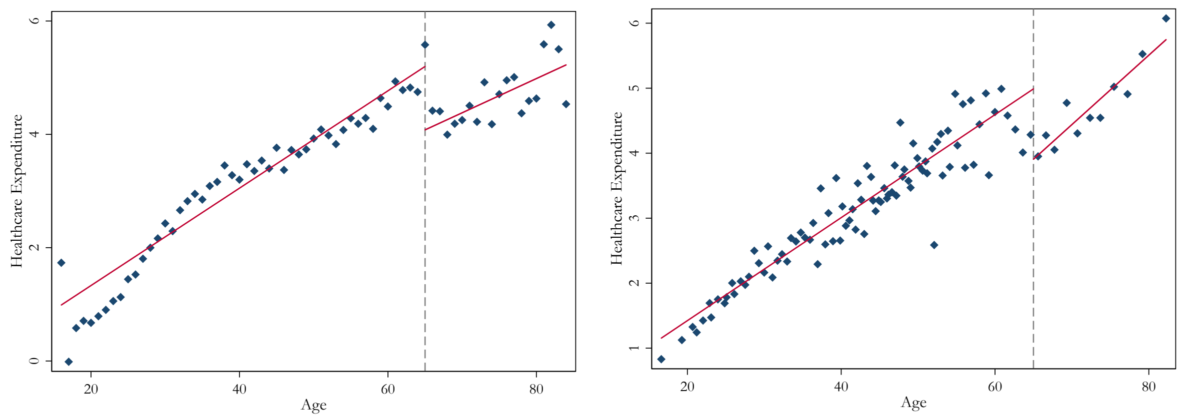


[a] Healthcare expenditures

[b] Healthcare expenditures adjusted for family size and composition

Notes: The figure plots household healthcare expenditure averaged over households by the age of the head. The data is a pooled sample of PSID for waves 1999-2015. The amounts are plotted in thousands 2010 dollars. Family size and the number of children are partialled out in the adjusted figure.

Figure 3.32: **Healthcare Expenditures for 85 years old and younger**



[a] Healthcare expenditures

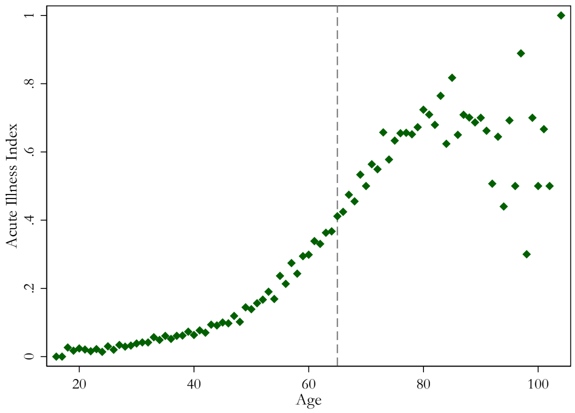
[b] Healthcare expenditures adjusted for family size and composition

Notes: The figure plots household healthcare expenditure for 85 years old and younger that is averaged over households by the age of the head. The data is a pooled sample of PSID for waves 1999-2015. The amounts are plotted in thousands 2010 dollars. Family size and the number of children are partialled out in the adjusted figure.

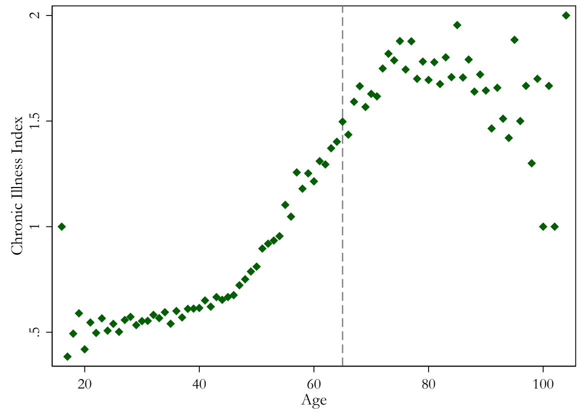
3.3.5 Health over the Lifecycle

Health is an important part of household well-being. It is important to assess its lifecycle dynamics and its relation to income and wealth. I construct two indices that count the number of acute and chronic illnesses for head and spouse of the household. Figure 3.33 plots acute index, chronic index and their sum over the lifecycle. As expected, the illnesses increase as the households ages. There is decline after around age 80 which is due to the survival bias. The relatively healthier households live longer past age 80.

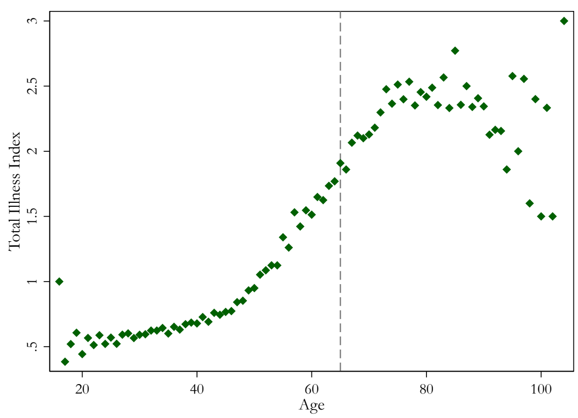
Figure 3.33: **Family health status over the lifecycle**



[a] Acute illnesses index



[b] Chronic illnesses index

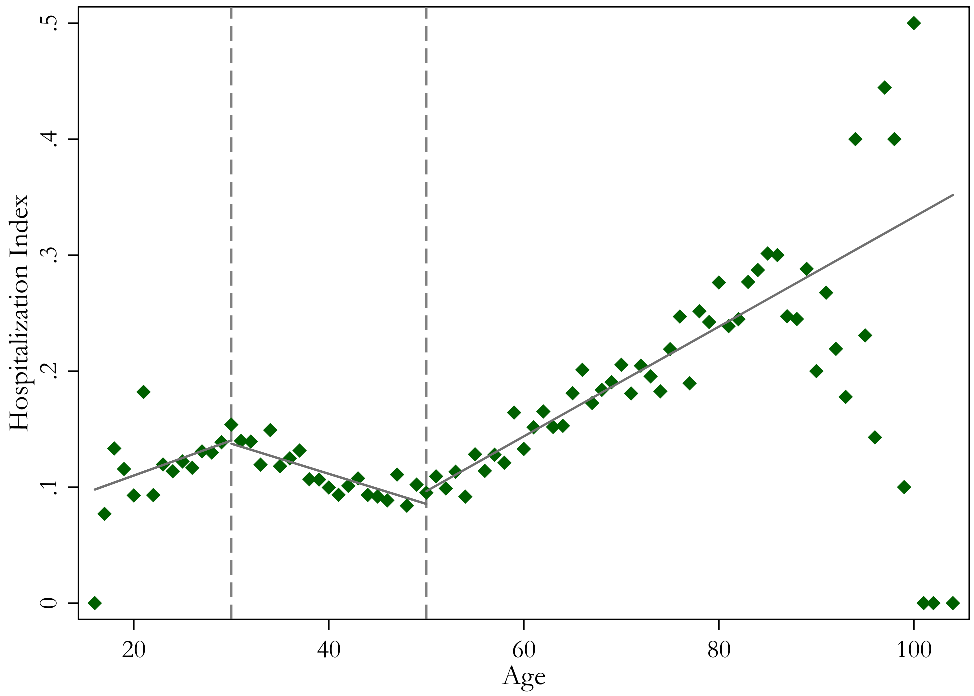


[c] Total illnesses index

Notes: The figure plots households acute index, chronic index and total index changes that is averaged over households by the age of the head. The data is a pooled sample of PSID for waves 1999-2015.

Figure 3.34 plots the hospitalization index that is constructed whether household head or spouse is hospitalized during the year. Hospitalizations increase with age in general. However, there is a small local peak around age 30. This peak is possibly due to the hospital stay of young women that give birth.

Figure 3.34: **Hospitalization over the lifecycle**



Hospitalization index

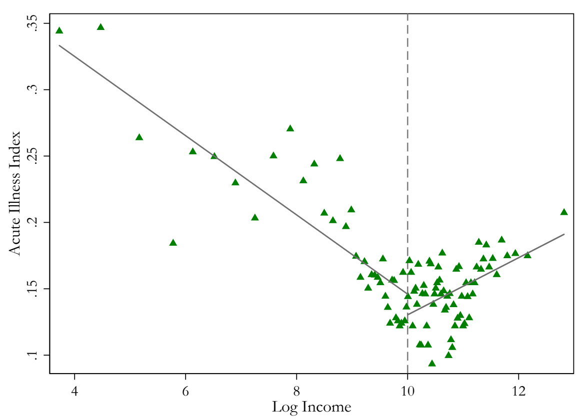
Notes: The figure plots households hospitalization index changes that is averaged over households by the age of the head. The data is a pooled sample of PSID for waves 1999-2015.

3.3.6 Health-Income Gradient

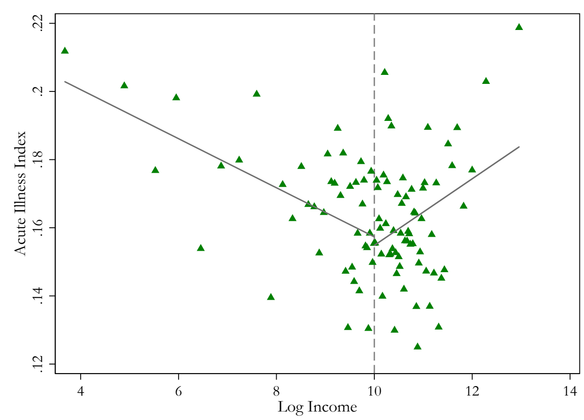
The relationship of health and income is essentially important where the society is aging and where the income distribution is getting more skewed. The high correlation of income with health points to an increase for healthcare in the future as the share of old population increases. On the other hand, the fact that income and health are highly correlated even after controlling for age warns against an increase in health inequality as the income inequality worsens.

The correlation between health status and income is shown in Figure 3.35 - 3.37. The figures plot acute index, chronic index and hospitalization index against disposable income. The panel a in all figures plot unadjusted index. The age profile of indices reveal high age effects in the number of illnesses in the family. Therefore, the panel b in the figures plot the residual indices adjusted for age effects. Acute index does not show a high income correlation. On the other hand, chronic index is highly negatively correlated with income. This relation is true even after the age effects are taken out. [1] Hospitalization is also negatively correlated with income though not as high as chronic index.

Figure 3.35: **Acute illnesses status by income**



[a] Acute illnesses index

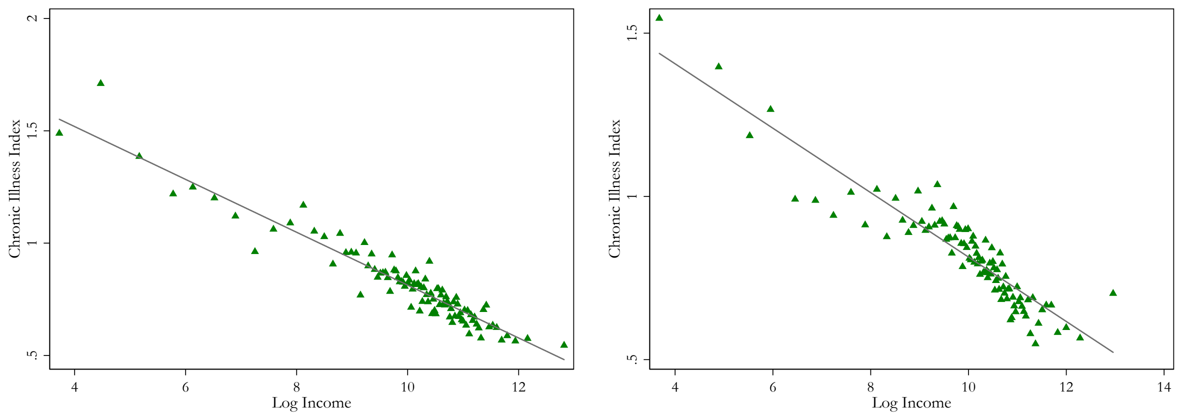


[b] Acute illnesses index adjusted for age

Notes: The figure plots households acute index changes unadjusted and adjusted for age effects that is averaged over households by the age of the head. The data is a pooled sample of PSID for waves 1999-2015.

[1]The plotted indices are residuals of a linear regression on age of the household. The results are similar if a quadratic polynomial in age is used.

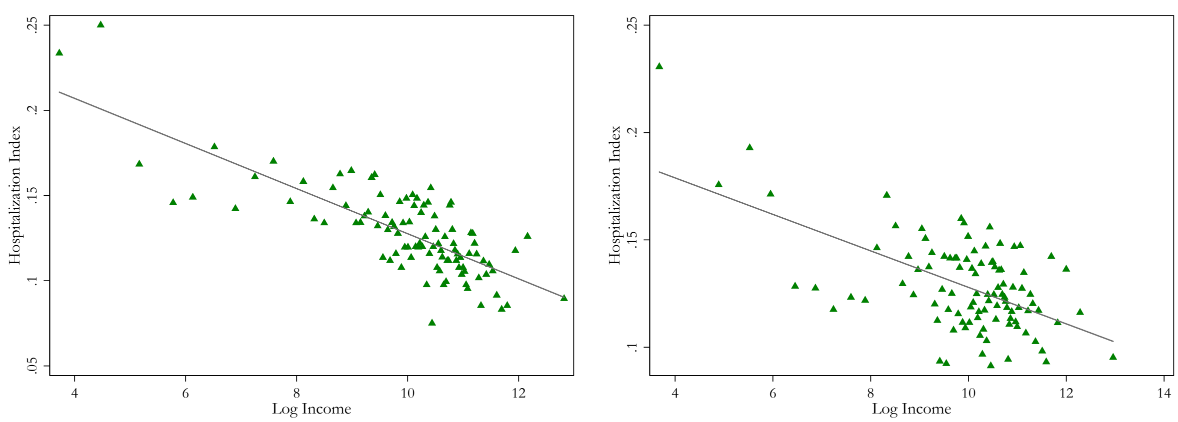
Figure 3.36: **Chronic illnesses status by income**



[a] Chronic illnesses index [b] Chronic illnesses index adjusted for age

Notes: The figure plots households chronic index changes unadjusted and adjusted for age effects that is averaged over households by the age of the head. The data is a pooled sample of PSID for waves 1999-2015.

Figure 3.37: **Hospitalization status by income**



[a] Hospitalization index [b] Hospitalization index adjusted for age

Notes: The figure plots households hospitalization index changes unadjusted and adjusted for age effects that is averaged over households by the age of the head. The data is a pooled sample of PSID for waves 1999-2015.

These negative correlations do not give information about the causal relation. It is possible that low income leads to lower nutrition, worse self care which results in worsening of health status. On the other hand, the low health workers are possibly less productive and therefore earn lower incomes.

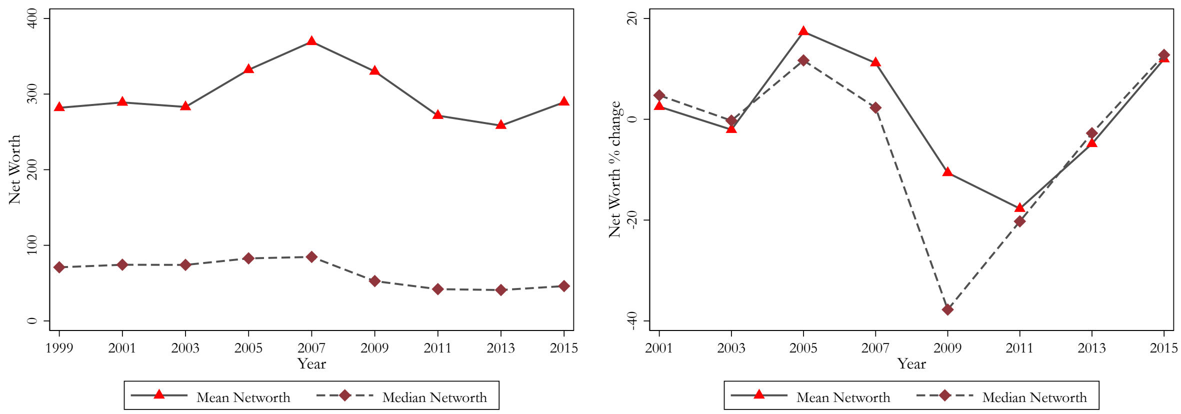
3.4 Welfare over the Business Cycle

This section presents the dynamics in household wealth, income and consumption over 1999-2015 time period. This period involves one of the most severe economic downturn in US history. The Great Recession from 2007 to 2009 has tremendous effect on household wellbeing.

3.4.1 Wealth, Income and Consumption over the Business Cycle

Figure 3.38 and Figure 3.39 plots mean and percentiles of household networth and their percent changes from previous period(2 years) for 1999-2015 time period. The figures clearly show the drop in networth from 2007 to 2009 and the drop is present across the distribution of networth. Similar results are observed for wealth excluding home equity.

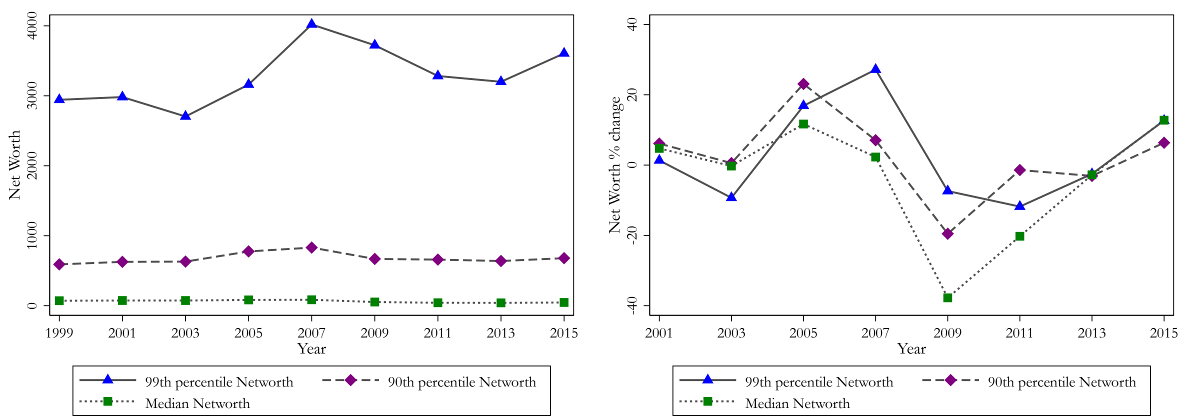
Figure 3.38: **Networth over time**



[a] Networth [b] % change in Networth

Notes: The figure plots mean and median net household wealth over years 1999-2015. The data is taken from 1999-2015 waves of PSID. The amounts are plotted in thousands 2010 dollars.

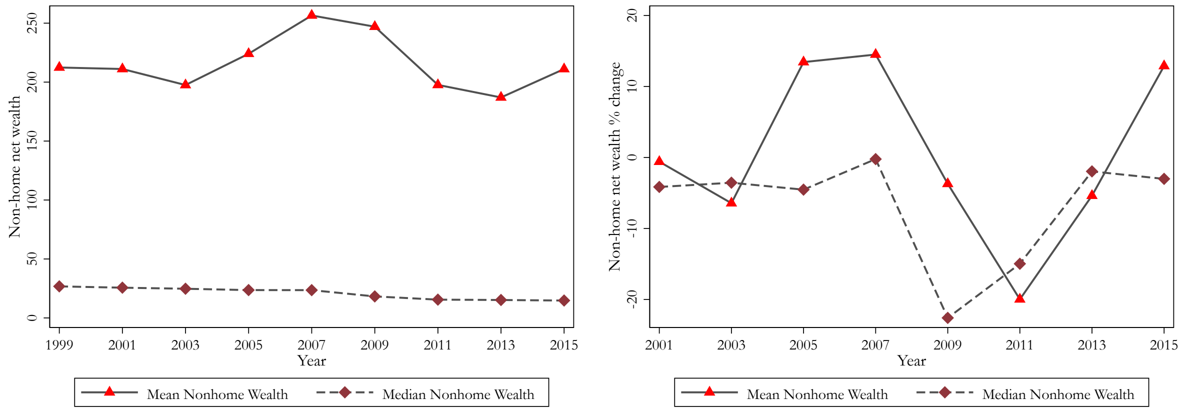
Figure 3.39: **Percentiles of Networth over time**



[a] Percentiles of net household wealth [b] % change in percentiles of net household wealth

Notes: The figure plots median, 90th and 99th percentiles of net household wealth over years 1999-2015. The data is taken from 1999-2015 waves of PSID. The amounts are plotted in thousands 2010 dollars.

Figure 3.40: **Nonhousing wealth over time**



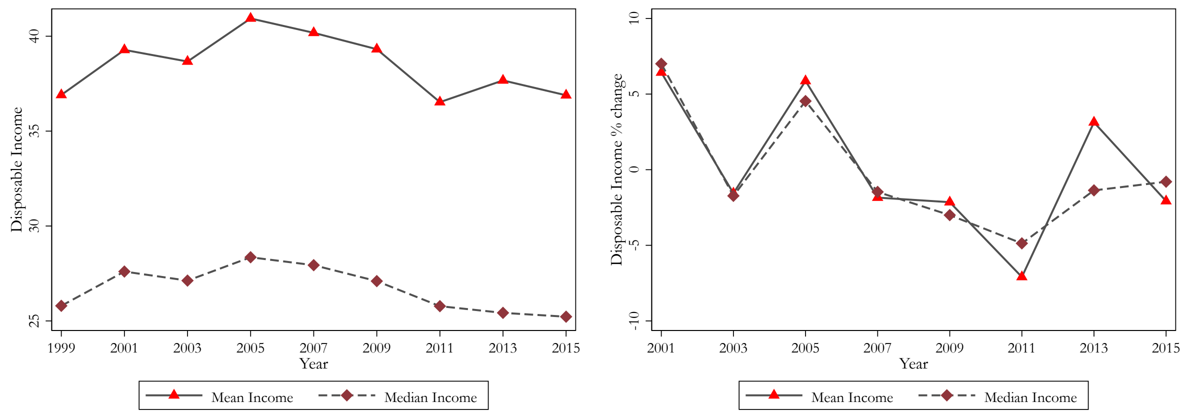
[a] Networth without home equity

[b] % change in networth without home equity

Notes: The figure plots mean and median net household wealth excluding home equity over years 1999-2015. The data is taken from 1999-2015 waves of PSID. The amounts are plotted in thousands 2010 dollars.

Figures 3.41 and 3.42 show the drop in disposable income and consumption during the recession and the recovery afterwards.

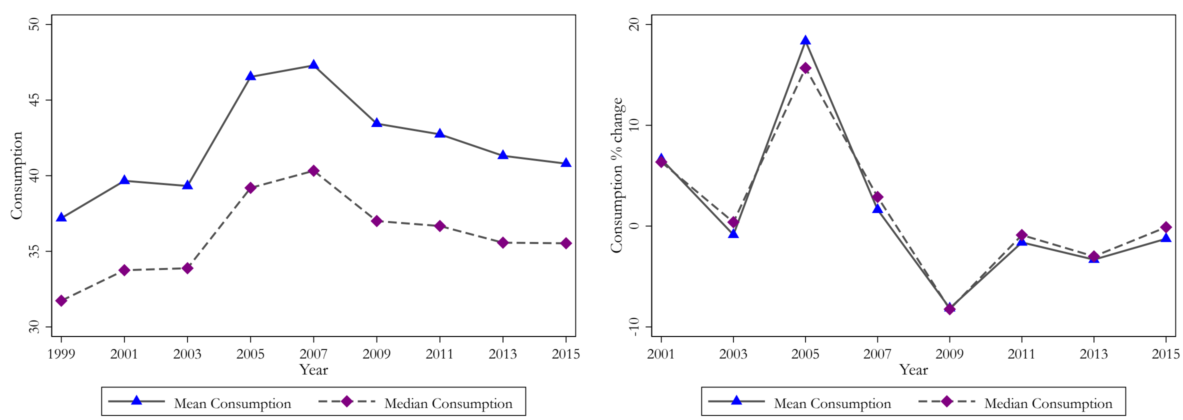
Figure 3.41: **Disposable Income over time**



[a] Disposable income [b] % change in disposable income

Notes: The figure plots mean and median net household income net of taxes for years 1999-2015. The data is taken from 1999-2015 waves of PSID. The amounts are plotted in thousands 2010 dollars.

Figure 3.42: **Consumption over time**

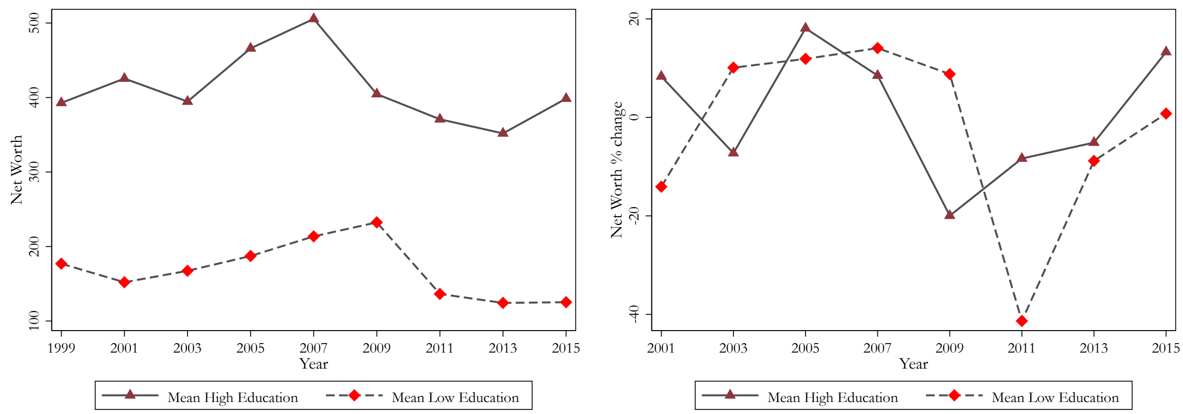


[a] Total household consumption [b] % change in total household consumption

Notes: The figure plots mean and median of total household consumption for years 1999-2015. The data is taken from 1999-2015 waves of PSID. The amounts are plotted in thousand 2010 dollars.

Figures 3.43 and 3.44 and 3.45 show the change in networth by education, sex and race of the head of the household. Although the fall during the recession is prevalent for all demographic groups, it is more severely felt by low educated, non-white and female households.

Figure 3.43: **Networth by education over time**

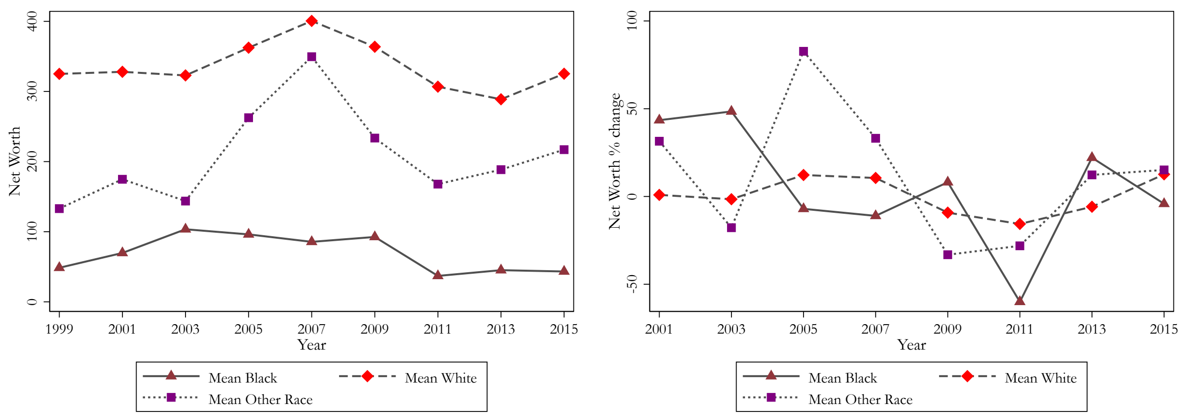


[a] Mean networth

[b] % change in mean networth

Notes: The figure plots mean networth for high and low educated households for years 1999-2015. The data is taken from 1999-2015 waves of PSID. The amounts are plotted in thousands 2010 dollars.

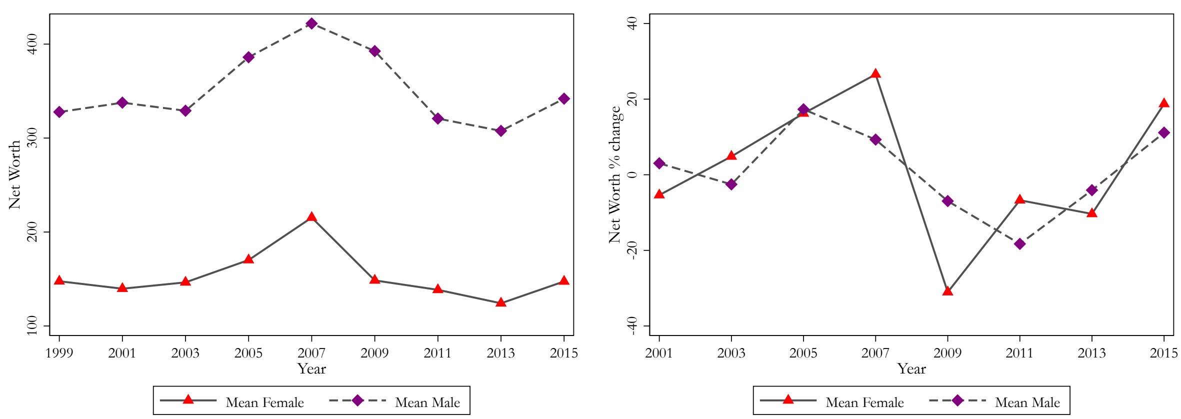
Figure 3.44: **Networth by race over time**



[a] Mean networth [b] % change in mean networth

Notes: The figure plots mean networth for race categories for years 1999-2015. The data is taken from 1999-2015 waves of PSID. The amounts are plotted in thousands 2010 dollars.

Figure 3.45: **Networth by sex over time**

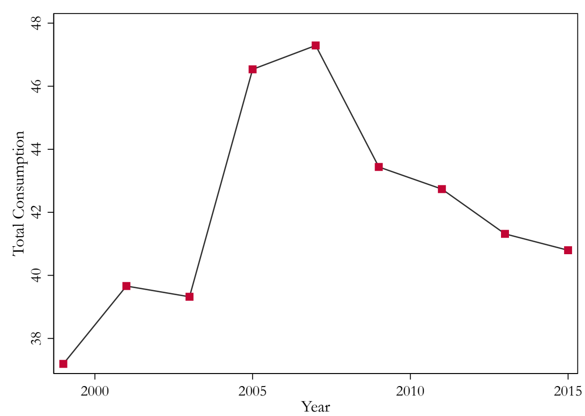


[a] Mean networth [b] % change in mean networth

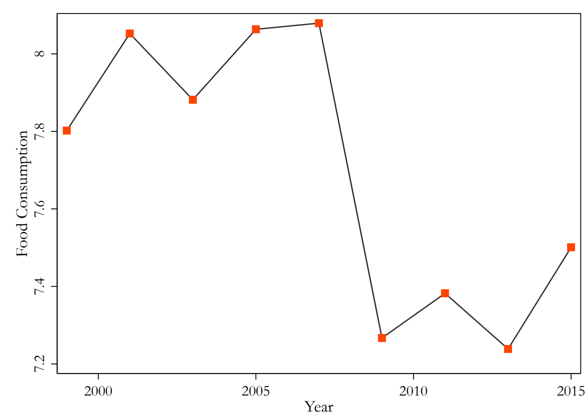
*Notes:*The figure plots mean networth for female and male headed households for years 1999-2015. The data is taken from 1999-2015 waves of PSID. The amounts are plotted in thousands 2010 dollars.

Figure 3.46 plots average consumption for 1999-2015. Consumption falls during the recession. This is particularly interesting for household out-of-pocket healthcare expenditures which had an increasing trend over many years. However, the effect of the recession seem to be short-lived.

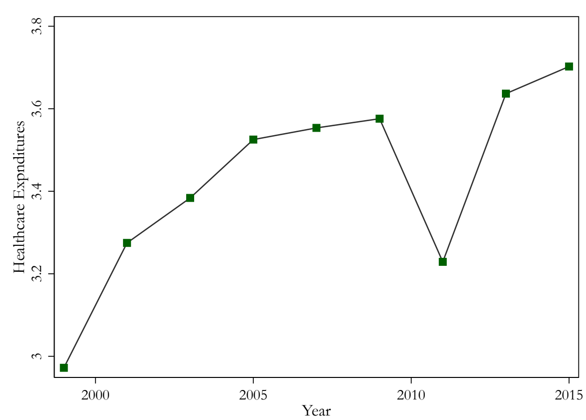
Figure 3.46: **Consumption over the business cycle**



[a] Total consumption



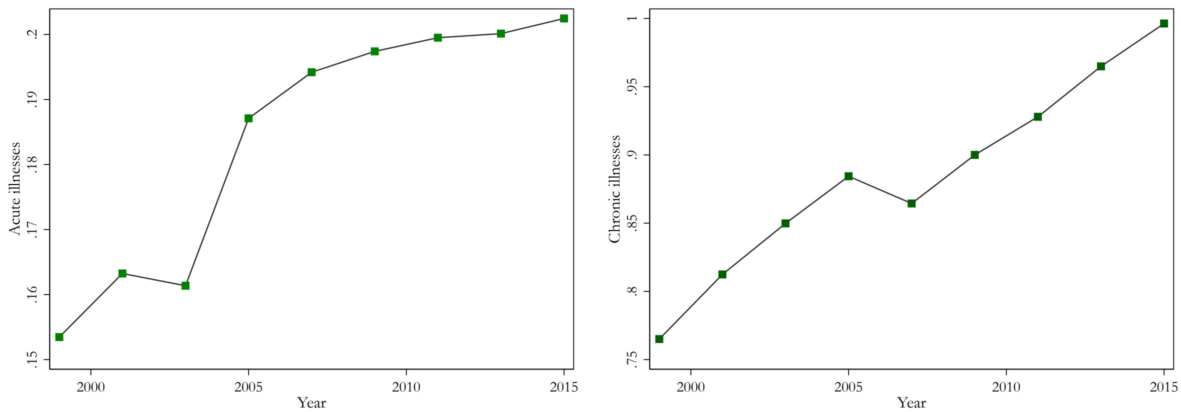
[b] Food consumption



[c] Healthcare expenditures

Notes: The figure plots total, food and healthcare expenditures for years 1999-2015. The data is taken from 1999-2015 waves of PSID. The amounts are plotted in thousands 2010 dollars.

Figure 3.47: **Health status over the business cycle**



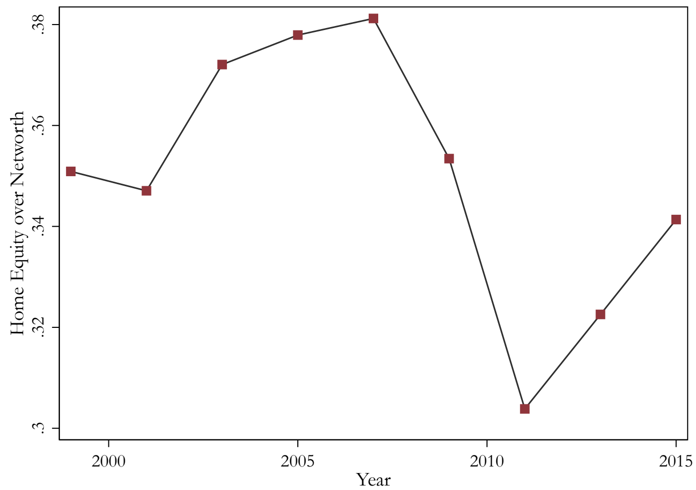
[a] Acute illnesses index

[b] Chronic illnesses index

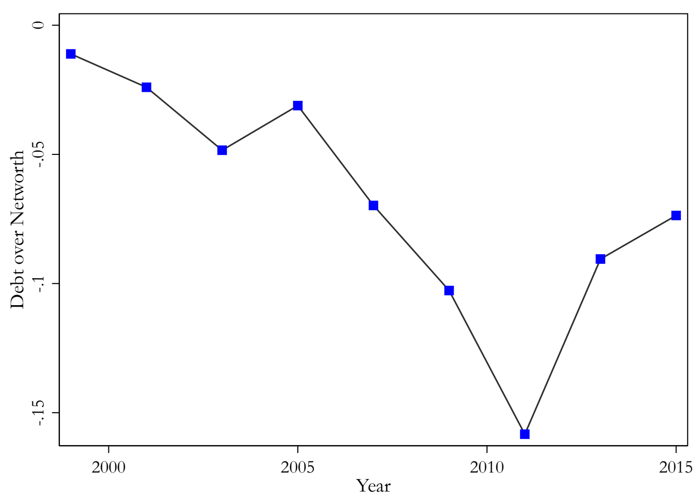
Notes: The figure plots household health indices for years 1999-2015. The data is taken from 1999-2015 waves of PSID.

Figures 3.48 to 3.53 show the change in household portfolios over 1999-2015. The recession adversely affected all the measures of household wealth and this effect is more severe for the most vulnerable households, namely for female, non-white and low educated.

Figure 3.48: **Portfolio over the business cycle**



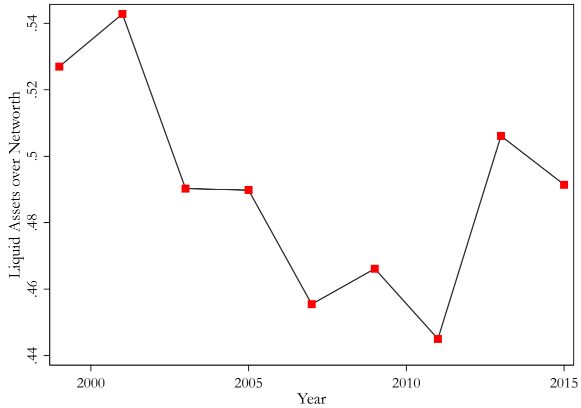
[a] Home equity to networth



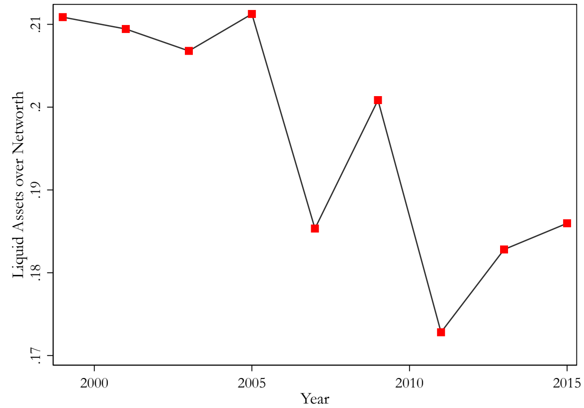
[b] Debt to networth

Notes: The figure plots ratios of home equity and debt to household net wealth for years 1999-2015. The data is taken from 1999-2015 waves of PSID.

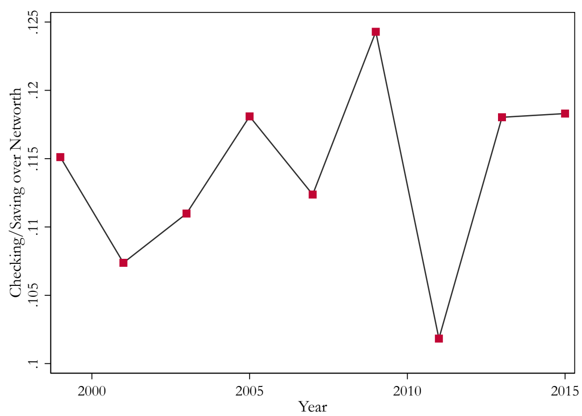
Figure 3.49: **Liquidity over the business cycle**



[a] Liquid assets to networth (broad)



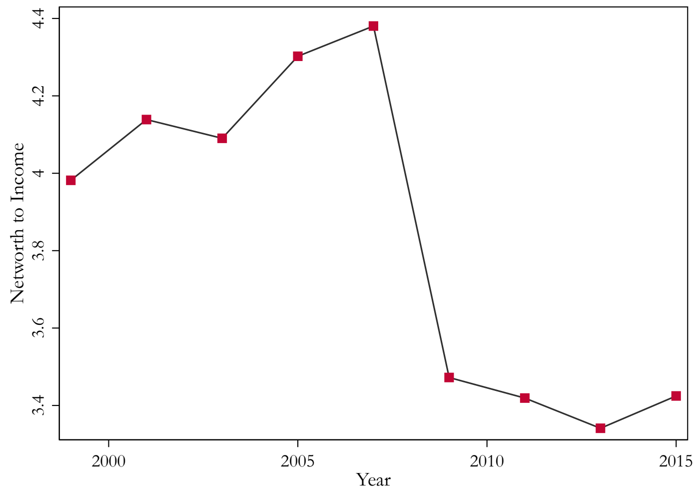
[b] Liquid assets to networth (narrow)



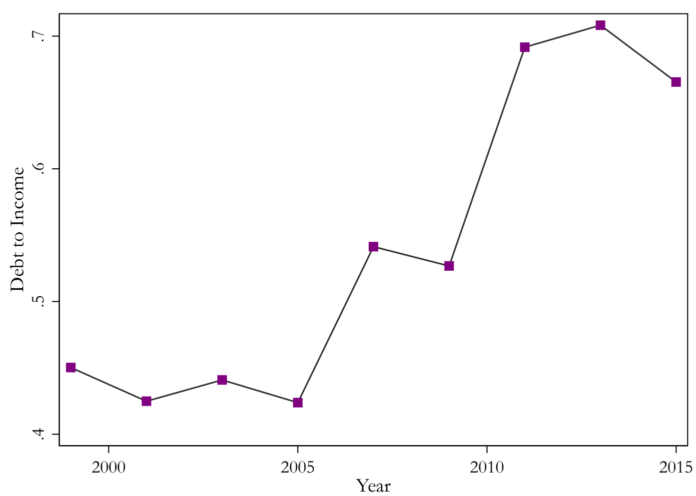
[c] Checking/Saving to networth

Notes: The figure plots ratios of liquid assets, and checking/saving to net wealth for years 1999-2015. The data is taken from 1999-2015 waves of PSID. Broad definition of liquid assets for PSID data is the sum of checking/savings account, stocks, value of vehicles, other assets and annuity/IRA. Narrow definition of liquid assets is the sum of checking/savings account, stocks, and other assets.

Figure 3.50: **Wealth to income over the business cycle**



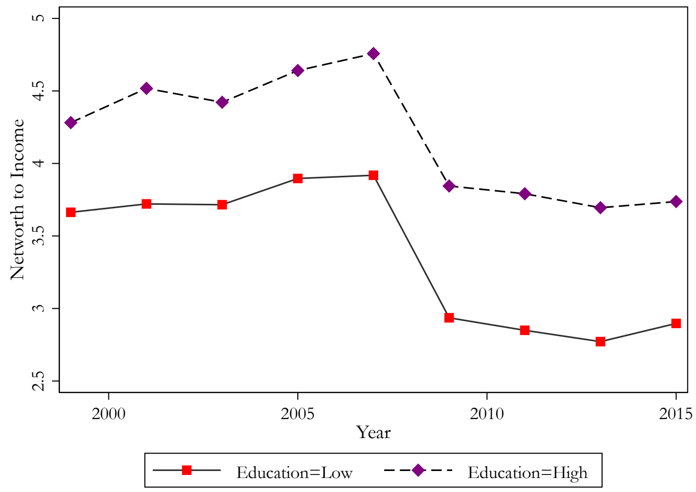
[a] Networth to income



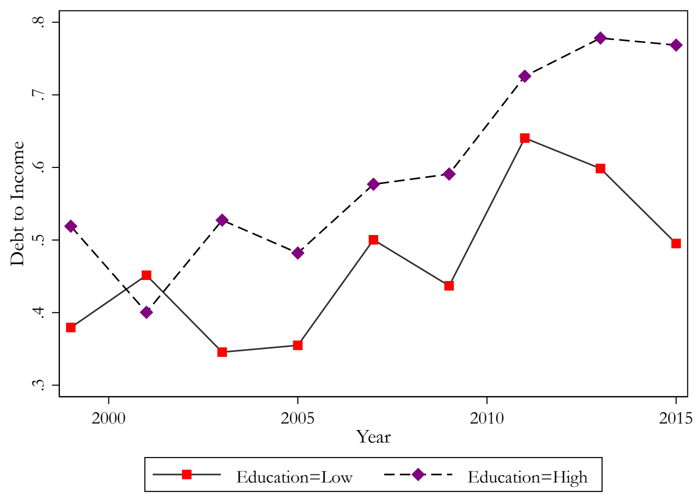
[b] Debt to income

Notes: The figure plots networth to income and debt to income ratios for years 1999-2015. The data is taken from 1999-2015 waves of PSID. Income is total income after taxes plus credits.

Figure 3.51: **Wealth to income by education over the business cycle**



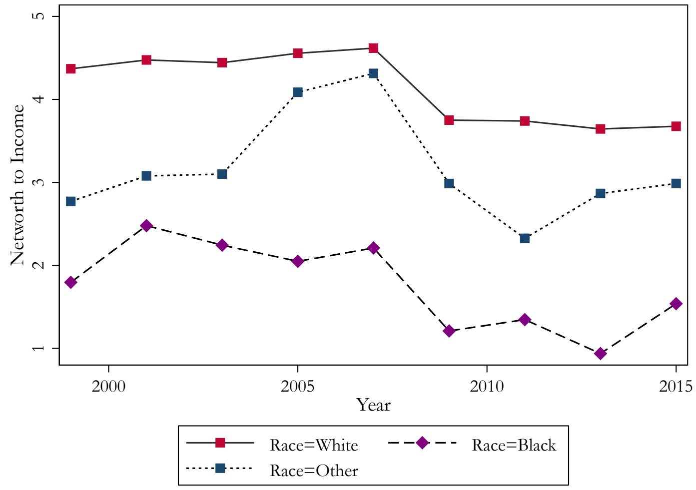
[a] Networth to income



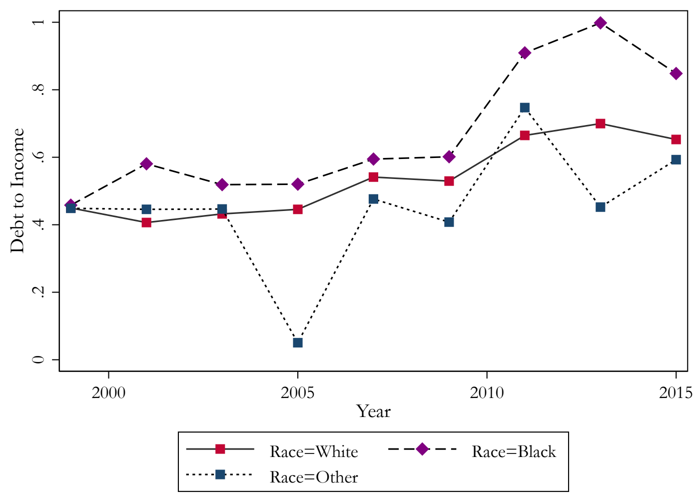
[b] Debt to income

Notes: The figure plots networth to income and debt to income ratios by education of the head of the household for years 1999-2015. The data is taken from 1999-2015 waves of PSID. Income is total income after taxes plus credits.

Figure 3.52: **Wealth to income by race over the business cycle**



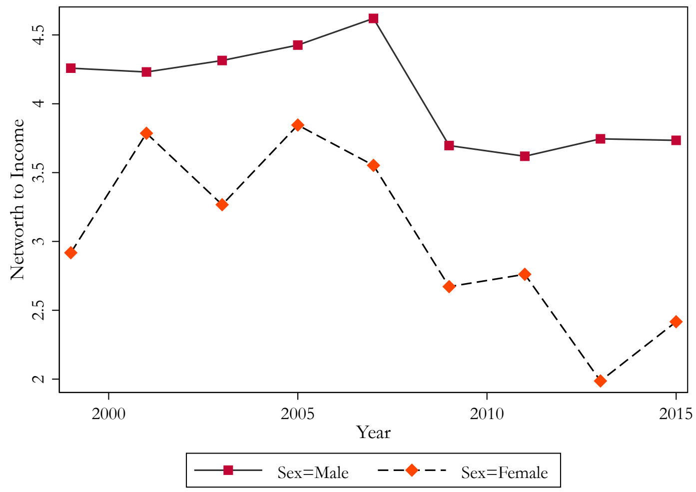
[a] Networth to income



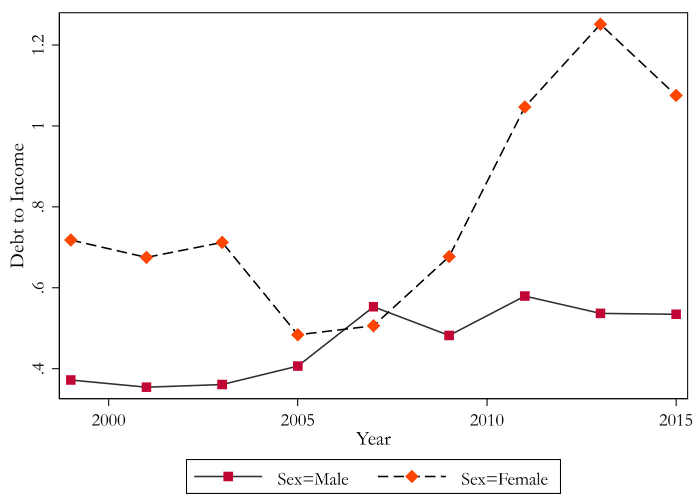
[b] Debt to income

Notes: The figure plots networth to income and debt to income ratios by race of the head of the household for years 1999-2015. The data is taken from 1999-2015 waves of PSID. Income is total income after taxes plus credits.

Figure 3.53: **Wealth to income by sex over the business cycle**



[a] Networth to income



[b] Debt to income

Notes: The figure plots networth to income and debt to income ratios by sex of the head of the household for years 1999-2015. The data is taken from 1999-2015 waves of PSID. Income is total income after taxes plus credits.

3.4.2 Poverty over the Business Cycle

In this section, I calculate poverty rate in PSID sample. I use weighted average poverty thresholds provided by the U.S. Census Bureau to calculate poverty rates. The thresholds vary by the number of persons in the family. I use disposable income to determine income poverty rates. Alternatively, before tax income is also used to calculate poverty rates in some measurements. The poverty thresholds are calculated to measure the fraction of households below an income threshold. I use the thresholds to calculate *Income Poverty* rate in the PSID sample. Additionally, I construct the fraction of households that have savings below the poverty threshold and call it *Asset Poverty* rate. This latter rate measures whether households have enough assets worth of a year's income. The poverty thresholds by the Census Bureau is provided in Table C.6 in the Appendix. Table 3.1 gives the poverty rates for the pooled sample between 1999-2015. Poverty rates for each year is provided in the Appendix Tables C.7- C.15.

Table 3.1: **Poverty Rates for 1999-2015 PSID sample**

		Asset Poverty		
		Above Poverty Line	Below Poverty Line	Total
Income	Above Poverty Line	41.53	22.90	64.43
Poverty	Below Poverty Line	11.48	24.10	35.57
	Total	53.01	46.99	100.00
	Observations	53774		

Notes: This table presents percent of household below or above poverty lines for disposable income and household networth for years 1999-2015. The data is taken from 1999-2015 waves of PSID.

According to the Table C.6, 35.57 % households have incomes below the threshold. 46.99 % households do not have enough assets worth of a year's income. This number reflects the fact that many households hold zero or very low levels of wealth in U.S. Most of the wealth is concentrated among few rich households. These poverty definitions are not mutually exclusive. Some households may be below income poverty line but may have enough assets and vice versa. Only 11.48 % of households that experience income poverty have assets above asset poverty level. 24.1 % of households experience income poverty as well as asset poverty.

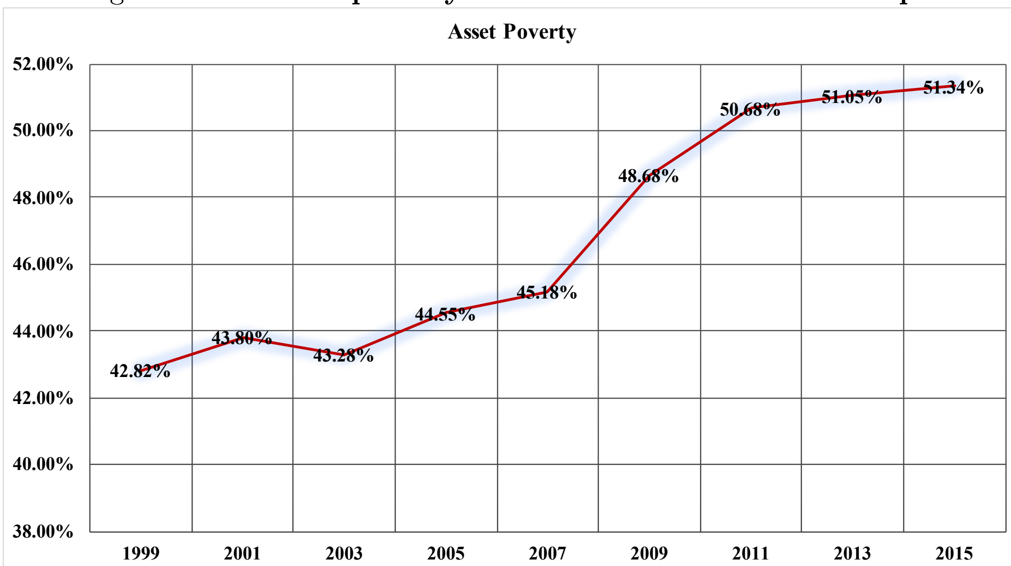
Figure 3.54: **Income poverty rate for 1999-2015 PSID sample**

Income poverty rate

Notes: The figure plots poverty rate calculated based on disposable income for years 1999-2015. The data is taken from 1999-2015 waves of PSID.

Figures 3.54 and 3.55 show the change in poverty rates over time. Both figures show the impact of Great Recession on US households. Poverty rates dramatically increases around 2009. Income poverty rate rises by 3.5 percentage points from 2007 to 2011. Asset poverty rises by around 5.5 percentage points during the same period. Figure 3.56 plots income and asset poverty rates together with GDP per capita for the same time period. The decline in GDP per capita corresponds to the increase in poverty rates showing the adverse effect of recession on poor households. However, the overall increase in per capita GDP during this period is not accompanied by a decline in poverty rates. Although the income poverty rate had a declining trend before the Great Recession, it actually continues to rise even after GDP per capita recovers. Asset poverty shows an increasing trend during all these periods. This results suggests that the poor households are not benefiting from the booms in the economy. The business cycles have asymmetric effects on the poor households, and the benefit of a growing economy goes to richer households which further increases the prevalent inequality.

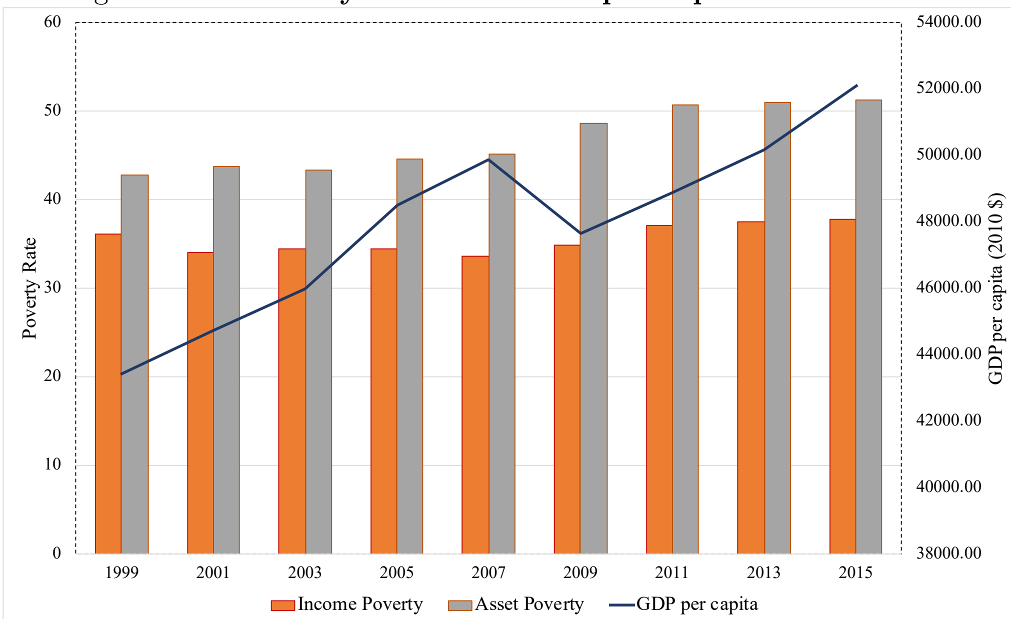
Figure 3.55: **Asset poverty rate for 1999-2015 PSID sample**



Asset poverty rate

Notes: The figure plots poverty rate calculated based on household networth for years 1999-2015. The data is taken from 1999-2015 waves of PSID.

Figure 3.56: **Poverty rates and GDP per capita for 1999-2015**

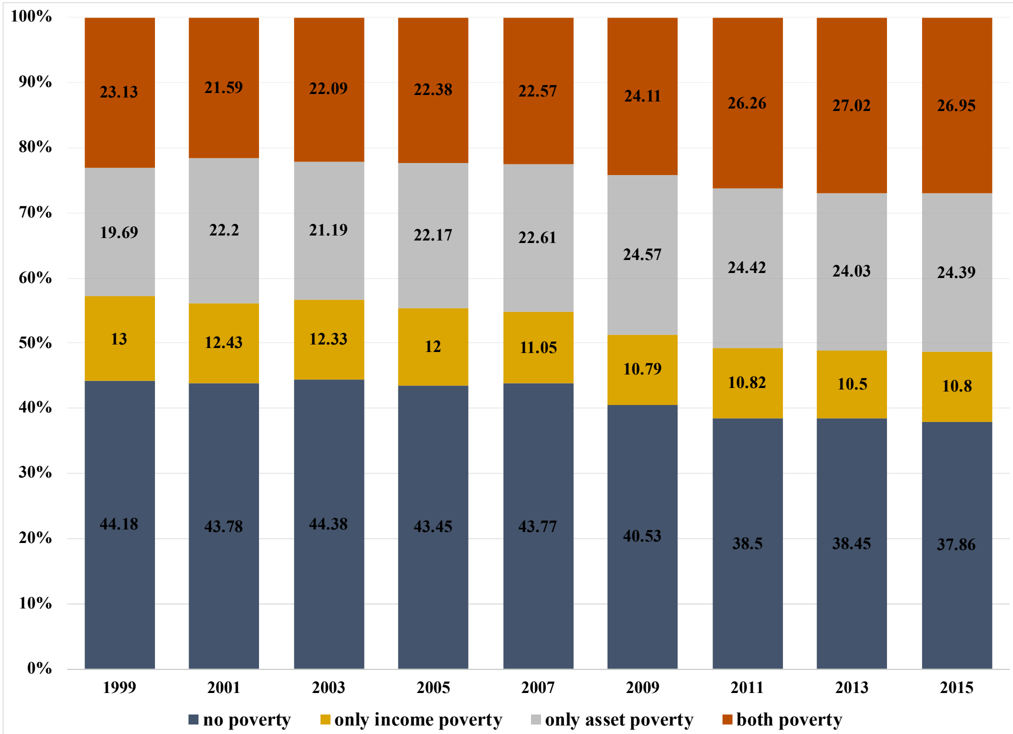


Poverty rate and GDP per capita

Notes: The figure plots poverty rates calculated based on household networth for years 1999-2015 and U.S. GDP per capita in 2010 dollars. The household data is taken from 1999-2015 waves of PSID. GDP per capita is from the World Bank.

Figure 3.57 shows the disaggregated poverty rates over time. The figure shows the declining share of households with no poverty and increasing share of households with both types of poverty. These trends together with an increasing GDP are worrisome and are further pointing to an increase in economic inequality in the society.

Figure 3.57: **Income and Asset Poverty rates for 1999-2015 PSID sample**

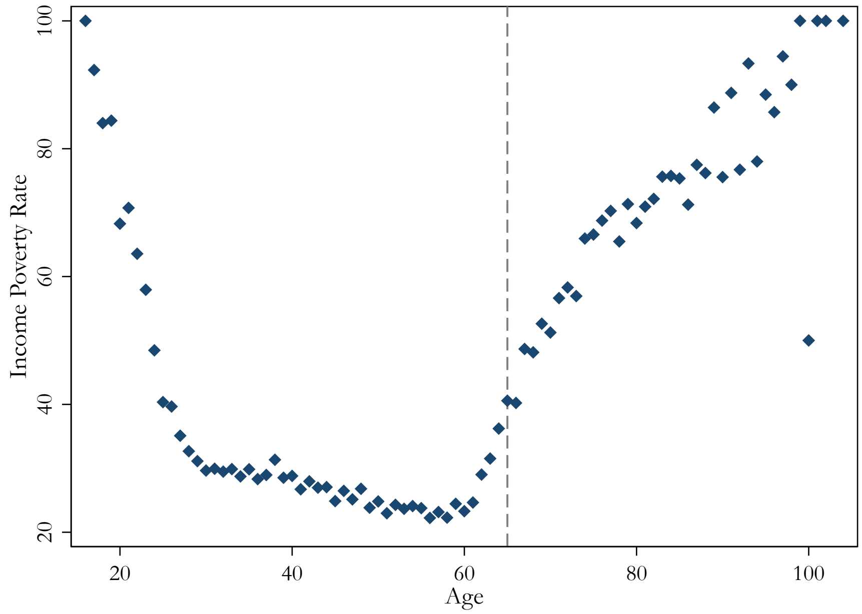


[a] Income and Asset poverty rates

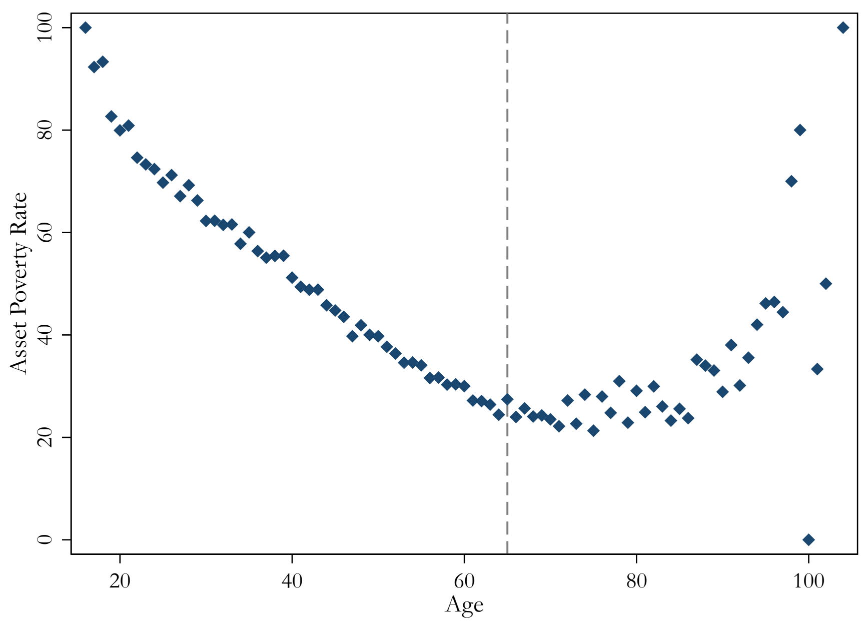
Notes: The figure plots income and asset poverty rates for years 1999-2015. The data is taken from 1999-2015 waves of PSID.

Figure 3.58 shows the poverty rates over the lifecycle. Both income and asset poverty declines as the young households enter to the labor force and increases after retirement and as the old households decumulate wealth. Figure 3.59, Figure 3.60 and Figure 3.61 plots poverty rates separately by education, race and sex of the head of the household. The poverty rates are dramatically higher for low educated defined as less than high school education, for black and for females. However, the adverse effect of the Recession can be seen for both low and high educated households. The most dramatically affected group by the recession is other non-white race households. The declining trend of both asset and income poverty among this group sharply reverses between 2007 to 2009.

Figure 3.58: **Income and Asset Poverty rates over the lifecycle**



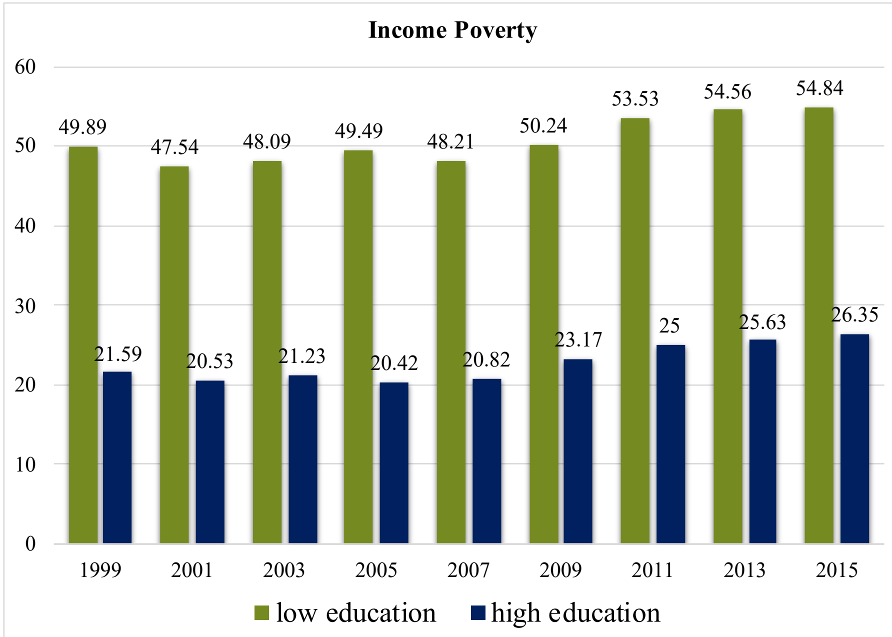
[a] Income poverty rate by age



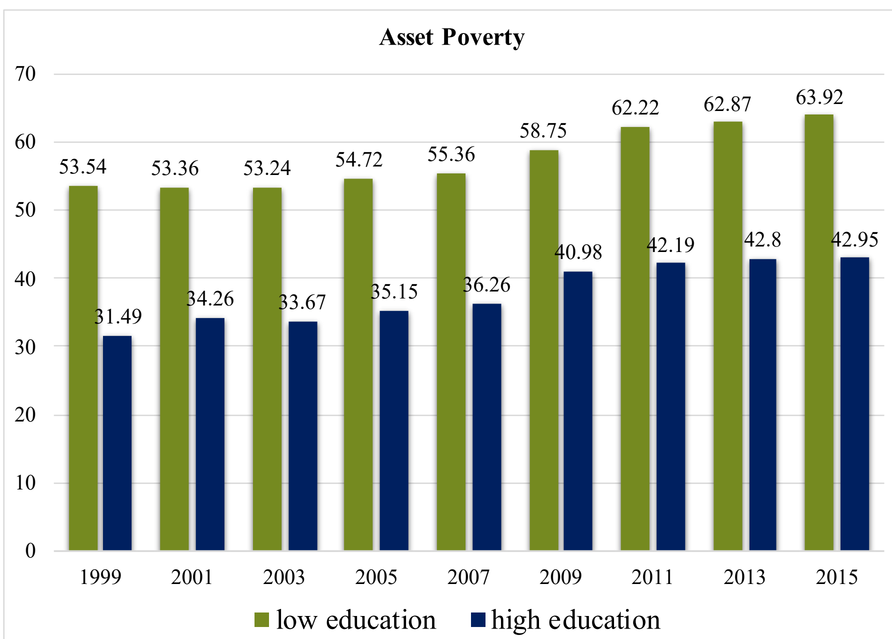
[b] Asset poverty rate by age

Notes: The figure plots income and asset poverty rates by age of the head of the household for years 1999-2015. The data is taken from 1999-2015 waves of PSID.

Figure 3.59: **Income and Asset Poverty rates by education**



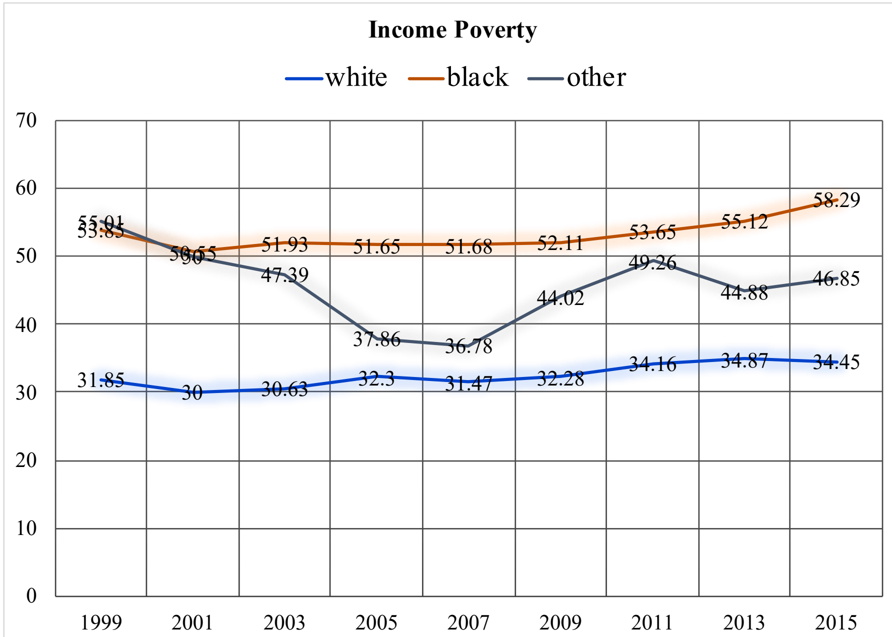
[a] Income poverty rate by education



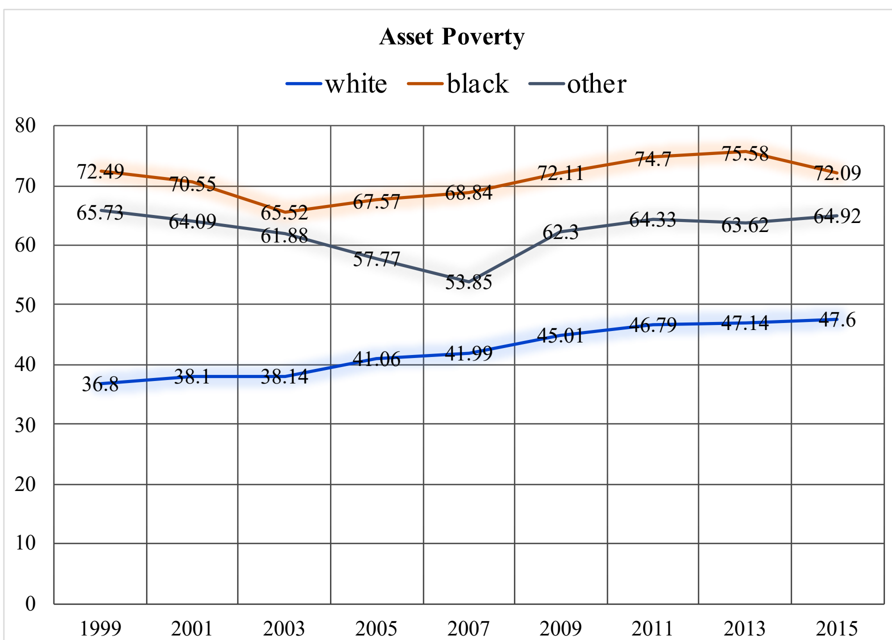
[b] Asset poverty rate by education

Notes: The figure plots income and asset poverty rates by education of the head of the household for years 1999-2015. The data is taken from 1999-2015 waves of PSID.

Figure 3.60: **Income and Asset Poverty rates by race**



[a] Income poverty rate by race

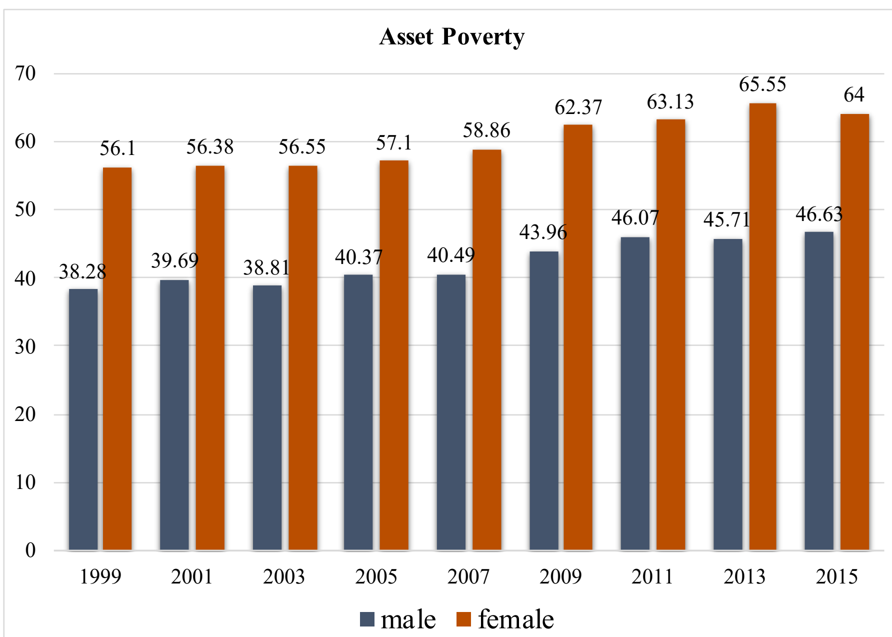


[b] Asset poverty rate by race

Notes: The figure plots income and asset poverty rates by race of the head of the household for years 1999-2015. The data is taken from 1999-2015 waves of PSID.

Figure 3.61: **Income and Asset Poverty rates by sex**

[a] Income poverty rate by by sex



[b] Asset poverty rate by sex

Notes: The figure plots income and asset poverty rates by sex of the head of the household for years 1999-2015. The data is taken from 1999-2015 waves of PSID.

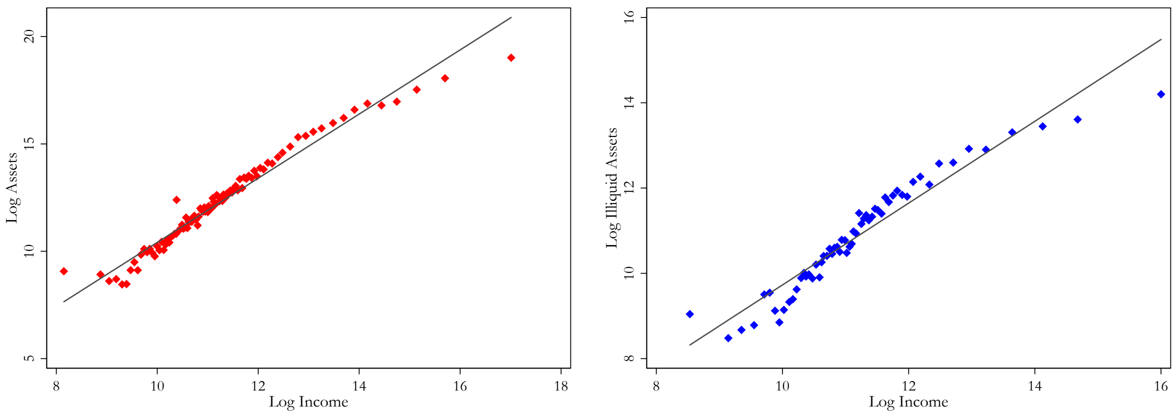
3.5 Portfolio Allocation in SCF

3.5.1 Wealth-Income Gradient in SCF

Survey of Consumer Finances survey is main source for wealth and portfolio statistics in the literature. SCF is a better source to assess the dynamics in portfolio allocation because it has detailed asset information. Moreover, SCF oversamples high income households drawn from tax records. This makes possible to include portfolio allocation of upper tail of income distribution. PSID lacks in this dimension, and indeed include lower income households disproportionately with added SEO and Latino samples. In this study I did not include these subsamples. However, the PSID sample is still on average poorer than SCF sample and provide more information on the lower tail of the income distribution. Therefore, a combined study using both of these datasets provide a more accurate picture of portfolio allocation across the income distribution including lower and upper tails. This section shows the SCF sample results and compares it with the PSID sample. In the middle income range, the two samples provide similar information about the income and portfolio allocation of US households. However, there are some differences in liquid asset share and debt share in some subsamples between PSID and SCF data.

Figures 3.62 and 3.63 show the positive associaliton between household income and assets, as well as debt. Debt in SCF is defined broader than the one in PSID sample which is the sum of all kinds of debt and includes residential and nonresidential real estate, loans as well as credit card debt.

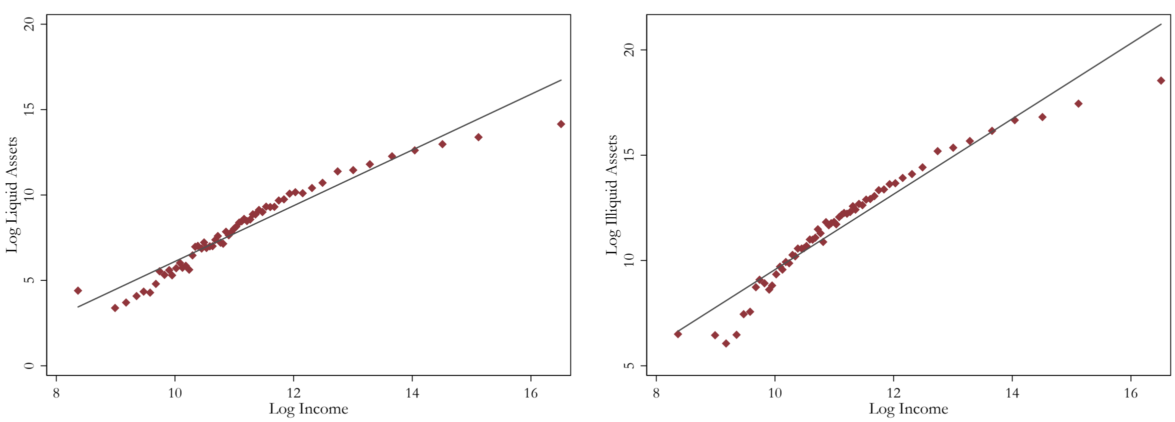
Figure 3.62: **Assets and Debt against income in SCF 2010**



[a] Assets [b] Debt

Notes: The figure plots total assets and total debt against income for households in 2010 wave of Survey of Consumer Finances. Debt includes residential and nonresidential real estate, loans as well as credit card debt. Income is total income before taxes.

Figure 3.63: **Liquid and Illiquid Assets against income in SCF 2010**

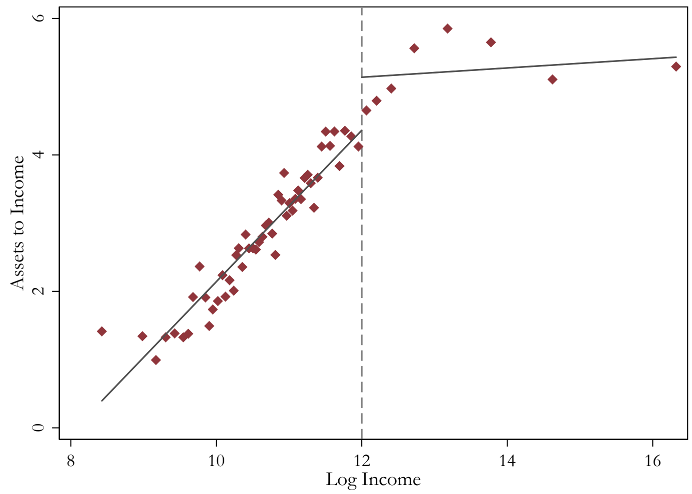


[a] Liquid assets [b] Illiquid assets

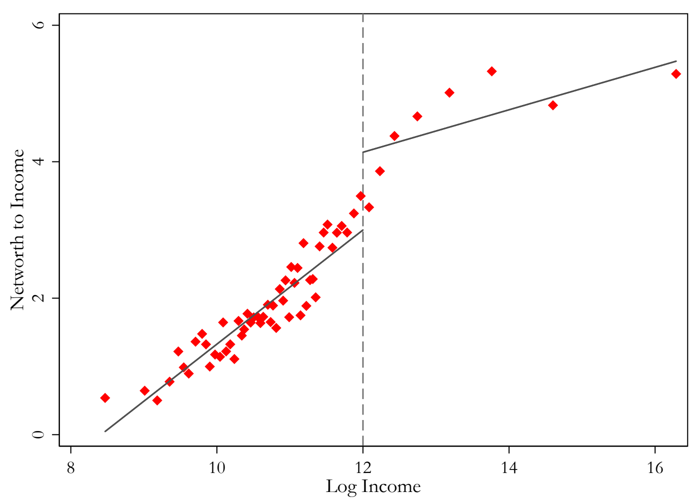
Notes: The figure plots liquid and illiquid assets against income for households in 2010 wave of Survey of Consumer Finances. Liquid assets are defined as the sum of the checking account, savings account, money market accounts (money market deposit accounts and money market mutual funds) and call accounts at brokerages. All other assets are considered as illiquid. Income is total income before taxes.

Wealth to income ratio is positively correlated with income for most of the households in the middle income range. This finding is similar to the PSID sample. However, two datasets differ in terms of information by very low and very high income earners. PSID sample includes very low income earners (below log income 8) which constant of declining assets to income ratio as is seen in Figures 3.3 - 3.5. On the other hand, SCF gives information on very high income earners which is missing in PSID sample. On the higher end of the income distribution (above log income 13), the positive association of wealth to income are not as strong especially for liquid assets. Debt to income ratio follows an inverted-V shape in both PSID and SCF samples where it peaks around log income 8 or 9 (around 3000$ - 8000$ annual income). It is important to note that PSID income measure is disposable income after tax plus credits, on the other hand SCF income measure is income before tax. However, log 8-9 income are very small income levels such that the tax paid must be very small.

Figure 3.64: **Wealth to Income ratio against income in SCF 2010**



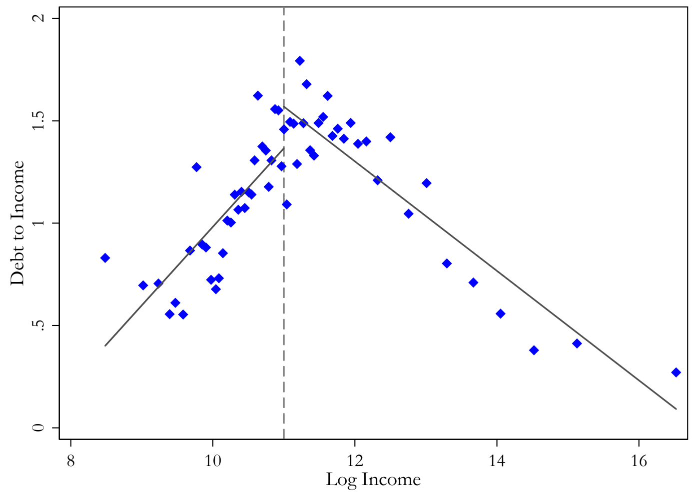
[a] Networth to income



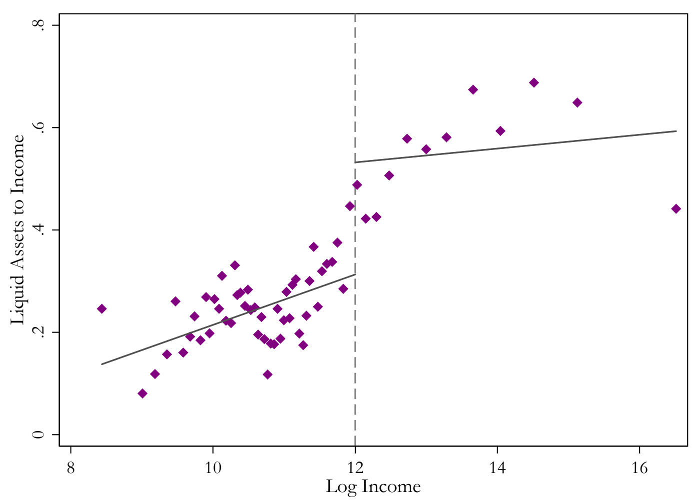
[b] Assets to income

Notes: The figure plots the ratio of networth to income and all assets to income against income in 2010 wave of Survey of Consumer Finances. Income is total income before taxes.

Figure 3.65: **Debt and Liquid assets to Income ratio against income in SCF 2010**



[a] Debt to income

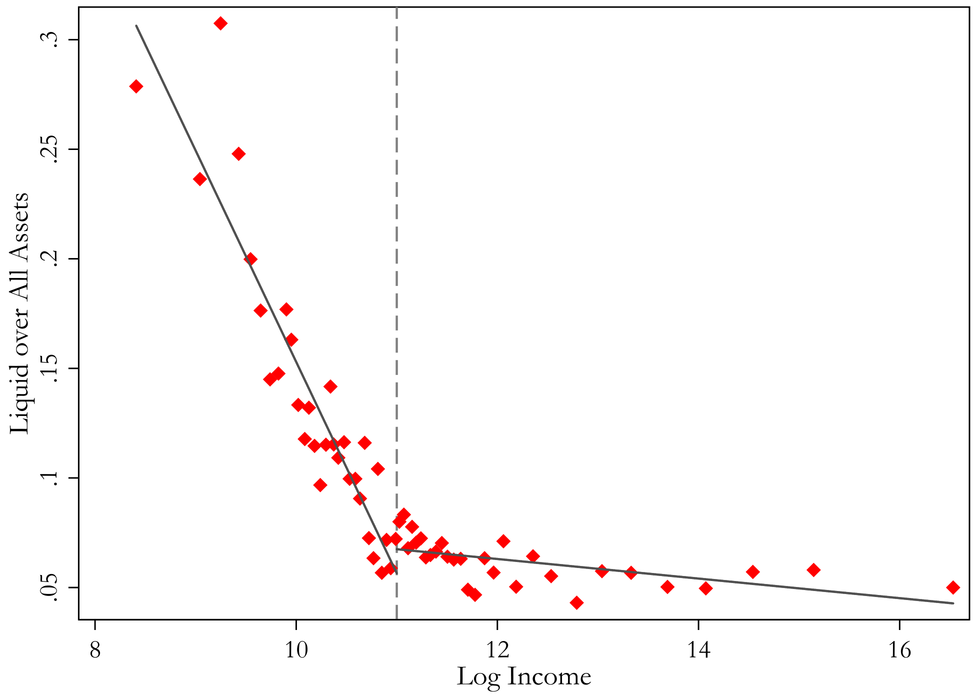


[b] Liquid Assets to income

Notes: The figure plots the ratio of debt to income and liquid assets to income against income in 2010 wave of Survey of Consumer Finances. Income is total income before taxes.

SCF and PSID draw very different pictures in terms of liquid asset share in wealth against income. Figure 3.66 show that liquid assets to income ratio is sharply declining as the income rises for low income earners in SCF sample. Above around log income 11 (around 22026$ annual income), the correlation is nearly constant. Liquid assets are defined as the sum of the checking account, savings account, money market accounts (money market deposit accounts and money market mutual funds) and call accounts at brokerages. Therefore I will use the most liquid asset definition in PSID, checking/savings account share, to compare with SCF. Figure 3.6 show a V shape for liquidity share in PSID sample. Comparing middle income class which is the biggest class in both samples, the correlation between liquidity ratio and income do not agree. In SCF sample, share share declines with income, but in PSID sample the share increase. This is an interesting finding and it points to important difference in SCF and PSID samples in portfolio allocation. Figure 3.68 represents that this divergence between the two datasets is driven by non-homeowners in SCF sample.

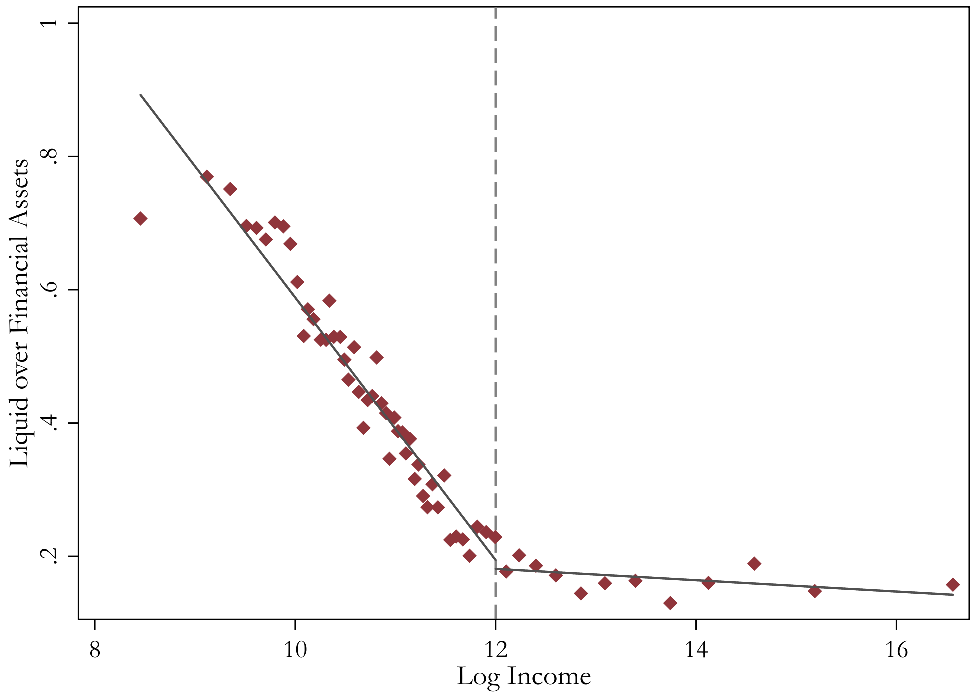
Figure 3.66: **Liquidity share in wealth against income in SCF 2010**



Ratio of liquid assets over all assets

Notes: The figure plots the ratio of liquid assets to all assets against income for households in 2010 wave of Survey of Consumer Finances. Liquid assets are defined as the sum of the checking account, savings account, money market accounts (money market deposit accounts and money market mutual funds) and call accounts at brokerages. Income is total income before taxes.

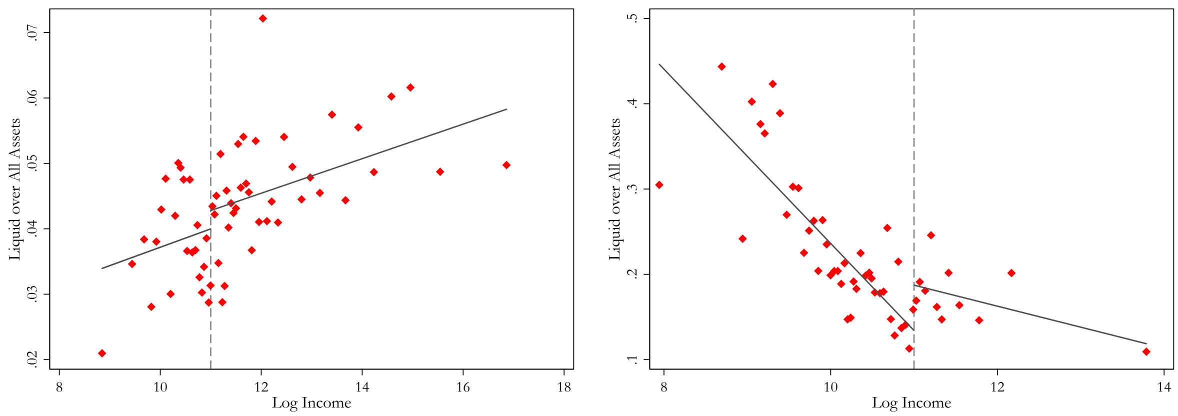
Figure 3.67: **Liquidity in Financial Assets against income in SCF 2010**



Ratio of liquid assets over financial assets

Notes: The figure plots the ratio of liquid assets to financial assets against income for households in 2010 wave of Survey of Consumer Finances. Liquid assets are defined as the sum of the checking account, savings account, money market accounts (money market deposit accounts and money market mutual funds) and call accounts at brokerages. Income is total income before taxes.

Figure 3.68: **Liquidity ratio by homeownership in SCF 2010**

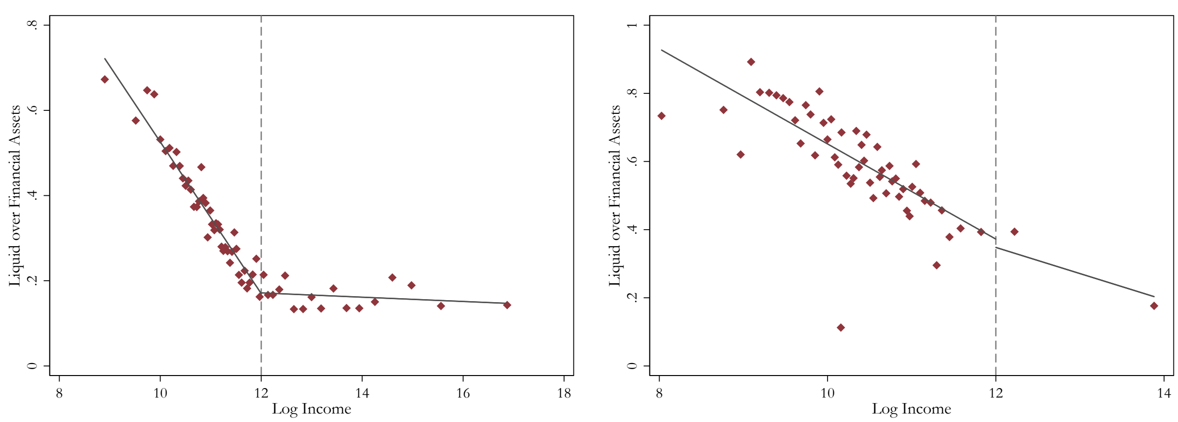


[a] Liquidity ratio for homeowners

[b] Liquidity ratio for for non-homeowners

Notes: The figure plots the ratio of liquid assets to all assets against income by homeownership status for households in 2010 wave of Survey of Consumer Finances. Liquid assets are defined as the sum of the checking account, savings account, money market accounts (money market deposit accounts and money market mutual funds) and call accounts at brokerages.

Figure 3.69: **Liquidity in Financial Assets by homeownership in SCF 2010**



[a] Financial liquidity for homeowners

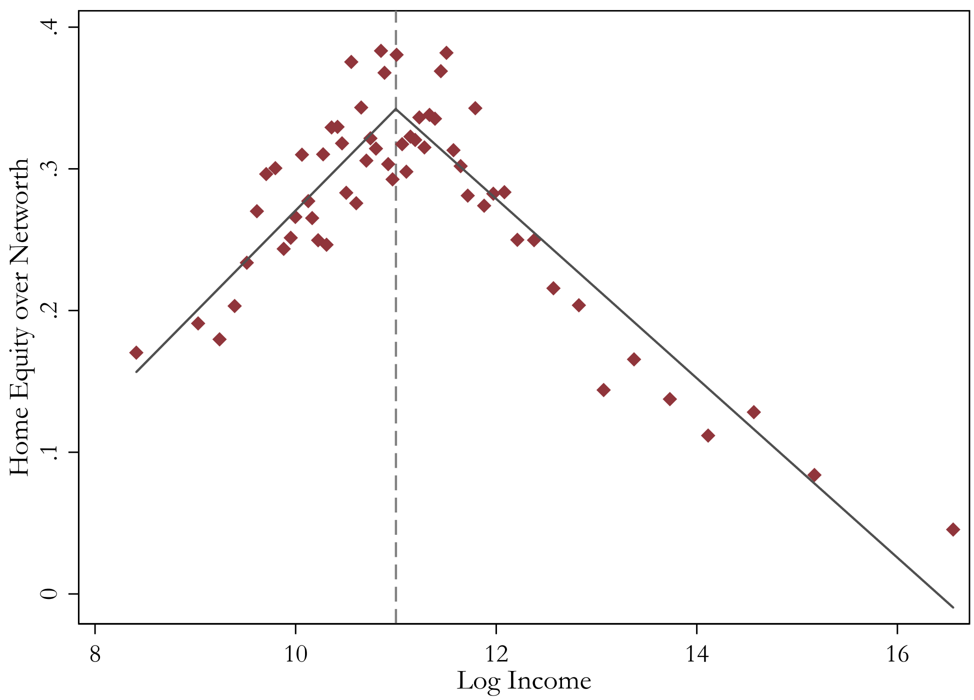
[b] Financial liquidity for non-homeowners

Notes: The figure plots the ratio of liquid assets to financial assets against income by homeownership status for households in 2010 wave of Survey of Consumer Finances. Liquid assets are defined as the sum of the checking account, savings account, money market accounts (money market deposit accounts and money market mutual funds) and call accounts at brokerages.

Home equity share in networth increase for low income earners who are possibly young households buying houses, then decline after around log income 11, as seen in Figures 3.70 and 3.71. This finding agrees with PSID sample as well.

The correlation between debt share in wealth and income is very similar to the observations in PSID sample for positive networth households as seen in Figure 3.73. For low income households, debt is high compared to their income and networth and they borrow even more with more income upto around log income 10. Then, as households have higher incomes, they have less debt compared to their net wealth.

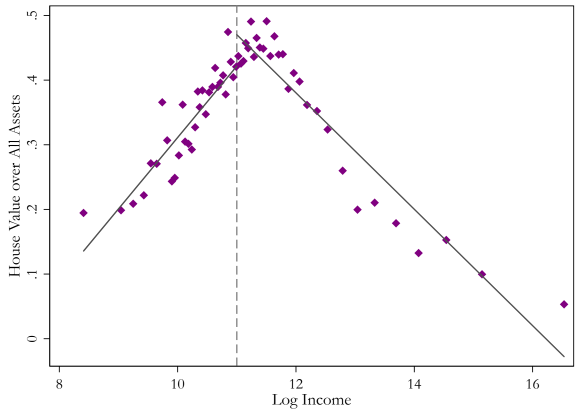
Figure 3.70: **Home equity over networth against income in SCF 2010**



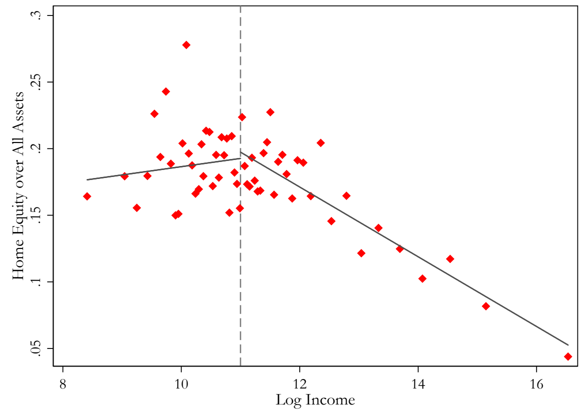
Home equity over networth

Notes: The figure home equity share in net wealth against income for households in 2010 wave of Survey of Consumer Finances. Income is total income before taxes.

Figure 3.71: **Housing share in wealth against income in SCF 2010**



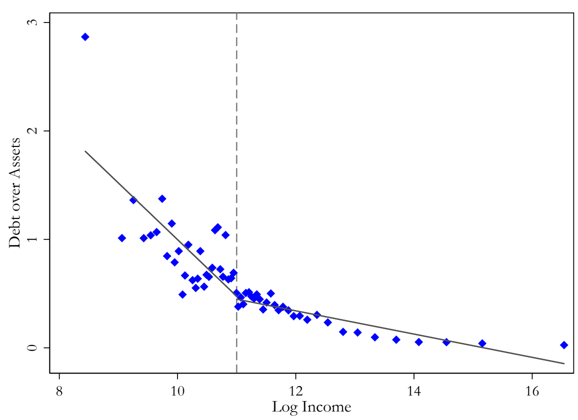
[a] Home value over all assets



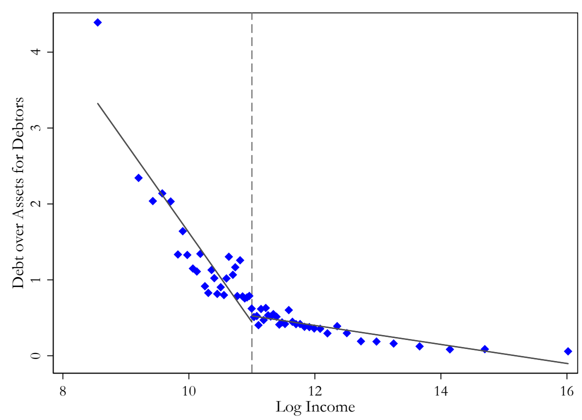
[b] Home equity over all assets

Notes: The figure housing home value over all assets, and home equity over all assets against income for households in 2010 wave of Survey of Consumer Finances. Income is total income before taxes.

Figure 3.72: **Debt share in wealth against income in SCF 2010**



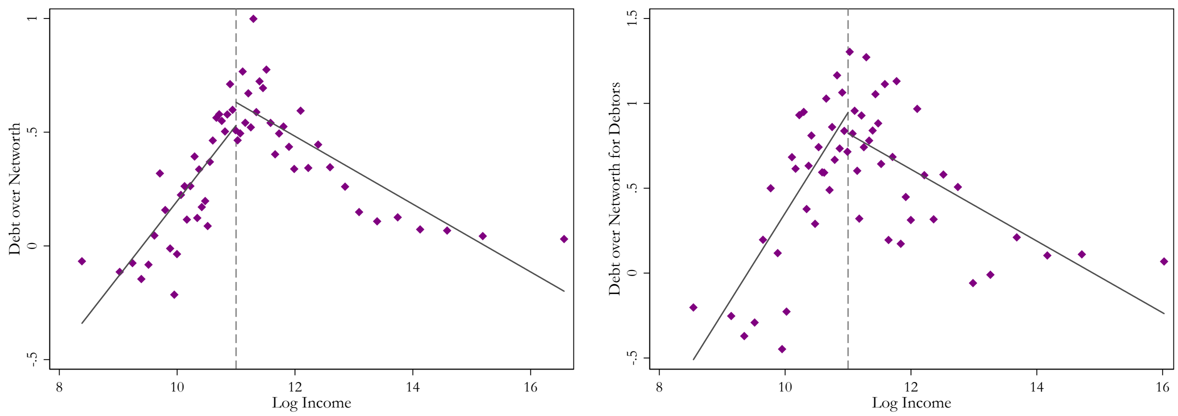
[a] Debt over all assets



[b] Debt over all assets for debtors

Notes: The figure debt over all assets against income for all households and for only debtors for households in 2010 wave of Survey of Consumer Finances. Income is total income before taxes.

Figure 3.73: **Debt share in networth against income in SCF 2010**



[a] Debt over networth

[b] Debt over networth for debtors

Notes: The figure debt over networth against income for all households and for only debtors for households in 2010 wave of Survey of Consumer Finances. Income is total income before taxes.

Table 3.2 gives OLS results of regressing liquid assets and debt share in household wealth on various household characteristics. The particular focus is the income-portfolio relationship when other demographic factors are controlled. The results indicate a highly negative correlation between income and liquid asset share with even after controlling for age. Illiquid assets usually necessitate high fixed costs and high transaction costs which can reduces their eligibility and practicality for low income households. Another interesting observation is that non-white other than Hispanic and Black households have a significantly high share of liquid assets in wealth compared white households keeping income constant. This can be cultural as these are groups are possibly experiencing higher income fluctuations and may want to keep easily accessible savings to cushion against rainy days.

Table 3.2: **Determinants of household portfolio allocation**

	Liquid/Assets	*Liquid/FinancialAssets*	*Debt/Assets*	*Debt/Networth*
	(1)	(2)	(3)	(4)
Log income	-0.0166***	-0.129***	-0.268***	0.0535*
	(0.00401)	(0.00684)	(0.0610)	(0.0313)
Age	0.000328	-0.00232***	-0.0184***	-0.0140***
	(0.000218)	(0.000358)	(0.00218)	(0.00188)
Education	0.00575***	-0.0168***	0.0575***	-0.0380***
	(0.00130)	(0.00235)	(0.0162)	(0.0105)
Female	0.00304	0.00335	0.158	-0.0174
	(0.0111)	(0.0177)	(0.123)	(0.0769)
Married	-0.0302***	-0.00461	0.0771	-0.0586
	(0.00877)	(0.0163)	(0.104)	(0.0766)
Non-homeowner	0.185***	0.104***	0.614***	-0.973***
	(0.00800)	(0.0140)	(0.0784)	(0.0717)
Black	-0.000604	0.0285	0.0371	-0.0543
	(0.00971)	(0.0182)	(0.117)	(0.0817)
Hispanic	0.0119	0.151***	-0.279***	0.157
	(0.0109)	(0.0196)	(0.106)	(0.0981)
Other non-white	0.0367**	0.0515**	-0.190	0.172
	(0.0151)	(0.0251)	(0.136)	(0.135)
Constant	0.145***	2.125***	3.476***	1.412***
	(0.0411)	(0.0736)	(0.597)	(0.349)
Observations	31212	30190	31068	30172
Adjusted R^2	0.195	0.210	0.0617	0.0539

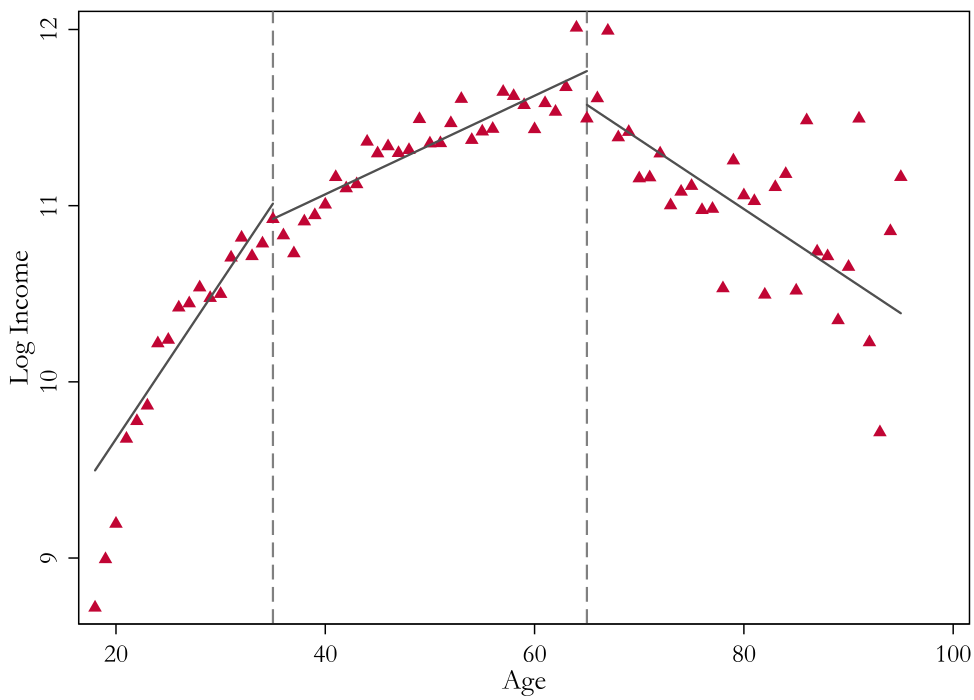
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table presents OLS estimates of ratio of liquid assets and debt in household portfolio on household demographics. The data is taken from 2010 wave of Survey of Consumer Finances. Liquid assets are defined as the sum of the checking account, savings account, money market accounts (money market deposit accounts and money market mutual funds) and call accounts at brokerages. Debt includes residential and nonresidential real estate, loans as well as credit card debt. Income is total income before taxes. Robust standard errors are in paranthesis.

3.5.2 Age Profile in SCF

Figure 3.74 shows that income has s hump-shape over the lifecycle which is a common finding in income studies. Figure 3.75 and 3.76 shows that assets and debt follow a similar shape over lifetime. Households accumulate wealth until retirement, then they start decumulating after the age of 65. However, this is not the case for liquid assets as old households prefer keeping wealth in liquid forms.

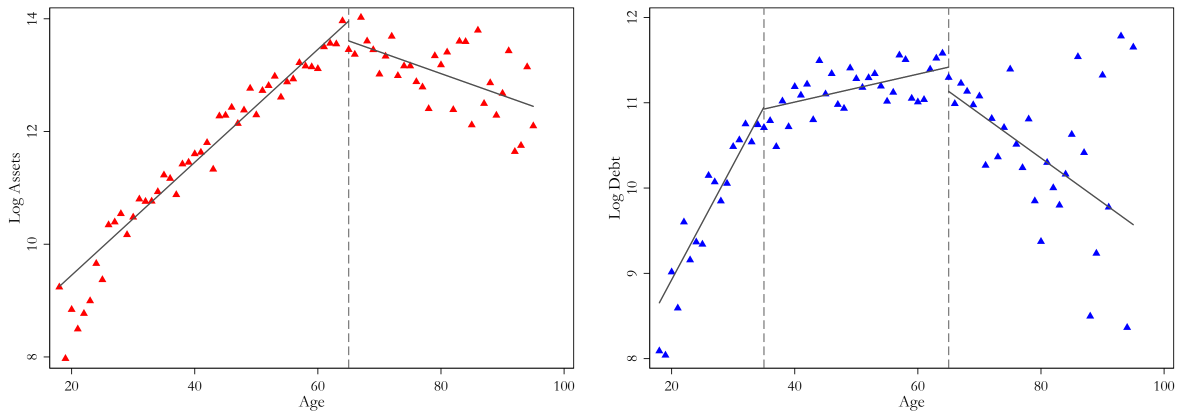
Figure 3.74: **Income over the lifecycle in SCF 2010**



Income by age

Notes: The figure plots total household income over the lifecycle for households in 2010 wave of Survey of Consumer Finances. Income is total income before taxes.

Figure 3.75: **Assets and Debt over the lifecycle in SCF 2010**

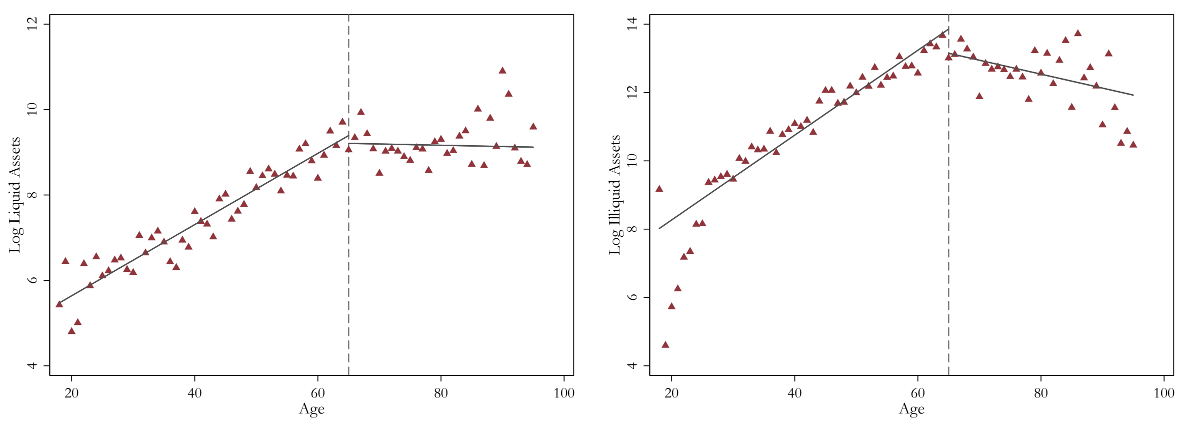


[a] Assets by age

[b] Debt by age

Notes: The figure plots total assets and total debt over the lifecycle for households in 2010 wave of Survey of Consumer Finances. Debt includes residential and nonresidential real estate, loans as well as credit card debt.

Figure 3.76: **Liquid and Illiquid Assets over the lifecycle in SCF 2010**

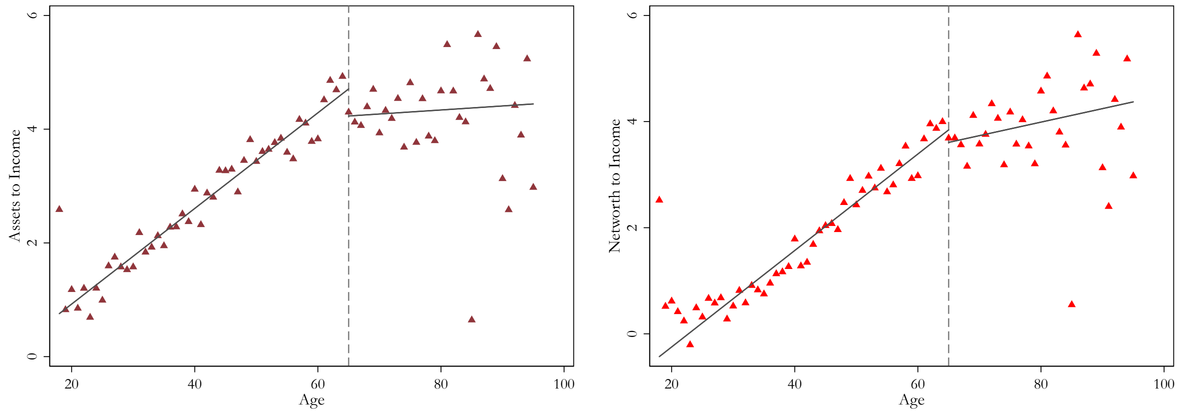


[a] Liquid assets by age

[b] Illiquid assets by age

Notes: The figure plots liquid and illiquid assets over the lifecycle for households in 2010 wave of Survey of Consumer Finances. Liquid assets are defined as the sum of the checking account, savings account, money market accounts (money market deposit accounts and money market mutual funds) and call accounts at brokerages.

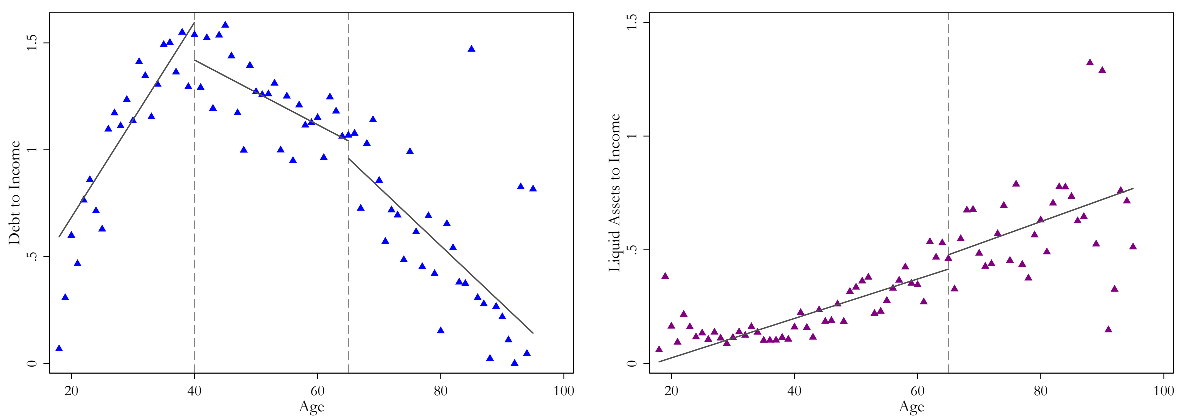
Figure 3.77: **Wealth to Income Ratio over the lifecycle in SCF 2010**



[a] Networth to income [b] Assets to income

Notes: The figure plots the ratio of networth to income and all assets to income over the lifecycle in 2010 wave of Survey of Consumer Finances. Income is total income before taxes.

Figure 3.78: **Debt to Income and Liquid assets to Income ratio over the lifecycle in SCF 2010**



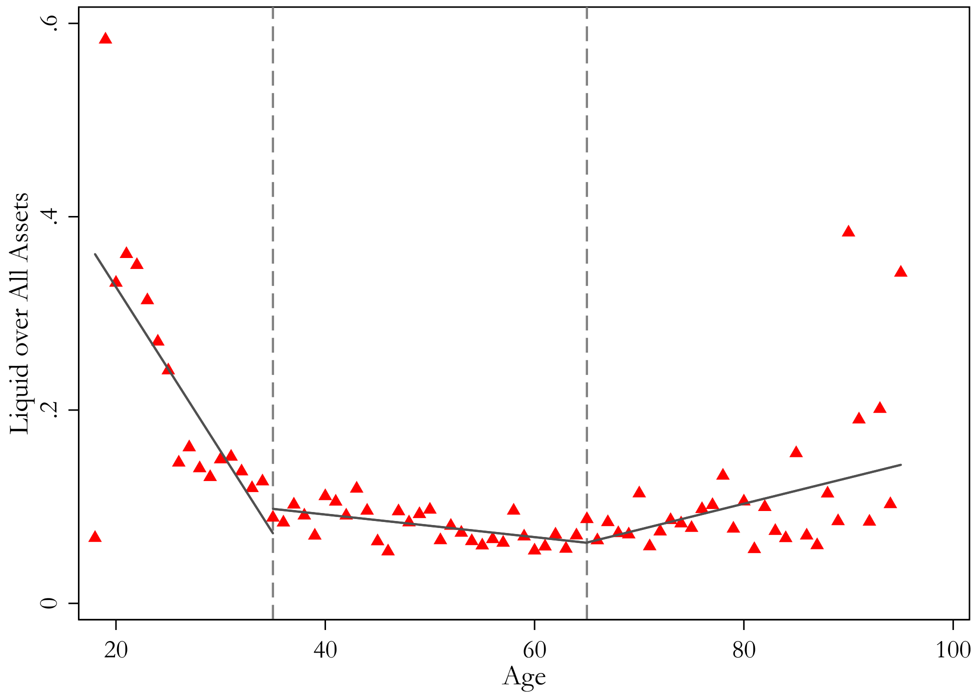
[a] Debt to income [b] Liquid Assets to income

Notes: The figure plots the ratio of debt to income and liquid assets to income over the lifecycle in 2010 wave of Survey of Consumer Finances. Income is total income before taxes.

Figures 3.77 and 3.78 show that wealth to income ratio increase until retirement and then stays stable which is a similar finding to PSID sample. Debt to income ratio increase initially in life as the households accumulate debt sharply in young ages, then falls during the middle and old ages. Liquid assets to income ratio continues to rise in retirement ages as seen in Figure 3.78 panel b.

Liquidity share in wealth shows very similar patterns for SCF and PSID samples. Initially, you households have high share of liquid assets, then the share is stable over lifetime until retirement. During retirement, household increase liquid assets share in their assets.

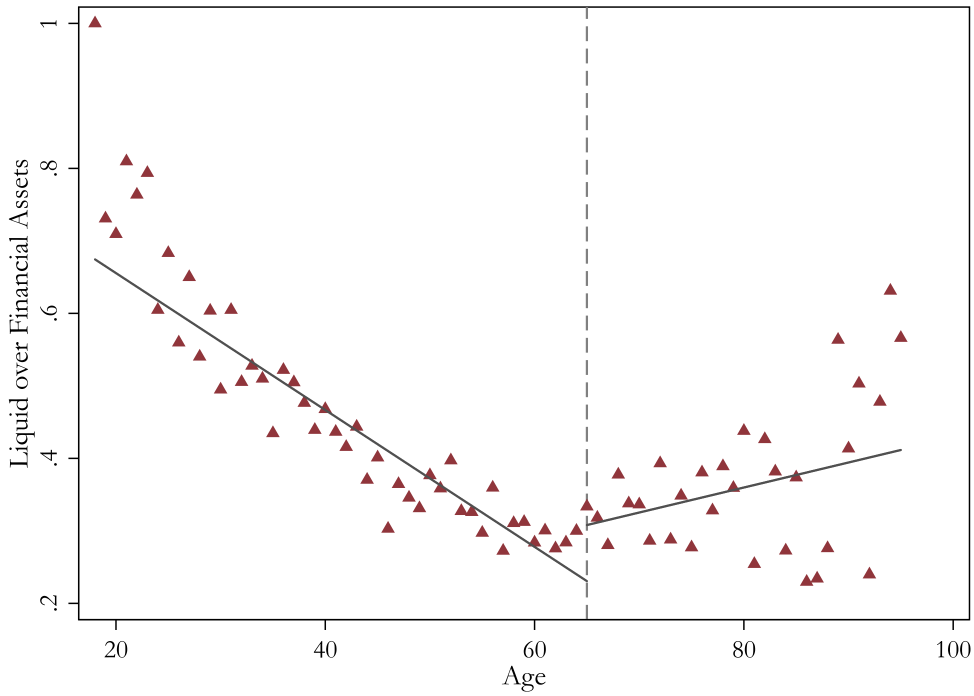
Figure 3.79: **Liquidity ratio over the lifecycle in SCF 2010**



Ratio of liquid assets over all assets by age

Notes: The figure plots the ratio of liquid assets to all assets over the lifecycle for households in 2010 wave of Survey of Consumer Finances. Liquid assets are defined as the sum of the checking account, savings account, money market accounts (money market deposit accounts and money market mutual funds) and call accounts at brokerages.

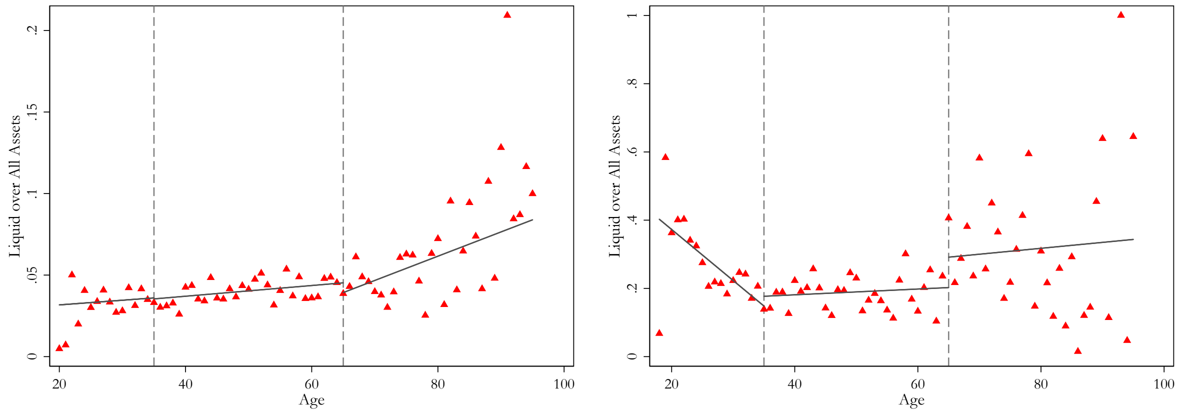
Figure 3.80: **Liquidity in Financial Assets over the lifecycle in SCF 2010**



Ratio of liquid assets over financial assets by age

Notes: The figure plots the ratio of liquid assets to financial assets over the lifecycle for households in 2010 wave of Survey of Consumer Finances. Liquid assets are defined as the sum of the checking account, savings account, money market accounts (money market deposit accounts and money market mutual funds) and call accounts at brokerages.

Figure 3.81: **Liquidity ratio over the lifecycle by homeownership in SCF 2010**

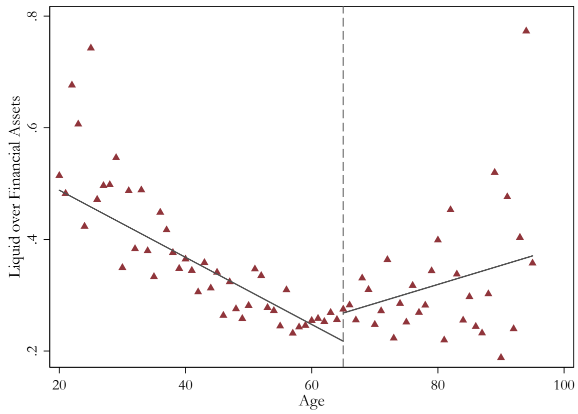


[a] Liquidity ratio for homeowners

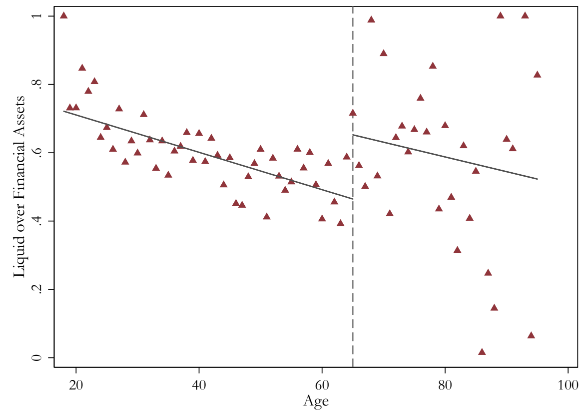
[b] Liquidity ratio for for non-homeowners

Notes: The figure plots the ratio of liquid assets to all assets over the lifecycle by homeownership status for households in 2010 wave of Survey of Consumer Finances. Liquid assets are defined as the sum of the checking account, savings account, money market accounts (money market deposit accounts and money market mutual funds) and call accounts at brokerages.

Figure 3.82: **Liquidity in Financial Assets over the lifecycle by homeownership in SCF 2010**



[a] Financial liquidity for homeowners



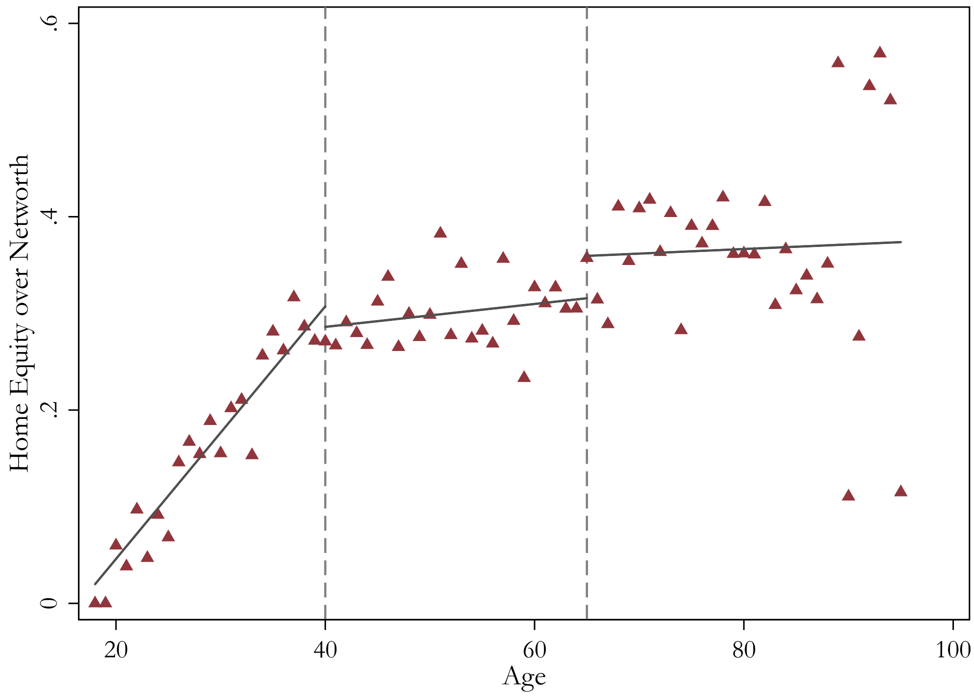
[b] Financial liquidity for non-homeowners

Notes: The figure plots the ratio of liquid assets to financial assets over the lifecycle by homeownership status for households in 2010 wave of Survey of Consumer Finances. Liquid assets are defined as the sum of the checking account, savings account, money market accounts (money market deposit accounts and money market mutual funds) and call accounts at brokerages.

Home equity share in wealth over the lifecycle is also similar to PSID sample. Young households buy houses and increase their home equity compared to all assets until the age of 40, then the share is almost stable during the lifetime as seen in Figures 3.83 and 3.84.

Debt share in networth is similar to PSID sample when all households are considered as in Figure 3.86 panel a. However, when only debtors are considered, the positive correlation in early ages disappears.

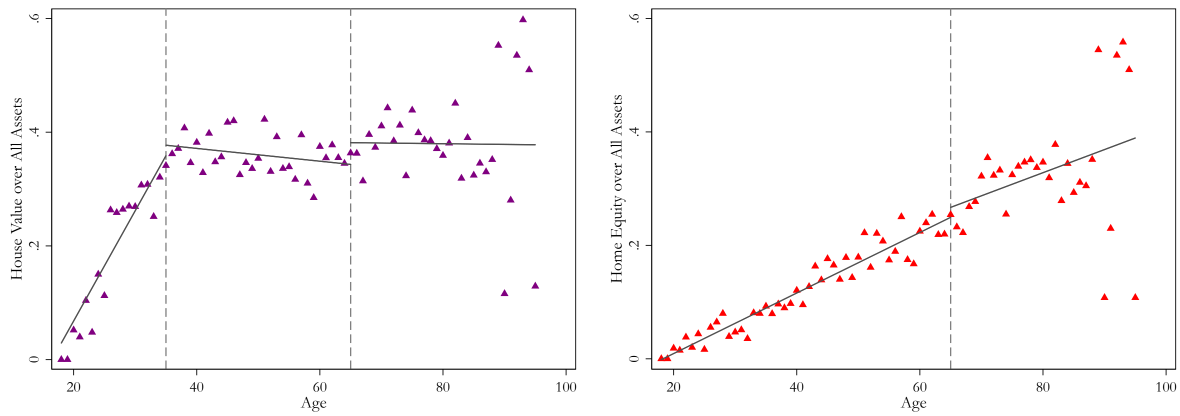
Figure 3.83: **Home equity over networth over the lifecycle in SCF 2010**



Ratio of home equity over networth by age

Notes: The figure home equity share in net wealth over the lifecycle for households in 2010 wave of Survey of Consumer Finances.

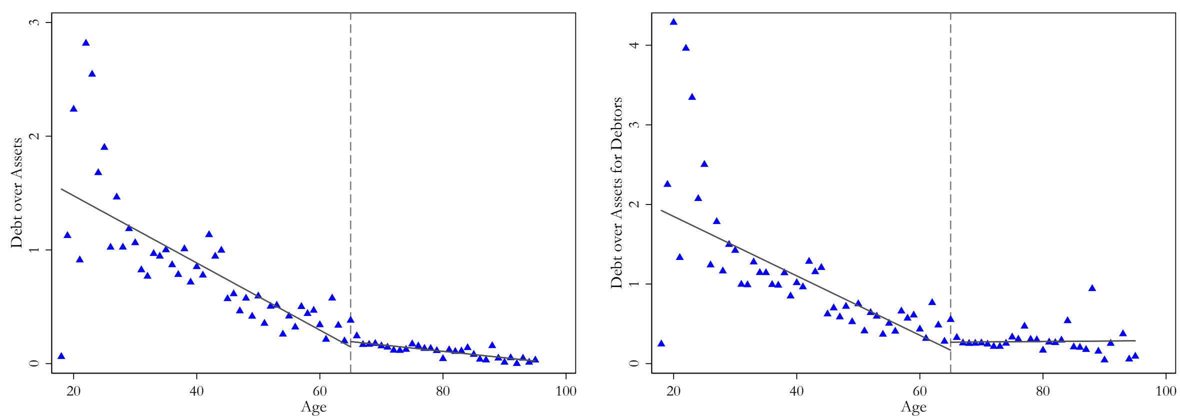
Figure 3.84: **Hosuing share in wealth over the lifecycle in SCF 2010**



[a] Home value over all assets by age [b] Home equity over all assets by age

Notes: The figure housing home value over all assets, and home equity over all assets over the lifecycle for households in 2010 wave of Survey of Consumer Finances.

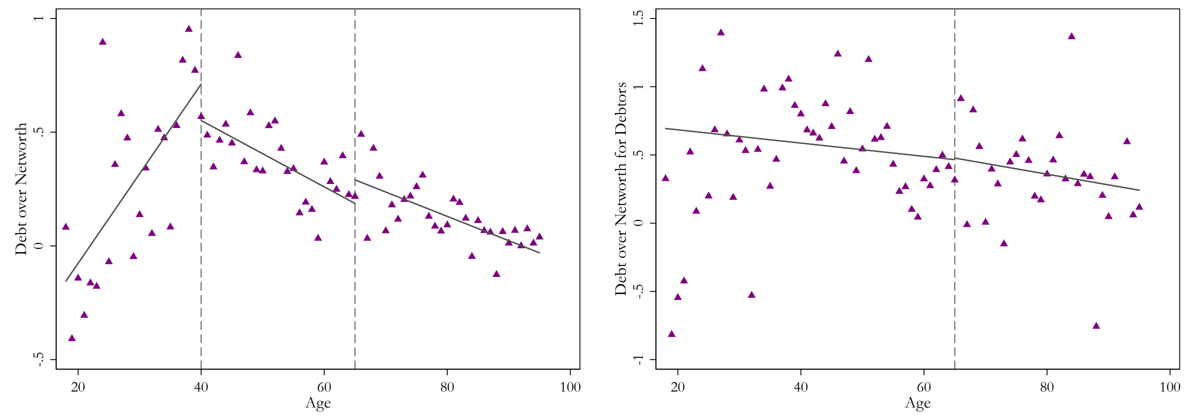
Figure 3.85: **Debt share in wealth over the lifecycle in SCF 2010**



[a] Debt over all assets by age [b] Debt over all assets by age for debtors

Notes: The figure debt over all assets over the lifecycle for all households and for only debtors for households in 2010 wave of Survey of Consumer Finances.

Figure 3.86: **Debt share in networth over the lifecycle in SCF 2010**



[a] Debt over networth by age

[b] Debt over networth by age for debtors

Notes: The figure debt over networth over the lifecycle for all households and for only debtors for households in 2010 wave of Survey of Consumer Finances.

3.6 Conclusion

This paper explores features of household portfolio allocation as well as the income-wealth gradient of household wealth over the lifecycle and over the business cycle. This question is addressed using two main household surveys in the United States: Panel Study of Income Dynamics and Survey of Consumer Finances. The paper provides several stylized facts on household portfolios and welfare using PSID and SCF samples.

The empirical findings show that asset accumulation have an inverted-V shape over the lifecycle. This observation is not true when considering most liquid assets. The liquid to networth ratio has a U shape throughout the lifecycle with a large flat region in mid-ages. The share increase after retirement. On the other hand, home equity share in wealth declines after retirement. These findings imply that older households prefer holding their assets in liquid forms.

Other important findings is that debt is front loaded in the lifecycle. There is a strong positive correlation with income and asset holdings for middle income households. Debt to income ratio, liquid assets to income ratio, debt share in networth, liquidity share in networth reverse correlation above approximately 22,000 $ annual household income.

Income follows a hump-shape over the lifecycle. Consumption follows the pattern of income even after controlling for family size and composition which points to the lack of perfect consumption smoothing. However, healthcare expenditure is different in the sense that it is steadily increasing over the lifecycle. Health is correlated with income even after controlling for age effects.

I use poverty thresholds provided by the U.S. Census Bureau to calculate *Income Poverty* rate and *Asset Poverty* rate in the PSID sample. For 1999-2015 time period, 35.57 % households have incomes below the poverty threshold and 46.99 % households have assets lower than the poverty line. 24.1 % of households experience both income poverty and asset poverty. Looking at the effect of Great Recession, poverty rates increase from 2007 to 2011. On the other hand, networth, liquid assets, consumption among other measures drops from 2007 to 2009 which is felt across the distribution of wealth. The most affected demographic groups are non-white households, female headed households and low educated households.

These facts are important in terms of pointing to the shortcomings of standard economic models. As a canonical example, the basic form of Permanent Income Hypothesis fails since consumption closely follows income over the lifecycle. An important reason for the failure is liquidity constraints which I evaluated in depth in the first chapter. Another example is the lack of full insurance in the economy indicated by the fact that consumption drops in recessions when income and wealth drops shows.

Moreover, these findings are important in guiding economic models of household portfolios. Household portfolio allocation is more complicated than one or two asset models incorporate. The piecewise correlations provided in this chapter gives the possible directions for future models.

Age profile of asset accumulation is particularly important in an aging society. For example, old households hold higher share of liquid assets in their portfolios which points to a possible increase in demand for liquid assets in the future as the society ages.

Another important dimension is the age profiles of consumption which show that the healthcare spending is increasing with age even after Medicare eligibility at the age of 65 while food consumption and overall consumption is decreasing. These findings are informative about the demand for consumption in the future.

As shown in the chapter, the wealth-income gradient also shows significant patterns in household portfolio allocation and this informs about future asset demand in an economy with a growing income and wealth inequality. For example, the high positive correlation of income with the share of home equity points to possible decline in housing demand relative to other assets.

Appendix A

Appendix A: Chapter 1

A.1 Proofs

A.1.1 Derivation of Euler Equations

This appendix contains derivation of Euler Equations with liquidity constraints, (1.7) and (1.8) as well as (1.19) and (1.20) and linearized equation (1.22).

Rewriting the recursive formulation of the problem, we have:

$$V_t(A_{i,t}, H_{i,t-1}) = \max_{C_{i,t}, H_{i,t}, A_{i,t+1}} \{u(C_{i,t}, H_{i,t}) + \beta \mathbb{E}_t V_{t+1}(A_{i,t+1}, H_{i,t})\} \tag{A.1}$$

subject to:

$$C_{i,t} + d_{i,t} + A_{i,t+1} = (1 + r_{i,t})(A_{i,t} + Y_{i,t}) \qquad \text{(budget constraint)} \tag{A.2}$$

$$H_{i,t} = (1 - \delta^h)H_{i,t-1} + d_{i,t} \qquad \text{(health capital accumulation)} \tag{A.3}$$

$$C_{i,t} \geq 0, \quad d_{i,t} \geq 0 \qquad \text{(non-negativity constraints)} \tag{A.4}$$

$$A_{i,t+1} \geq \underline{\text{A}} \qquad \text{(liquidity constraint)} \tag{A.5}$$

$$A_{i,0}, H_{i,0} \text{ is given}$$

Substitute (A.3) into the value function:

$$\begin{aligned} V_t(A_{i,t}, H_{i,t-1}) = \max_{C_{i,t}, d_{i,t}, A_{i,t+1}} &\{u(C_{i,t}, (1 - \delta^h)H_{i,t-1} + d_{i,t}) \\ &+ \beta \mathbb{E}_t V_{t+1}(A_{i,t+1}, (1 - \delta^h)H_{i,t-1} + d_{i,t})\} \end{aligned} \tag{A.6}$$

Maximize (A.6) subject to (A.2), (A.4), (A.5) and let $\lambda_{i,t}$ is Kuhn-Tucker multipler on budget constraint, $\mu_{i,t}$ is the Lagrange multiplier on liquidity constraint and $\eta_{1i,t}$ and $\eta_{2i,t}$ are Lagrange multipliers on non-negativity constraints. Moreover, denote the partial derivatives of value function with respect to state variables as
$V_A^{i,t+1} = \partial V_{t+1}(A_{i,t+1}, H_{i,t})/\partial A_{i,t+1}$ and $V_H^{i,t+1} = \partial V_{t+1}(A_{i,t+1}, H_{i,t})/\partial H_{i,t}$ in order to simplify notation. The first order necessary conditions with respect to $C_{i,t}$, $d_{i,t}$ and $A_{i,t+1}$ and the Envelope conditions for state variables $A_{i,t}$ and $H_{i,t-1}$ are derived as:

F.O.C.s:

$$u_C^{i,t} - \lambda_{i,t} + \eta_{1i,t} = 0 \tag{A.7}$$

$$u_H^{i,t} + \beta \mathbb{E}_t V_H^{i,t+1} - \lambda_{i,t} + \eta_{2i,t} = 0 \tag{A.8}$$

$$\beta \mathbb{E}_t V_A^{i,t+1} - \lambda_{i,t} + \mu_{i,t} = 0 \tag{A.9}$$

Envelope Conditions:

$$V_A^{i,t} = (1 + r_{i,t})\lambda_{i,t} \tag{A.10}$$

$$V_H^{i,t} = (1 - \delta^h)\beta \mathbb{E}_t V_H^{i,t+1} + (1 - \delta^h)u_H^{i,t} = (1 - \delta^h)\{u_H^{i,t} + \beta \mathbb{E}_t V_H^{i,t+1}\} \tag{A.11}$$

The complementary slackness condition from a constrained optimization problem implies that when constraints are slack, Kuhn-Tucker multiplier on the constraint must be zero.

I assume for now that the nonnegativity constraints do not bind ($\eta_{1i,t} = 0, \eta_{2i,t} = 0$) which holds for the most common instantaneous utility functions assumed in the literature (This is also verified by the data in hand).

Proposition 1 *The intertemporal condition for nondurable consumption takes the form:*

$$u_C^{i,t} = \beta \mathbb{E}_t[(1 + r_{i,t+1})u_C^{i,t+1}] + \mu_{i,t}. \tag{1.7}$$

Proof:

Combine (A.9) and (A.10):

$$V_A^{i,t} = (1 + r_{i,t})\{\beta \mathbb{E}_t V_A^{i,t+1} + \mu_{i,t}\}. \tag{A.10'}$$

Combine (A.7) and (A.9):

$$u_C^{i,t} = \beta \mathbb{E}_t V_A^{i,t+1} + \mu_{i,t} = \frac{V_A^{i,t}}{(1 + r_{i,t})}. \tag{A.12}$$

Iterate (A.10) and take expectations of both sides:

$$\mathbb{E}_t V_A^{i,t+1} = \mathbb{E}_t[(1 + r_{i,t+1})\lambda_{i,t+1}] \tag{A.13}$$

Then, plugging (A.13) into (A.12) and using (A.7) gives us the Euler equation for consumption good (1.7) :

$$u_C^{i,t} = \beta \mathbb{E}_t[(1 + r_{i,t+1})u_C^{i,t+1}] + \mu_{i,t}. \tag{1.7}$$

■

Assumption 1 *Nonnegativity constraint for healthcare expenditure does not bind, i.e.* $\eta_{2i,t} = 0,\ \forall i,\ \forall t.$

Assumption 2 *Households hold constant expectation about future rate of return,* $\mathbb{E}_t[r_{i,t+1}] = \mathbb{E}_{t+1}[r_{i,t+2}]$.

Proposition 2 *Under Assumptions 1 - 2, the intertemporal condition for health capital takes the following form:*

$$u_H^{i,t} = \beta \mathbb{E}_t[(1+r_{i,t+1})u_H^{i,t+1}] - \beta(1-\delta^h)\frac{\mathbb{E}_t[(1+r_{i,t+1})\mu_{i,t+1}]}{\mathbb{E}_t[1+r_{i,t+1}]} + \mu_{i,t}. \tag{1.8}$$

Proof:

In order to derive Euler equation for health capital, combine (A.8) and (A.11):

$$V_H^{i,t} = (1-\delta^h)(u_H^{i,t} + \beta \mathbb{E}_t V_H^{i,t+1}) = (1-\delta^h)\lambda_{i,t}$$

$$\lambda_{i,t} = \frac{V_H^{i,t}}{1-\delta^h} \tag{A.14}$$

$$\lambda_{i,t+1} = \frac{V_H^{i,t+1}}{1-\delta^h} \tag{A.14$'$}$$

Insert (A.9) into (A.13):

$$\lambda_{i,t} = \beta \mathbb{E}_t[(1+r_{i,t+1})\lambda_{i,t+1}] + \mu_{i,t} \tag{A.15}$$

Insert (A.14) and (A.14′) into (A.15):

$$V_H^{i,t} = \beta \mathbb{E}_t[(1+r_{i,t+1})V_H^{i,t+1}] + (1-\delta^h)\mu_{i,t} \tag{A.16}$$

$$V_H^{i,t} = \mathbb{E}_t[(1+r_{i,t+1})]\beta \mathbb{E}_t[V_H^{i,t+1}] + (1-\delta^h)\mu_{i,t}$$

$$\Rightarrow \quad \beta \mathbb{E}_t[V_H^{i,t+1}] = \frac{V_H^{i,t} - (1-\delta^h)\mu_{i,t}}{\mathbb{E}_t[1+r_{i,t+1}]} \tag{A.17}$$

Note that in deriving (A.17), the fact that $r_{i,t+1}$ and $V_H^{i,t+1}$ are independent conditional on information set at t, $\mathcal{F}_{i,t}$, is used. This is because $H_{i,t}$ is chosen at time t hence is depending on $r_{i,t}$ (not on $r_{i,t+1}$) which is in $\mathcal{F}_{i,t}$. $H_{i,t}$ is the state variable in $V_{t+1}(A_{i,t+1}, H_{i,t})$ and the partial is $V_H^{i,t+1} = \partial V_{t+1}(A_{i,t+1}, H_{i,t})/\partial H_{i,t}$.

Insert (A.14) and (A.17) into (A.8):

$$u_H^{i,t} + \beta \mathbb{E}_t V_H^{i,t+1} = \frac{V_H^{i,t}}{1-\delta^h}$$

$$u_H^{i,t} = \frac{V_H^t}{1-\delta^h} - \frac{V_H^{i,t} - (1-\delta^h)\mu_{i,t}}{\mathbb{E}_t[1+r_{i,t+1}]} = \frac{V_H^{i,t}(\delta + \mathbb{E}_t[r_{i,t+1}]) + (1-\delta^h)^2\mu_{i,t}}{(1-\delta^h)\mathbb{E}_t[1+r_{i,t+1}]}$$

$$\Rightarrow \quad V_H^{i,t} = \frac{(1-\delta^h)\mathbb{E}_t[1+r_{i,t+1}]}{\delta^h + \mathbb{E}_t[r_{i,t+1}]} u_H^{i,t} - \frac{(1-\delta^h)^2\mu_{i,t}}{\delta^h + \mathbb{E}_t[r_{i,t+1}]} \tag{A.18}$$

Now plug (A.18) and one period iteration of (A.18) into (A.16):

$$\frac{(1-\delta^h)\mathbb{E}_t[1+r_{i,t+1}]}{\delta^h + \mathbb{E}_t[r_{i,t+1}]} u_H^{i,t} - \frac{(1-\delta^h)^2\mu_{i,t}}{\delta^h + \mathbb{E}_t[r_{i,t+1}]}$$
$$= \beta \mathbb{E}_t\left[(1+r_{i,t+1})\left(\frac{(1-\delta^h)\mathbb{E}_{t+1}[1+r_{i,t+2}]}{\delta^h + \mathbb{E}_{t+1}[r_{i,t+2}]} u_H^{i,t+1} - \frac{(1-\delta^h)^2\mu_{i,t+1}}{\delta^h + \mathbb{E}_{t+1}[r_{i,t+2}]}\right)\right] + (1-\delta^h)\mu_{i,t} \tag{A.19}$$

I assume that the households have constant subjective expectations about future interest rate, i.e., $\mathbb{E}_t[r_{i,t+1}] = \mathbb{E}_{t+1}[r_{i,t+2}]$. This is a similar assumption to the one in [Hayashi, 1985]. He assumes that household j have static and point expectations about future rates at t such that $r_{j,t+1} = r_{j,t+2}$. Note that by the Tower rule, $\mathbb{E}_t[\mathbb{E}_{t+1}[r_{i,t+2}]] = \mathbb{E}_t[r_{i,t+2}]$ since the information set is a filtration such that $\mathcal{F}_{i,t} \subseteq \mathcal{F}_{i,t+1}$. Then, the assumption reduces to $\mathbb{E}_t[r_{i,t+1}] = \mathbb{E}_t[r_{i,t+2}]$, i.e. $\mathbb{E}_t[\Delta r_{i,t+2}] = 0$. This is a milder assumption than assuming rate of return has a martingale property which would be the case if $\mathbb{E}_t[r_{i,t+1}] = r_{i,t}$ also holds.

$$\begin{aligned}
&\frac{(1-\delta^h)\mathbb{E}_t[1+r_{i,t+1}]}{\delta^h + \mathbb{E}_t[r_{i,t+1}]} u_H^{i,t} - \frac{(1-\delta^h)^2 \mu_{i,t}}{\delta^h + \mathbb{E}_t[r_{i,t+1}]} \\
&= \beta \mathbb{E}_t\left[(1+r_{i,t+1})\left(\frac{(1-\delta^h)\mathbb{E}_t[1+r_{i,t+1}]}{\delta^h + \mathbb{E}_t[r_{i,t+1}]} u_H^{i,t+1} - \frac{(1-\delta^h)^2 \mu_{i,t+1}}{\delta^h + \mathbb{E}_t[r_{i,t+1}]}\right)\right] + (1-\delta^h)\mu_{i,t} \\
&= \frac{\beta \mathbb{E}_t[1+r_{i,t+1}](1-\delta^h)\mathbb{E}_t[(1+r_{i,t+1})u_H^{i,t+1}]}{\delta^h + \mathbb{E}_t[r_{i,t+1}]} - \frac{\beta(1-\delta^h)^2 \mathbb{E}_t[(1+r_{i,t+1})\mu_{i,t+1}]}{\delta^h + \mathbb{E}_t[r_{i,t+1}]} \\
&+ (1-\delta^h)\mu_{i,t}
\end{aligned}$$

Simplifying and reorganizing give the Euler equation for health stock in (1.8):

$$\begin{aligned}
&\mathbb{E}_t[1+r_{i,t+1}]u_H^{i,t} - (1-\delta^h)\mu_{i,t} \\
&= \beta \mathbb{E}_t[1+r_{i,t+1}]\mathbb{E}_t[(1+r_{i,t+1})u_H^{i,t+1}] - \beta(1-\delta^h)\mathbb{E}_t[(1+r_{i,t+1})\mu_{i,t+1}] + (\delta^h + \mathbb{E}_t[r_{i,t+1}])\mu_{i,t}
\end{aligned}$$

$$u_H^{i,t} = \beta \mathbb{E}_t[(1+r_{i,t+1})u_H^{i,t+1}] - \beta(1-\delta^h)\frac{\mathbb{E}_t[(1+r_{i,t+1})\mu_{i,t+1}]}{\mathbb{E}_t[1+r_{i,t+1}]} + \mu_{i,t}. \tag{1.8}$$

■

In order to derive Euler equations in terms of consumption levels, a preference structure must be determined. I assume CRRA form for instantaneous utility function with additively separable nondurable consumption and health capital as in (1.18).

Assumption 3 *The felicity function takes additively separable form over non-durable consumption and the service flow from the health stock as well as over time. The consumption good and service flow from health stock take CRRA form.* [1]

$$u(C_{i,t}, H_{i,t}; \Theta_{i,t}) = \left(\frac{C_{i,t}^{1-\phi}}{1-\phi} + \frac{H_{i,t}^{1-\xi}}{1-\xi} \right) exp(\Theta_{i,t}) \tag{1.18}$$

where $\Theta_{i,t}$ is the household specific taste shifter. The coefficients of relative risk aversion for nondurable consumption and health capital , ϕ and ξ, are assumed equal across households.

The derivation with alternative utility functions will be similar. However, when health is non-separable, the consumption of other goods will enter the regression equations as extra regressor. I assume away complementarities between leisure, consumption and health in order to show the impact of liquidity constraints alone.

Then, the Euler equations in (1.19) and (1.20) are written in terms of non-health consumption and health stock.

Proposition 4 *Under Assumptions 1-3 and the results in Propositions 1-2, the Euler equations for non-durable consumption and health capital take the forms:*

$$C_{i,t} = C_{i,t+1} \left(\frac{1 + e'_{i,t+1}}{\beta(1 + r_{i,t+1})(1 + \mu'_{i,t}) exp(\Delta\Theta_{i,t+1})} \right)^{1/\phi} \tag{1.19}$$

$$H_{i,t} = H_{i,t+1} \left(\frac{1 + e''_{i,t+1}}{\beta(1 + r_{i,t+1})(1 + \mu''_{i,t} - \mu'''_{i,t+1}) exp(\Delta\Theta_{i,t+1})} \right)^{1/\xi}. \tag{1.20}$$

Proof: Insert $u_C^{i,t}$ into 1.7 and $u_H^{i,t}$ into 1.8 using Assumption 3. ■

[1] I ignore the utility weight on health capital for now since it does not play any role in empirical analysis when it is a constant.

Since there is no data about health stock, the Equler equation (1.20) cannot be used for empirical analysis. An Euler equation for healthcare expenditures must be derived.

Proposition 5 *Taking natural logs of the results in Proposition 4, (1.19) and (1.20), and rearranging, the specifications for log-linear Euler equation estimations become:*

$$\Delta \ln C_{i,t+1} = \frac{1}{\phi}\{\ln(1+\mu'_{i,t}) + \ln\beta_i + \ln(1+r_{i,t+1}) - \ln(1+e'_{i,t+1}) + \Delta\Theta_{i,t+1}\} \tag{1.21}$$

$$\begin{aligned} \Delta \ln d_{i,t+1} =& \frac{\hat{m}}{\xi}\{\ln(1+\mu''_{i,t} - \mu'''_{i,t+1}) + \ln\beta_i + \ln(1+r_{i,t+1}) - \ln(1+e''_{i,t+1}) + \Delta\Theta_{i,t+1}\} \\ & - \frac{\hat{m}-1}{\xi}\{\ln(1+\mu''_{i,t-1} - \mu'''_{i,t}) + \ln\beta_i + \ln(1+r_{i,t}) - \ln(1+e''_{i,t}) + \Delta\Theta_{i,t}\} \end{aligned} \tag{1.22}$$

where $\Delta \ln C_{i,t+1} = \ln C_{i,t+1} - \ln C_{i,t}$ *is the growth of non-health consumption, and* $\Delta \ln d_{i,t+1} = \ln d_{i,t+1} - \ln d_{i,t}$ *is the growth of health-care expenditures.* $\hat{m}$ *is a constant given as* $\hat{m} = \frac{\overline{m}^{1/\xi}}{\overline{m}^{1/\xi}-(1-\delta^h)}$*, where* $\overline{m}$ *is a fixed number such that Taylor expansion of the term in parentheses in (1.20) is taken around it to linearize the Euler relation for the health capital.*

Proof:

Let's call the term inside parenthesis in (1.20) as $1/m_{t+1}$ for expositional purposes.[2] Thus, the equilibrium condition (1.20) is written as:

$$H_{i,t+1} = H_{i,t} m_{t+1}^{1/\xi} \tag{A.20}$$

[2] I am ignoring i subscript in m_{t+1} for brevity as it does not play any role.

Then, using the law of motion for health stock, we can write the Euler equation in terms of health-care expenditures d_t.

$$\begin{aligned}
H_{i,t+1} &= (1-\delta^h)H_{i,t} + d_{i,t+1} = H_{i,t}m_{t+1}^{1/\xi} \\
d_{i,t+1} &= H_{i,t}[m_{t+1}^{1/\xi} - (1-\delta^h)] \\
&= H_{i,t-1}m_t^{1/\xi}[m_{t+1}^{1/\xi} - (1-\delta^h)] \\
&= \frac{d_{i,t}}{m_t^{1/\xi} - (1-\delta^h)} m_t^{1/\xi}[m_{t+1}^{1/\xi} - (1-\delta^h)]
\end{aligned}$$

taking logs;

$$\ln d_{i,t+1} = \ln d_{i,t} + \frac{1}{\xi}\ln m_t + \ln(m_{t+1}^{1/\xi} - (1-\delta^h)) - \ln(m_t^{1/\xi} - (1-\delta^h)) \tag{A.21}$$

taking 1st order Taylor approximation of $\ln(m_{t+1}^{1/\xi} - (1-\delta^h))$ and $\ln(m_t^{1/\xi} - (1-\delta^h))$ around a fixed $\overline{m}$ gives [3];

$$\begin{aligned}
\ln(m_{t+1}^{1/\xi} - (1-\delta^h)) &\approx \ln(\overline{m}^{1/\xi} - (1-\delta^h)) + \frac{1}{\xi}\frac{\overline{m}^{1/\xi-1}}{\overline{m}^{1/\xi} - (1-\delta^h)}(m_{t+1} - \overline{m}) \\
&= \ln(\overline{m}^{1/\xi} - (1-\delta^h)) + \frac{1}{\xi}\frac{\overline{m}^{1/\xi}}{\overline{m}^{1/\xi} - (1-\delta^h)}\left(\frac{m_{t+1} - \overline{m}}{\overline{m}}\right)
\end{aligned}$$

[3] $\overline{m}$ can be interpreted as the steady state value of m_t.

$$
\begin{aligned}
\ln(m_t^{1/\xi} - (1-\delta^h)) &\approx \ln(\overline{m}^{1/\xi} - (1-\delta^h)) + \frac{1}{\xi}\frac{\overline{m}^{1/\xi-1}}{\overline{m}^{1/\xi} - (1-\delta^h)}(m_t - \overline{m}) \\
&= \ln(\overline{m}^{1/\xi} - (1-\delta^h)) + \frac{1}{\xi}\frac{\overline{m}^{1/\xi}}{\overline{m}^{1/\xi} - (1-\delta^h)}\left(\frac{m_t - \overline{m}}{\overline{m}}\right)
\end{aligned}
$$

Further approximating $\left(\frac{m_{t+1}-\overline{m}}{\overline{m}}\right) - \left(\frac{m_t - \overline{m}}{\overline{m}}\right) = \frac{1}{\overline{m}}\Delta m_{t+1} \approx \Delta \ln m_{t+1}$ and inserting into (A.21),

$$
\begin{aligned}
\Delta \ln d_{i,t+1} &\approx \frac{1}{\xi}\ln m_t + \frac{1}{\xi}\frac{\overline{m}^{1/\xi}}{\overline{m}^{1/\xi} - (1-\delta^h)}\left(\frac{m_{t+1} - \overline{m}}{\overline{m}}\right) - \frac{1}{\xi}\frac{\overline{m}^{1/\xi}}{\overline{m}^{1/\xi} - (1-\delta^h)}\left(\frac{m_t - \overline{m}}{\overline{m}}\right) \\
&\approx \frac{1}{\xi}\ln m_t + \frac{1}{\xi}\frac{\overline{m}^{1/\xi}}{\overline{m}^{1/\xi} - (1-\delta^h)}\Delta \ln m_{t+1} \\
&= \frac{1}{\xi}\frac{\overline{m}^{1/\xi}}{\overline{m}^{1/\xi} - (1-\delta^h)}\ln m_{t+1} + \frac{1}{\xi}\left(1 - \frac{\overline{m}^{1/\xi}}{\overline{m}^{1/\xi} - (1-\delta^h)}\right)\ln m_t \\
&= \frac{1}{\xi}\underbrace{\frac{\overline{m}^{1/\xi}}{\overline{m}^{1/\xi} - (1-\delta^h)}}_{\hat{m}}\ln m_{t+1} - \frac{1}{\xi}\underbrace{\frac{1-\delta^h}{\overline{m}^{1/\xi} - (1-\delta^h)}}_{\hat{m}-1}\ln m_t
\end{aligned}
$$

Plugging back m_t and m_{t+1} to get (1.22);

$$
\begin{aligned}
\Delta \ln d_{i,t+1} =& \frac{\hat{m}}{\xi}\{\ln(1+\mu''_{i,t} - \mu'''_{i,t+1}) + \ln\beta_i + \ln(1+r_{i,t+1}) - \ln(1+e''_{i,t+1}) + \Delta\Theta_{i,t+1}\} \\
&- \frac{\hat{m}-1}{\xi}\{\ln(1+\mu''_{i,t-1} - \mu'''_{i,t}) + \ln\beta_i + \ln(1+r_{i,t}) - \ln(1+e''_{i,t}) + \Delta\Theta_{i,t}\}
\end{aligned}
$$

Rearranging;

$$
\begin{aligned}
\Delta \ln d_{i,t+1} = & \underbrace{\frac{1}{\xi}\{\gamma_1 + \frac{1}{2}\sigma_e^2\}}_{\alpha_0^d} + \underbrace{\frac{1}{\xi}\ln\beta_i}_{\alpha_{1i}^d} + \underbrace{\frac{\hat{m}}{\xi}(\chi_{t+1} - \chi_t) + \frac{1-\hat{m}}{\xi}(\chi_t - \chi_{t-1})}_{\alpha_{2t}^d} \\
& + \underbrace{\frac{\hat{m}}{\xi}}_{\alpha_3^d} \ln(1 + r_{i,t+1}) + \underbrace{\frac{1-\hat{m}}{\xi}}_{\alpha_4^d} \ln(1 + r_{i,t}) + \frac{\hat{m}}{\xi} X'_{i,t+1}\tilde{\Gamma}_1 + \frac{1-\hat{m}}{\xi} X'_{i,t}\tilde{\Gamma}_2 \\
& + \underbrace{\frac{\hat{m}}{\xi}\{(\nu_{i,t+1} - \nu_{i,t}) - \ln(1 + e''_{i,t+1}) - \frac{1}{2}\sigma_e^2\}}_{\epsilon_{it+1}^d} \\
& + \underbrace{\frac{1-\hat{m}}{\xi}\{(\nu_{i,t} - \nu_{i,t-1}) - \ln(1 + e''_{i,t}) - \frac{1}{2}\sigma_e^2\}}_{\epsilon_{it+1}^d} \\
& + \frac{\hat{m}}{\xi}\ln(1 + \mu''_{i,t} - \mu'''_{i,t+1}) - \frac{\hat{m}-1}{\xi}\ln(1 + \mu''_{i,t-1} - \mu'''_{i,t})
\end{aligned}
$$

■

Since the Kuhn-Tucker multipliers are not observed,they enter the error term. These are combined with the innovation and the terms in expectation error as $u_{it+1}^d = \epsilon_{it+1}^d + \hat{m}/\xi \ln(1 + \mu''_{i,t} - \mu'''_{i,t+1}) - (\hat{m} - 1)/\xi \ln(1 + \mu''_{i,t-1} - \mu'''_{i,t})$. Also, taking first order Taylor expansion for after-tax return and relabeling $\hat{m}/\xi\ \tilde{\Gamma}_1 \equiv \Gamma_1^d$ and $(1-\hat{m})/\xi\ \tilde{\Gamma}_2 \equiv \Gamma_2^d$ gives equation (1.28):

$$
\Delta \ln d_{i,t+1} = \alpha_0^d + \alpha_{1i}^d + \alpha_{2t}^d + \alpha_3^d r_{i,t+1} + \alpha_4^d r_{i,t} + X'_{i,t+1}\Gamma_1^d + X'_{i,t}\Gamma_2^d + u_{it+1}^d \tag{1.28}
$$

The error term includes $\mu_{i,t-1}$, $\mu_{i,t}$, and$\mu_{i,t+1}$. For the current binding constraint, the term $\mu_{i,t}$ enters twice into u_{it+1}^d, however note that its loading factor would be $2\hat{m}/\xi$, a positive number, if it were a linear function. For the lag binding constraint $\mu_{i,t-1}$, the loading factor is negative since $\hat{m} > 1$. I control for the lag binding constraint by adding lag income as an additional regressor.

A.1.2 Derivation of Marginal Rate of Substitution

This appendix contains derivation of marginal rate of substitution between health capital and non-durable consumption (1.9) and spending ratio (1.10) .

Assume $u(C_{i,t}, H_{i,t}) = \ln C_{i,t} + \ln H_{i,t}$ and r is constant. Then, the MRS for the unconstrained case (1.9) with the assumed preferences gives the ratio of health spending to nondurable consumption as:

Proposition 3 *Under Assumption 1 and assuming r is held constant, the marginal rate of substitution (MRS) between health capital and non-durable consumption goods for household i at time t is:*

$$MRS^{i,t}_{H,C} = \frac{u^{i,t}_H}{u^{i,t}_C} = \frac{\delta^h + r}{1+r} + \frac{(1-\delta^h)\mu_{i,t}}{V^{i,t}_A}. \tag{1.9}$$

Proof:

From F.O.C.s plug (A.9) into (A.8):

$$u^{i,t}_H = \beta\mathbb{E}_t V^{i,t+1}_A - \beta\mathbb{E}_t V^{i,t+1}_H + \mu_{i,t} - \eta_{2i,t}. \tag{A.22}$$

Premultiply by $(1-\delta^h)$ and rearrange:

$$(1-\delta^h)(u_H^{i,t}+\beta\mathbb{E}_tV_H^{i,t+1})=(1-\delta^h)(\beta\mathbb{E}_tV_A^{i,t+1}+\mu_{i,t}-\eta_{2i,t}). \tag{A.23}$$

Plug (A.11) and (A.12) into (A.23):

$$V_H^{i,t}=(1-\delta^h)\frac{V_A^{i,t}}{1+r_{i,t}}-(1-\delta^h)\eta_{2i,t}. \tag{A.24}$$

Assume $r_{i,t}$ is constant at the rate r, and iterate (A.24) by one period:

$$\mathbb{E}_tV_H^{i,t+1}=(1-\delta^h)\frac{\mathbb{E}_t[V_A^{i,t+1}]}{1+r}-(1-\delta^h)\mathbb{E}_t[\eta_{2i,t+1}]. \tag{A.25}$$

Insert (A.25) into (A.22):

$$u_H^{i,t}=\beta\mathbb{E}_tV_A^{i,t+1}+\mu_{i,t}-\eta_{2i,t}-\beta(1-\delta^h)\frac{\mathbb{E}_t[V_A^{i,t+1}]}{1+r}+\beta(1-\delta^h)\mathbb{E}_t[\eta_{2i,t+1}]. \tag{A.26}$$

Simplifying and using ($A.10'$) gives:

$$u_H^{i,t}=\frac{\delta^h+r}{1+r}\frac{V_A^{i,t}}{1+r}+\frac{1-\delta^h}{1+r}\mu_{i,t}-\eta_{2i,t}-\beta(1-\delta^h)\mathbb{E}_t[\eta_{2i,t+1}]. \tag{A.27}$$

Then, $MRS^{i,t}_{H,C}$ is the ratio of (A.27) to (A.12):

$$MRS^{i,t}_{H,C} = \frac{u^{i,t}_H}{u^{i,t}_C} = \frac{\delta^h + r}{1+r} + \frac{(1-\delta^h)\mu_{i,t}}{V^{i,t}_A} - \frac{(1+r)\eta_{i,2t}}{V^{i,t}_A} + \frac{\beta(1-\delta^h)(1+r)\mathbb{E}_t[\eta_{2i,t+1}]}{V^{i,t}_A}. \tag{A.28}$$

Assuming interior solution in both periods, $\eta_{2i,t} = 0$ and $\eta_{2i,t+1} = 0$,gives:

$$MRS^{i,t}_{H,C} = \frac{u^{i,t}_H}{u^{i,t}_C} = \frac{\delta^h + r}{1+r} + \frac{(1-\delta^h)\mu_{i,t}}{V^{i,t}_A}. \tag{1.9}$$

■

Lemma 3.1

$$\frac{d_{i,t}}{C_{i,t}} = \frac{1+r}{\delta^h + r} + \left[1 - (1-\delta^h)\left(\frac{C_{i,t}}{C_{i,t-1}}\right)^{-1}\right]. \tag{1.10}$$

Proof:

For the ratio equation in (1.10), the derivation is done assuming preferences are of the form $U(C_{i,t}, H_{i,t}) = \ln C_{i,t} + \ln H_{i,t}$. Also, assume constraint at t is not binding, $\mu_{i,t} = 0$. The MRS in (1.9) becomes:

$$\frac{H_{i,t}}{C_{i,t}} = \frac{1+r}{\delta^h + r}. \tag{A.29}$$

Then, substituting health capital accumulation gives:

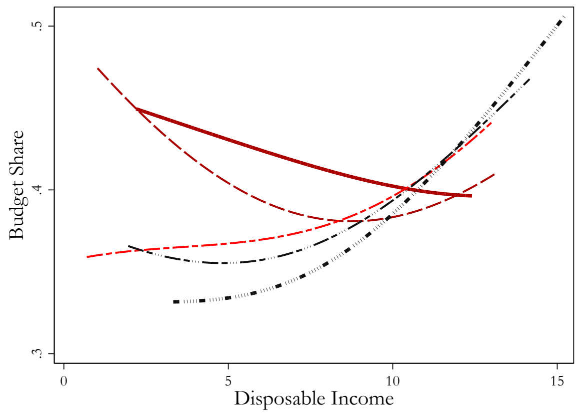
$$\frac{d_{i,t}}{C_{i,t}} = \frac{H_{i,t} - (1-\delta^h)H_{i,t-1}}{C_{i,t}} = \frac{H_{i,t}}{C_{i,t}} - (1-\delta^h)\frac{H_{i,t-1}}{C_{i,t}} = \frac{1+r}{\delta^h + r} - (1-\delta^h)\frac{1+r}{\delta^h+r}\frac{C_{i,t-1}}{C_{i,t}} \tag{A.30}$$

$$\Rightarrow \quad \frac{d_{i,t}}{C_{i,t}} = \frac{1+r}{\delta^h + r} + \left[1 - (1-\delta^h)\left(\frac{C_{i,t}}{C_{i,t-1}}\right)^{-1}\right]. \tag{1.10}$$

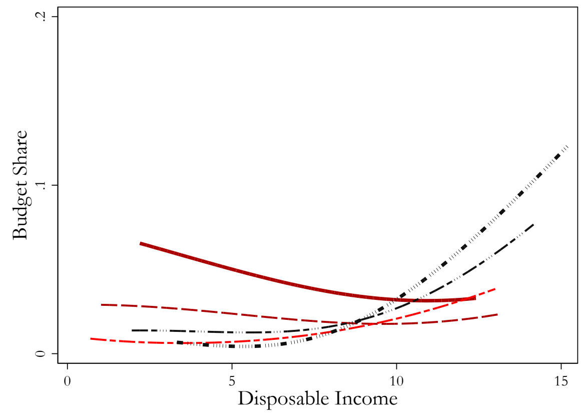
■

A.2 Additional Figures

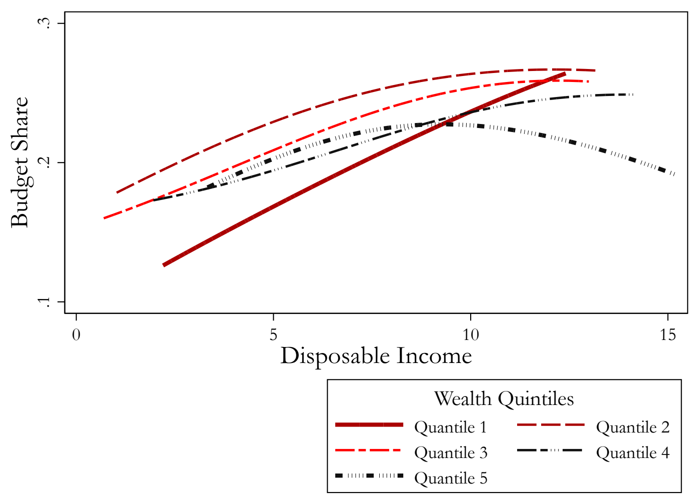
Figure A.1: **Engel Curves for housing, education and transportation expenditure shares**



[a] Housing Expenditure Share



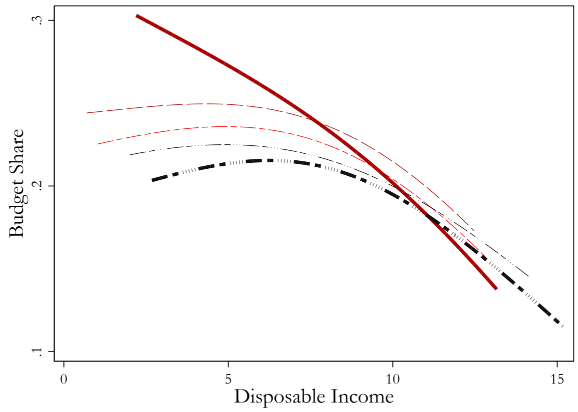
[b] Education Expenditure Share



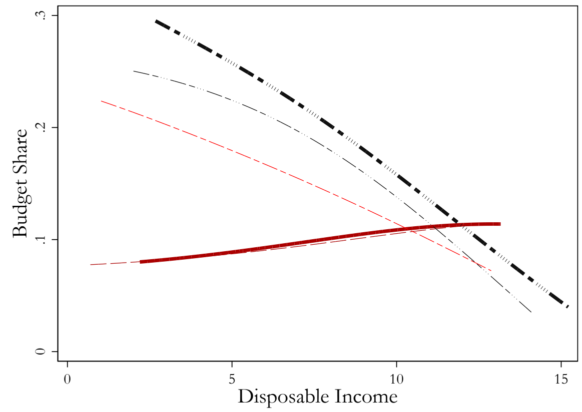
[c] Transportation Expenditure Share

Notes: Engel Curves for Housing end Education and Transportation Expenditures. The curves are expenditure shares log of consumption categories as a function of disposable income, fitted for each wealth quintile. The fits are nonparametric local linear polynomial regressions using Gaussian kernel weights and a bandwidth choice of 4. The data is from 1999-2015 waves of PSID, includes families with heads between 25-65 years old.

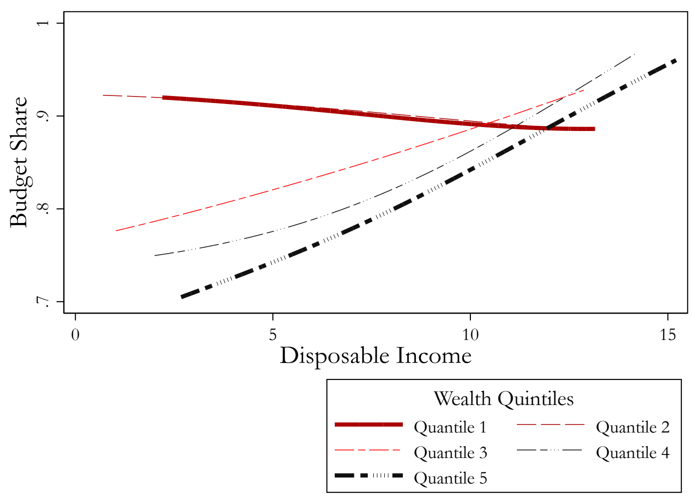
Figure A.2: **Engel Curves with alternative sample splitting**



[a] Food Consumption Share



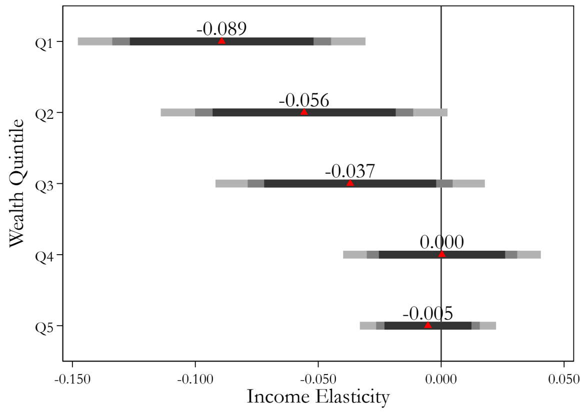
[b] Healthcare Expenditure Share

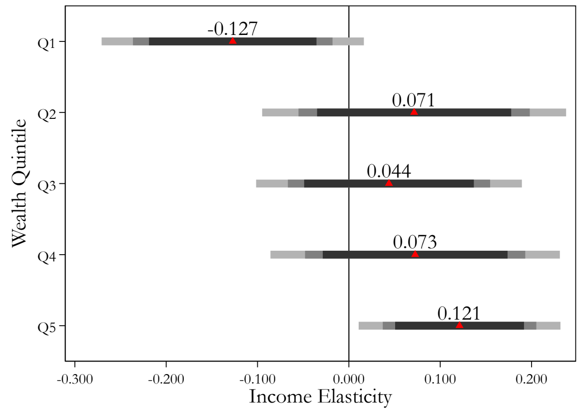


[c] Non-Health Consumption Share

Notes: Engel Curves for Non-Health consumption, Healthcare Expenditure and Food Consumption. The curves are expenditure shares log of consumption categories as a function of disposable income, fitted for each wealth quintile. The fits are nonparametric local linear polynomial regressions using Gaussian kernel weights and a bandwidth choice of 4. The healthcare expenditure is the sum of out-of-pocket health spending and health insurance payments of household. Food consumption includes food at home and food away from home. Non-health consumption includes food, housing, education, childcare, transportation spending of families. The data is from 1999-2015 waves of PSID, includes families with heads between 25-65 years old. The alternative sample split is based on net worth excluding home equity.

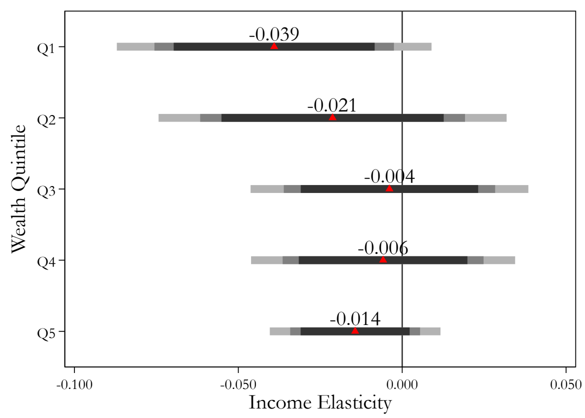
Figure A.3: **Euler Equation Estimates with insurance dummies**





[a] Food Consumption Growth

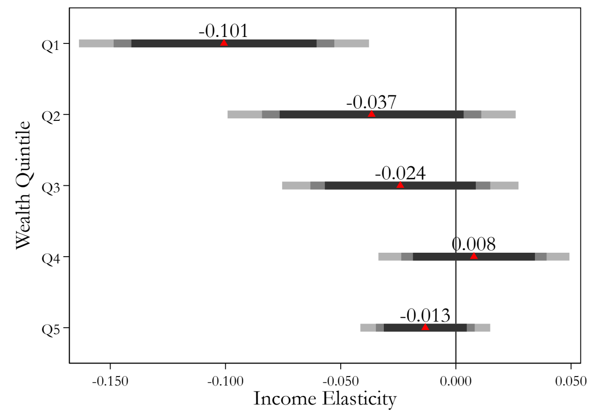
[b] Healthcare Expenditure Growth



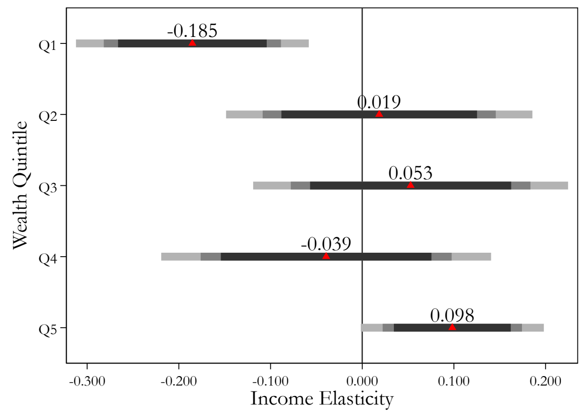
[c] Non-Health Consumption Growth

Notes: The figure plots coefficients from regressing growth of food consumption in panel a, growth of healthcare spending in panel b and growth of total consumption in panel c on disposable income for each wealth quintiles Q1-Q5 with the upmost coefficient belonging to the first quintile. The confidence intervals are also plotted at 99%, 95%, 90% confidence levels with fading colors respectively. The IV regressions include household specific rate of return, taste shifters as well as time and individual fixed effects. Instrument set consists of time t-1 values of the variables which are head and spouse marginal tax rates, log disposable income and average hours per week of head. Robust standard errors are clustered at household level. Insurance types are private, public and uninsured.

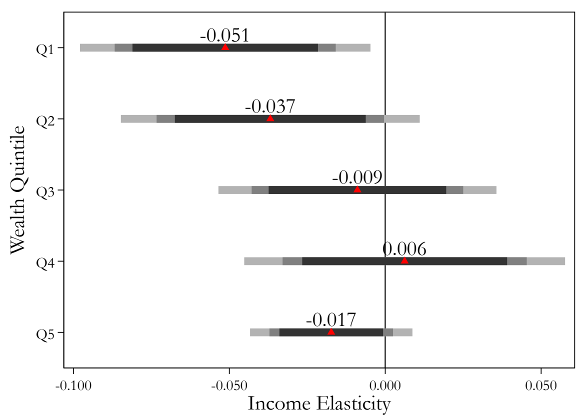
Figure A.4: **Euler Equation Estimates with alternative splitting**



[a] Food Consumption Growth



[b] Healthcare Expenditure Growth



[c] Non-Health Consumption Growth

Notes: The figure plots coefficients from regressing growth of food consumption in panel a, growth of healthcare spending in panel b and growth of total consumption in panel c on disposable income for each wealth quintiles Q1-Q5 with the upmost coefficient belonging to the first quintile. The confidence intervals are also plotted at 99%, 95%, 90% confidence levels with fading colors respectively. The IV regressions include household specific rate of return, taste shifters as well as time and individual fixed effects. Instrument set consists of time t-1 values of the variables which are head and spouse marginal tax rates, log disposable income and average hours per week of head. Robust standard errors are clustered at household level. The alternative sample split is based on net worth excluding home equity.

A.3 Additional Tables

Table A.1: **Health Index Statistics**

	Wealth Quintiles					
	1st	2nd	3rd	4th	5th	Total
Acute illness index	0.094	0.106	0.159	0.202	0.298	0.172
Chronic illness index	0.856	0.748	0.797	0.844	0.872	0.823
Hospitalization shock	0.136	0.120	0.125	0.114	0.122	0.123
Observations	7,111	7,109	7,105	7,108	7,108	35,541

Notes: Mean health index for each quintile. Higher index corresponds to more illnesses.

Table A.2: **Insurance Statistics**

	Wealth Quintiles					
	1st	2nd	3rd	4th	5th	Total
Private insurance	67.73	76.76	82.28	81.98	78.60	77.47
Public insurance	11.50	8.26	9.63	13.65	18.91	12.39
Uninsured/Unknown	20.77	14.98	8.09	4.38	2.49	10.14
Observations	7,111	7,109	7,105	7,108	7,108	35,541

Notes: Percent insured for each insurance type within wealth quintiles.

Table A.3: **Instrumental Variable Estimation of Consumption Growth controlling for insurance types**

	Food Consumption		Healthcare Expenditure		Total Consumption	
	Low Wealth (1)	High Wealth (2)	Low Wealth (3)	High Wealth (4)	Low Wealth (5)	High Wealth (6)
Ex-post rate	0.104	-0.0798	-0.262	-2.458	0.0527	-0.804
	(0.109)	(0.987)	(0.383)	(2.771)	(0.112)	(0.959)
Current income	-0.076***	-0.01	-0.024	0.068**	-0.033***	-0.013*
	(0.012)	(0.008)	(0.03)	(0.032)	(0.01)	(0.007)
Acute index	0.049	0.028*	0.014	0.412*	0.066**	-0.013
	(0.039)	(0.017)	(0.202)	(0.240)	(0.027)	(0.016)
Chronic index	0.009	0.011	0.034	0.122	0.005	-0.001
	(0.014)	(0.01)	(0.101)	(0.088)	(0.012)	(0.009)
Δ Acute index	0.061*	0.044***	-0.053	-0.016	0.062***	0.007
	(0.034)	(0.016)	(0.077)	(0.044)	(0.023)	(0.014)
Δ Chronic index	0.011	0.017**	0.045*	0.044**	0.014*	0.005
	(0.011)	(0.008)	(0.026)	(0.02)	(0.008)	(0.007)
Hospitalization	-0.003	0.029	-0.182	-0.309*	-0.001	0.017
	(0.029)	(0.018)	(0.228)	(0.188)	(0.021)	(0.017)
Δ Hospitalization	-0.016	0.001	0.122**	0.146***	0.008	0.029**
	(0.0207)	(0.0137)	(0.0503)	(0.0397)	(0.0146)	(0.0127)
Household Size	-0.054***	-0.053***	-0.005	-0.03	-0.06***	-0.013*
	(0.009)	(0.008)	(0.027)	(0.026)	(0.007)	(0.007)
Education	0.019**	-0.012	-0.002	0.029	0.001	-0.001
	(0.01)	(0.009)	(0.03)	(0.036)	(0.007)	(0.009)
Constant	0.567	0.479	1.492	0.130	0.693	1.408
	(1.170)	(1.027)	(3.151)	(4.215)	(0.871)	(1.121)
Age polynomial	✓	✓	✓	✓	✓	✓
Household FE	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓
N	12449	14726	12449	14726	12449	14726
R^2	0.012	0.005	0.03	0.004	0.03	0.008
Within R^2	0.023	0.013	0.043	0.009	0.044	0.015

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Robust standard errors clustered at household level in parentheses. The instrumental variable regressions include household specific rate of return, taste shifters as well as time and individual fixed effects. Instrument set consists of time t-1 values of the variables which are head and spouse marginal tax rates, log disposable income and average hours per week of head. Insurance types are private, public and uninsured.

A.3.1 Elasticity Estimations

Table A.4: **Log of total consumption**

	Dependent variable: Log of total consumption				
	(1)	(2)	(3)	(4)	(5)
Acute index	-0.003	0.03	-0.004	-0.009	-0.002
	(0.025)	(0.022)	(0.021)	(0.018)	(0.016)
Chronic index	-0.001	0.003	0.009	-0.015**	0.002
	(0.01)	(0.008)	(0.008)	(0.007)	(0.009)
Hospitalization	-0.016	0.015	-0.014	0.032**	-0.009
	(0.017)	(0.015)	(0.014)	(0.014)	(0.015)
Current income	0.051***	0.039***	0.028***	0.024***	0.013*
	(0.009)	(0.012)	(0.009)	(0.007)	(0.007)
Household Size	0.121***	0.082***	0.069***	0.067***	0.071***
	(0.009)	(0.008)	(0.007)	(0.008)	(0.011)
Education	0.012*	-0.012**	0.005	0.007	0.004
	(0.007)	(0.009)	(0.01)	(0.012)	(0.015)
Age	0.073***	0.044**	0.027	0.035*	0.074***
	(0.021)	(0.02)	(0.02)	(0.019)	(0.02)
Age^2	-0.0003***	-0.0004***	-0.0003***	-0.0004***	-0.0004***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Constant	6.167***	8.671***	9.400***	9.555***	7.456***
	(0.917)	(0.924)	(1.045)	(1.101)	(1.266)
Race	✓	✓	✓	✓	✓
Marital Status	✓	✓	✓	✓	✓
Insurance type	✓	✓	✓	✓	✓
Household FE	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓
State FE	✓	✓	✓	✓	✓
N	7111	7109	7105	7108	7108
Adjusted R^2	0.214	0.213	0.155	0.133	0.081

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Robust standard errors clustered at household level in parentheses. The table shows the fixed effect regression coefficients of log of total consumption on log of family disposable income and covariates for each wealth quintile. Wealth is net worth of family that is sum of all assets minus debts that include housing equity.

Table A.5: **Log of health-care expenditure**

	Dependent variable: Log of health-care expenditure				
	(1)	(2)	(3)	(4)	(5)
Acute index	0.120	0.029	0.145**	-0.078	-0.036
	(0.110)	(0.086)	(0.066)	(0.063)	(0.041)
Chronic index	0.078**	0.072**	0.093***	0.027	0.026
	(0.032)	(0.033)	(0.027)	(0.024)	(0.021)
Hospitalization	0.087	0.234***	0.119**	0.204***	0.139***
	(0.067)	(0.061)	(0.048)	(0.05)	(0.042)
Current income	0.175***	0.058*	0.023	-0.027	-0.064***
	(0.026)	(0.033)	(0.028)	(0.022)	(0.017)
Household size	0.145***	0.119***	0.072**	0.099***	0.112***
	(0.034)	(0.027)	(0.029)	(0.026)	(0.028)
Education	-0.026	-0.038	0.024	0.048	0.044
	(0.027)	(0.031)	(0.023)	(0.039)	(0.033)
Age	0.168**	0.171**	0.0719	0.130**	0.194***
	(0.083)	(0.075)	(0.074)	(0.066)	(0.057)
Age^2	-0.0004	-0.001***	-0.0008***	-0.0008***	-0.001***
	(0.0003)	(0.0003)	(0.0002)	(0.0002)	(0.0002)
Constant	-1.500	2.012	5.776	1.434	2.165
	(3.596)	(3.431)	(3.872)	(3.766)	(3.562)
Race	✓	✓	✓	✓	✓
Marital Status	✓	✓	✓	✓	✓
Insurance type	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓
State FE	✓	✓	✓	✓	✓
N	7109	7109	7105	7108	7108
Adjusted R^2	0.149	0.153	0.092	0.077	0.060

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Robust standard errors clustered at household level in parentheses. The table shows the fixed effect regression coefficients of log of healthcare expenditure on log of family disposable income and covariates for each wealth quintile. Healthcare expenditure consists of out-of-pocket expenditure and insurance premium paid by the household. Wealth is net worth of family that is sum of all assets minus debts that include housing equity.

Table A.6: **Log of food consumption**

	Dependent variable: Log of food consumption				
	(1)	(2)	(3)	(4)	(5)
Acute index	-0.04	0.044	-0.04	0.027	0.040*
	(0.043)	(0.038)	(0.036)	(0.029)	(0.021)
Chronic index	-0.032**	0.004	-0.005	-0.020	0.014
	(0.015)	(0.015)	(0.012)	(0.013)	(0.011)
Hospitalization	-0.055*	-0.032	-0.023	-0.061***	-0.006
	(0.028)	(0.023)	(0.023)	(0.020)	(0.017)
Current income	0.082***	0.086***	0.058***	0.02*	0.034***
	(0.013)	(0.016)	(0.018)	(0.012)	(0.011)
Household size	0.083***	0.098***	0.112***	0.111***	0.120***
	(0.015)	(0.013)	(0.011)	(0.012)	(0.01)
Education	0.002	-0.008	0.031**	0.017	0.018
	(0.011)	(0.013)	(0.013)	(0.015)	(0.014)
Age	0.032	0.079**	0.013	0.084***	0.042**
	(0.031)	(0.034)	(0.027)	(0.024)	(0.021)
Age^2	-0.0004***	-0.0003**	-0.0003***	-0.0004***	-0.0003***
	(0.0002)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Constant	6.121***	5.162***	7.081***	4.940***	6.999***
	(1.322)	(1.496)	(1.248)	(1.268)	(1.125)
Race	✓	✓	✓	✓	✓
Marital Status	✓	✓	✓	✓	✓
Insurance type	✓	✓	✓	✓	✓
Household FE	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓
State FE	✓	✓	✓	✓	✓
N	5930	5925	5927	5927	5927
Adjusted R^2	0.095	0.100	0.099	0.089	0.084

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Robust standard errors clustered at household level in parentheses. The table shows the fixed effect regression coefficients of log of food consumption on log of family disposable income and covariates for each wealth quintile. Wealth is net worth of family that is sum of all assets minus debts that include housing equity.

Table A.7: **Log of non-health consumption**

	Dependent variable: Log of non-health consumption				
	(1)	(2)	(3)	(4)	(5)
Acute index	-0.008	0.032	-0.024	-0.005	-0.005
	(0.026)	(0.023)	(0.021)	(0.017)	(0.018)
Chronic index	-0.005	-0.001	-0.002	-0.020***	0.002
	(0.010)	(0.009)	(0.008)	(0.007)	(0.009)
Hospitalization	-0.048***	-0.009	-0.027*	0.003	-0.036**
	(0.017)	(0.015)	(0.014)	(0.015)	(0.017)
Current income	0.046***	0.041***	0.033***	0.032***	0.024***
	(0.009)	(0.012)	(0.008)	(0.008)	(0.008)
Household Size	0.123***	0.081***	0.074***	0.066***	0.074***
	(0.010)	(0.008)	(0.008)	(0.008)	(0.011)
Education	0.012	-0.020**	0.004	-0.005	0.0008
	(0.008)	(0.01)	(0.01)	(0.012)	(0.015)
Age	0.065***	0.033	0.022	0.039**	0.064***
	(0.022)	(0.021)	(0.020)	(0.02)	(0.023)
Age^2	-0.0003***	-0.0003***	-0.0003***	-0.0004***	-0.0004***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Constant	6.485***	8.932***	9.211***	9.364***	7.490***
	(0.952)	(0.959)	(1.062)	(1.141)	(1.441)
Race	✓	✓	✓	✓	✓
Marital Status	✓	✓	✓	✓	✓
Insurance type	✓	✓	✓	✓	✓
Household FE	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓
State FE	✓	✓	✓	✓	✓
N	7111	7109	7105	7108	7108
Adjusted R^2	0.181	0.178	0.150	0.117	0.074

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Robust standard errors clustered at household level in parentheses. The table shows the fixed effect regression coefficients of log of total non-health consumption on log of family disposable income and covariates for each wealth quintile. Wealth is net worth of family that is sum of all assets minus debts that include housing equity.

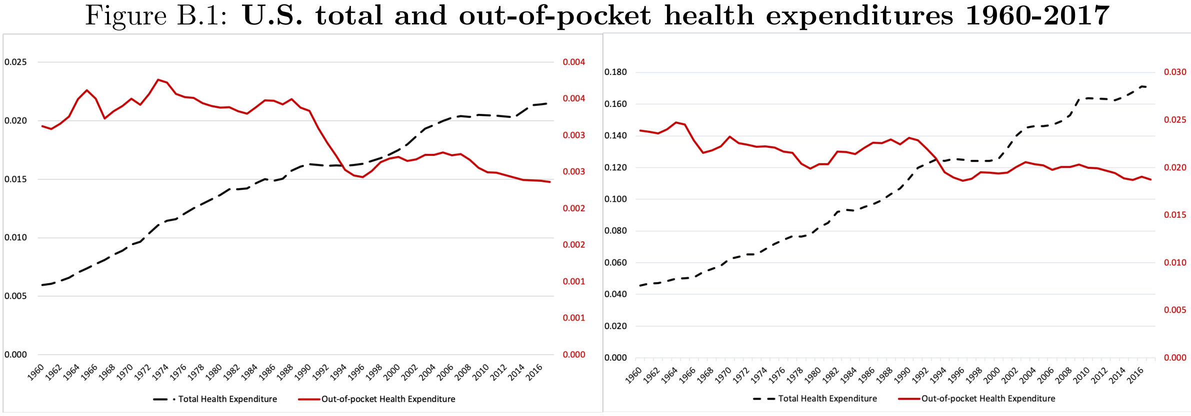
Appendix B

Appendix B: Chapter 2

B.1 Additional Figures and Tables

B.1.1 Healthcare expenditure over time

Figure B.1: **U.S. total and out-of-pocket health expenditures 1960-2017**



[a] U.S. total (left) and out-of-pocket (right) health expenditure per capita

[b] GDP share of U.S. total (left) and out-of-pocket (right) health expenditure

Notes: The figure shows time series of U.S. total and out-of-pocket healthcare expenditure per capita (in billion dollars) and its GDP share between 1960-2017. The expenditures are deflated to 2010 dollars using CPI for medical expenditures (CPIMEDSL). The health data is from National Health Expenditure data of Center for Medicare and Medicaid Services. GDP and price data are extracted from FRED database of Federal Reserve Bank of St. Louis.

B.1.2 Data Summary

Table B.1: **Descriptive Statistics**

	Wealth Groups		
	Low Wealth	High Wealth	Total
Logs:			
Net Wealth	15.2	695.7	355.5
Disposable Income	29.6	63.1	46.4
Total Consumption	38.4	56.0	47.2
Food Consumption	7.3	9.6	8.4
Health Expenditure	4.2	7.3	5.8
Growths:			
Δ Disposable Income	0.09	-0.04	0.02
Δ Total Consumption	0.05	0.02	0.03
Δ Food Consumption	0.03	-0.02	0.005
Δ Health Expenditure	0.18	0.07	0.12
Demographics:			
Age	38.9	52.6	45.8
Education	13.2	14.2	13.7
Household Size	2.7	2.7	2.7
Observations	17,771	17,770	35,541

Notes: This table presents mean of corresponding variables for low wealth and high households and all sample. Wealth, income and consumption are in thousand dollars. The wealth variable used in this analysis is all assets net of debt, including home equity.

Table B.2: **Median Absolute Deviation**

	Wealth Groups		
	Low Wealth	High Wealth	Total
Net Wealth	18.9	177.1	90.5
Disposable Income	13	23.7	18.8
Total Consumption	11.8	17.5	14.8
Food Consumption	2.4	2.9	2.7
Health Expenditure	2.1	3.4	2.8
Observations	17,771	17,770	35,541

Notes: This table presents median absolute deviations of each variable are in thousand dollars for low wealth and high households and all sample. The wealth variable used in this analysis is all assets net of debt, including home equity.

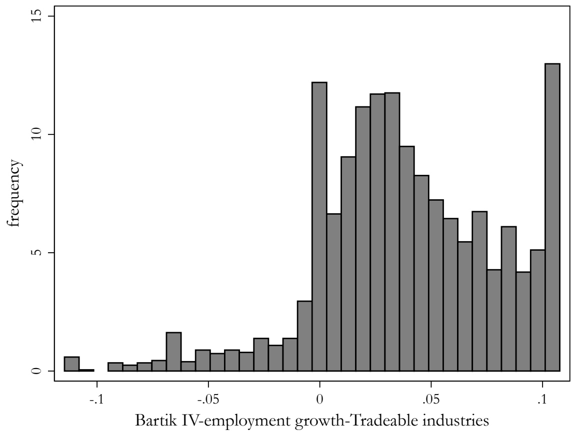
Table B.3: **Health Index Statistics**

	Wealth Groups		
	Low Wealth	High Wealth	Total
Acute illness index	0.109	0.234	0.172
Chronic illness index	0.796	0.851	0.823
Hospitalization shock	0.127	0.120	0.123
Observations	17,771	17,770	35,541

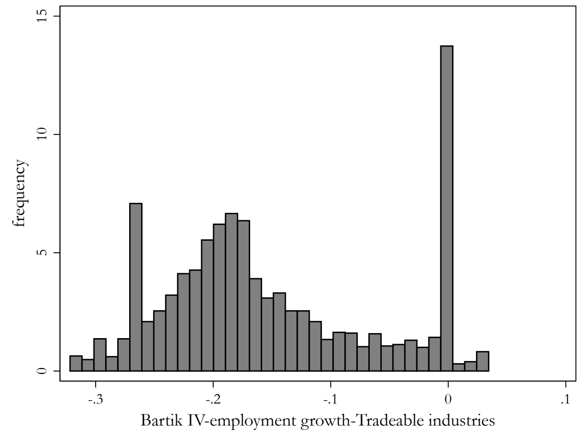
Notes: This table presents mean health index for low wealth and high households and all sample. Higher index corresponds to more illnesses. The wealth variable used in this analysis is all assets net of debt, including home equity.

B.1.3 Histograms for Bartik IV - LQ-based-sector employment

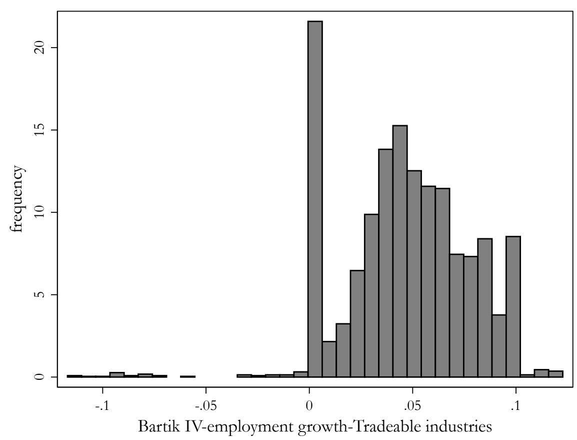
Figure B.2: **Within-year distribution of Bartik IV tradable-employment growth rates**



[a] County Employment Growth 1998-2000



[b] County Employment Growth 2008-2010

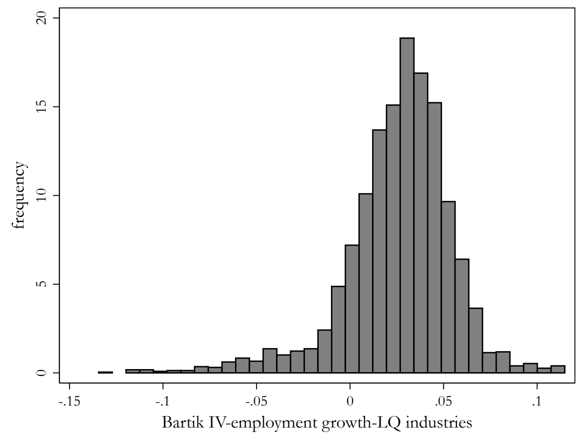


[c] County Employment Growth 2012-2014

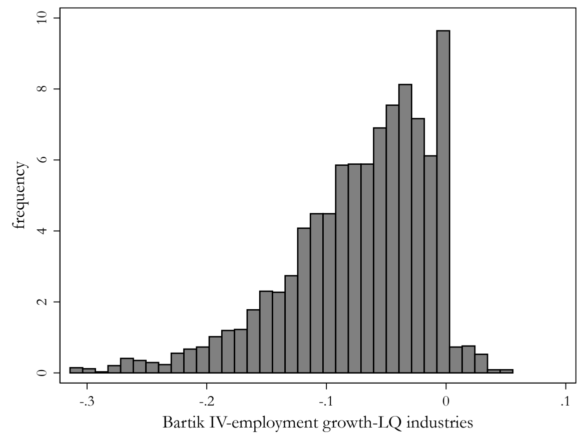
Notes: The distribution of Bartik IV employment growth rates within each year. The IV is constructed using employment growth for tradable industries. The data is taken from Quarterly Census of Employment and Wages (QCEW).

B.1.4 Histograms for Bartik IV - tradable-sector employment

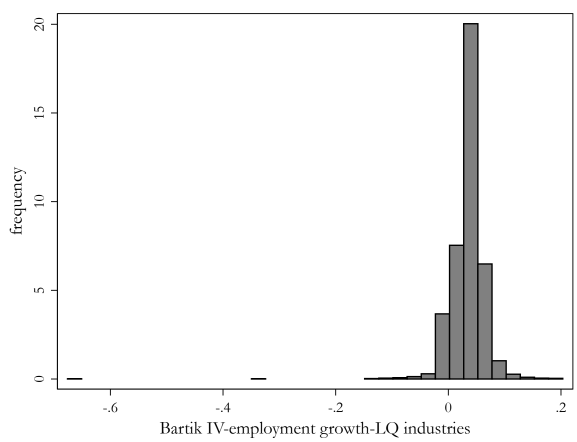
Figure B.3: **Within-year distribution of Bartik IV LQ-employment growth rates**



[a] County Employment Growth 1998-2000



[b] County Employment Growth 2008-2010

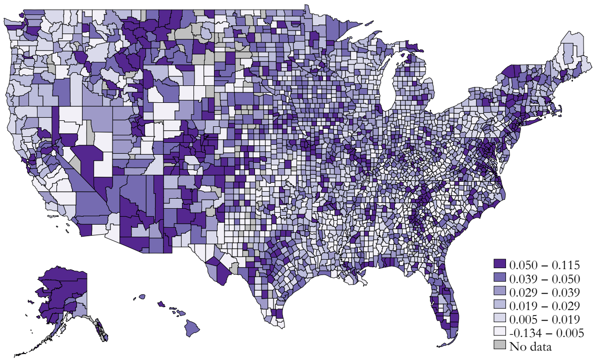


[c] County Employment Growth 2012-2014

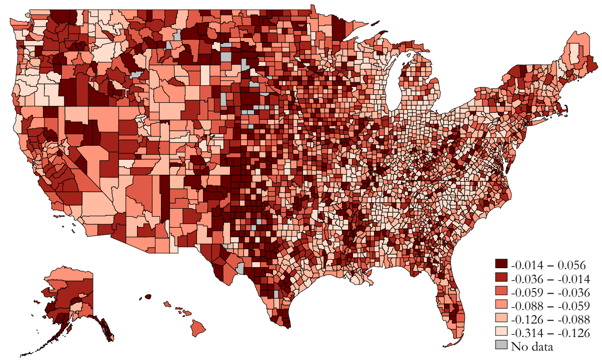
Notes: The distribution of Bartik IV employment growth rates within each year. The IV is constructed using employment growth for LQ industries. The data is taken from Quarterly Census of Employment and Wages (QCEW).

B.1.5 Distribution of Employment Growth across counties - LQ-based-sector employment

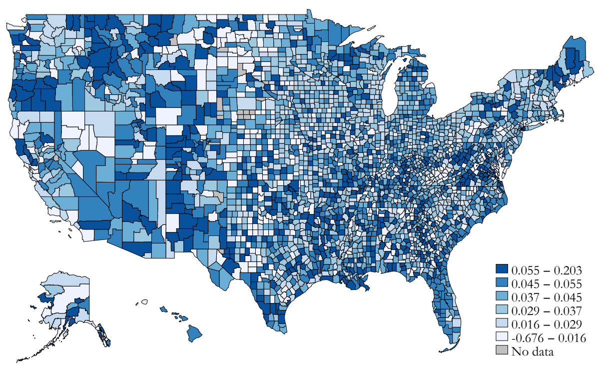
Figure B.4: **Bartik IV of employment growth rates across space**



[a] County Employment Growth 1998-2000



[b] County Employment Growth 2008-2010

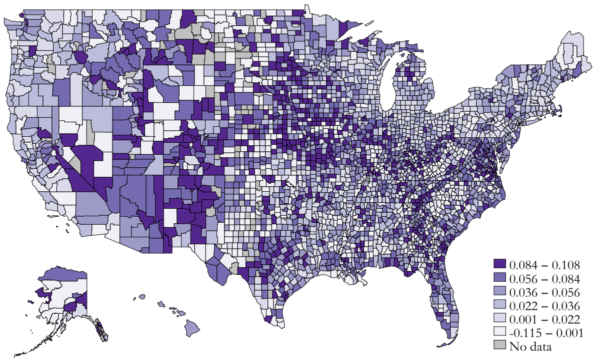


[c] County Employment Growth 2012-2014

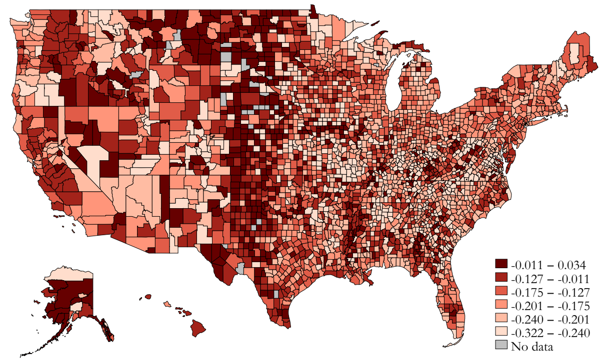
Notes: Bartik IV distributions over U.S. counties. Bartik IV is constructed using employment growth for all industries. The data is taken from Quarterly Census of Employment and Wages (QCEW).

B.1.6 Distribution of Employment Growth across counties - tradable-sector employment

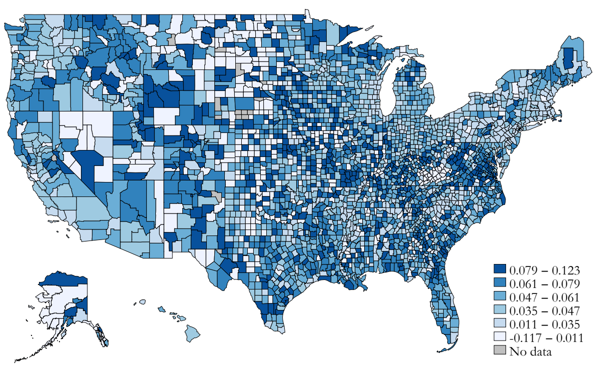
Figure B.5: **Bartik IV of employment growth rates across space**



[a] County Employment Growth 1998-2000



[b] County Employment Growth 2008-2010

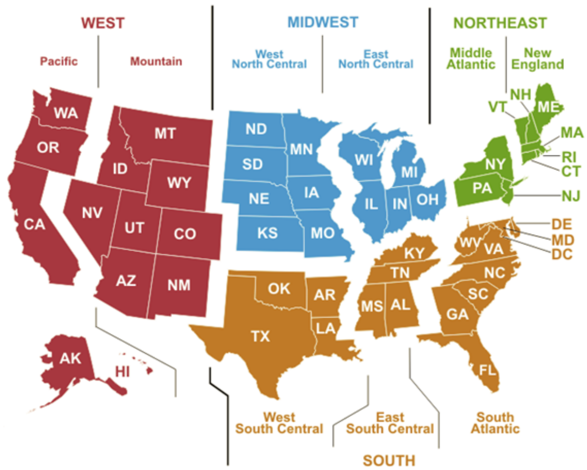


[c] County Employment Growth 2012-2014

Notes: Bartik IV distributions over U.S. counties. Bartik IV is constructed using employment growth for all industries. The data is taken from Quarterly Census of Employment and Wages (QCEW).

B.1.7 Census Region Heterogeneity of Elasticities for alternative instruments

Figure B.6: **U.S. Census Bureau statistical regions**



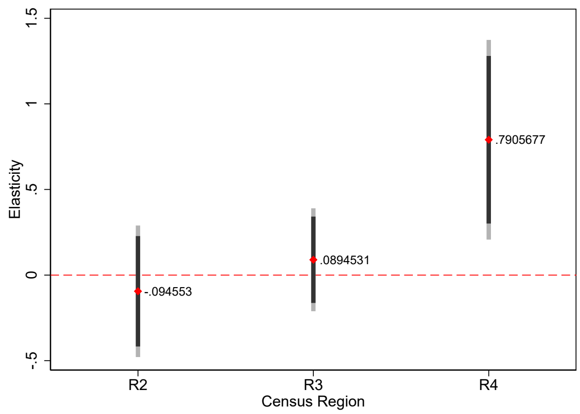
Notes: The map shows the division of Census regions and included states across the United States. (Region 1: Northeast — Region 2: Midwest — Region 3: South — Region 4: West)
Source: https://www.eia.gov/consumption/commercial/maps.php

Figure B.7: **States in each Census Bureau statistical region**

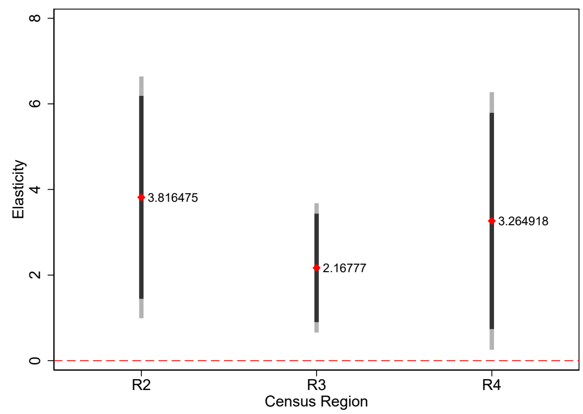
Region 1 Northeast		Region 2 Midwest		Region 3 South		Region 4 West	
FIPS code	*State*	*FIPS code*	*State*	*FIPS code*	*State*	*FIPS code*	*State*
9	Connecticut	17	Illinois	1	Alabama	2	Alaska
23	Maine	18	Indiana	5	Arkansas	4	Arizona
25	Massachusetts	19	Iowa	10	Delaware	6	California
33	New Hampshire	20	Kansas	11	District of Columbia	8	Colorado
34	New Jersey	26	Michigan	12	Florida	15	Hawaii
36	New York	27	Minnesota	13	Georgia	16	Idaho
42	Pennsylvania	29	Missouri	21	Kentucky	30	Montana
44	Rhode Island	31	Nebraska	22	Louisiana	32	Nevada
50	Vermont	38	North Dakota	24	Maryland	35	New Mexico
		39	Ohio	28	Mississippi	41	Oregon
		46	South Dakota	37	North Carolina	49	Utah
		55	Wisconsin	40	Oklahoma	53	Washington
				45	South Carolina	56	Wyoming
				47	Tennessee		
				48	Texas		
				51	Virginia		
				54	West Virginia		

Notes: The table shows states in each Census region.
(Region 1: Northeast — Region 2: Midwest — Region 3: South — Region 4: West)

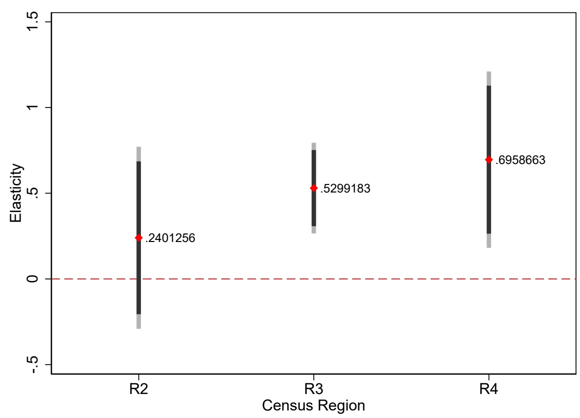
Figure B.8: **Elasticity of Consumption for Census regions - Tradable Industries**



[a] Elasticity of Food Consumption



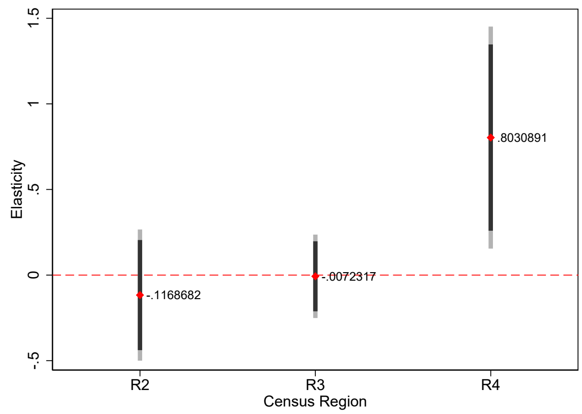
[b] Elasticity of Out-of-pocket Health Expenditures



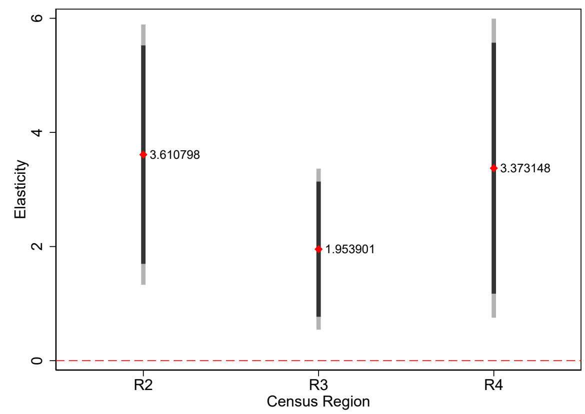
[c] Elasticity of Total Consumption

Notes: Second stage coefficients of income elasticity of consumption of 2SLS estimations where Bartik IV for tradable industries is used. R2:Midwest, R3:South, R4:West. Region1:Northeast is omitted because of high confidence intervals and noisy estimates.

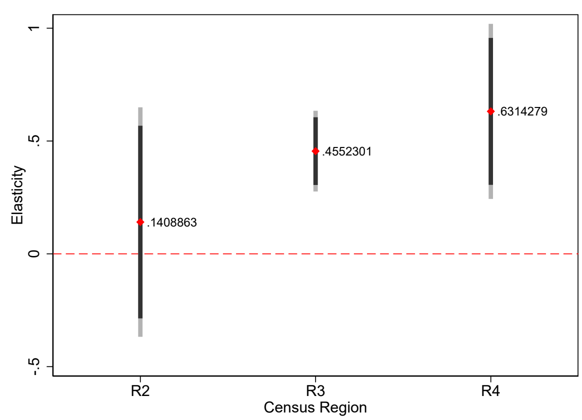
Figure B.9: **Elasticity of Consumption for Census regions - LQ-based Industries**



[a] Elasticity of Food Consumption



[b] Elasticity of Out-of-pocket Health Expenditures



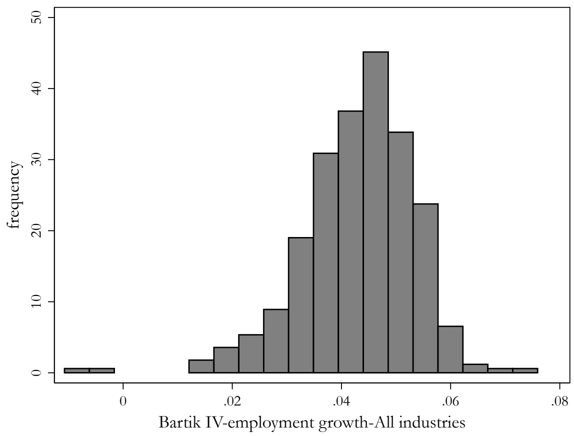
[c] Elasticity of Total Consumption

Notes: Second stage coefficients of income elasticity of consumption of 2SLS estimations where Bartik IV for LQ-based industries is used. R2:Midwest, R3:South, R4:West. Region1:Northeast is omitted because of high confidence intervals and noisy estimates.

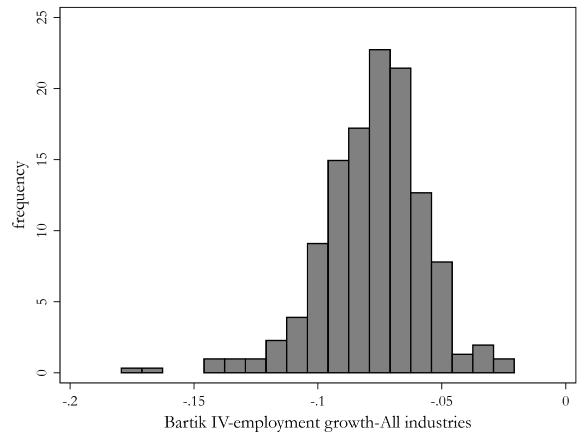
B.2 MSA Results

B.2.1 Histograms for Bartik IV - all sectors employment for MSAs

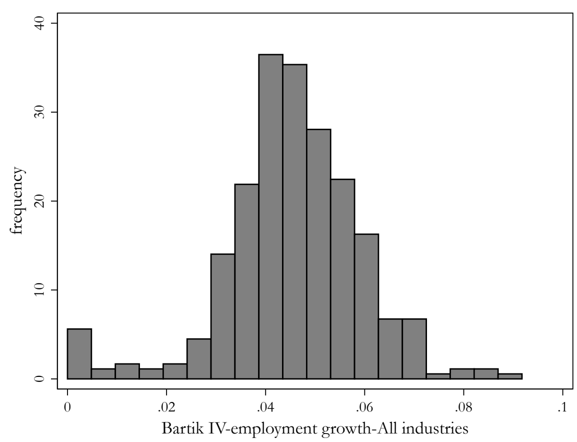
Figure B.10: **Within-year distribution of Bartik IV for total employment growth rates**



[a] County Employment Growth 1998-2000



[b] County Employment Growth 2008-2010

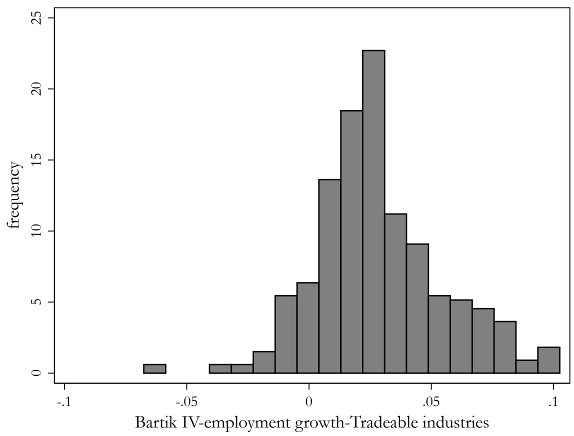


[c] County Employment Growth 2012-2014

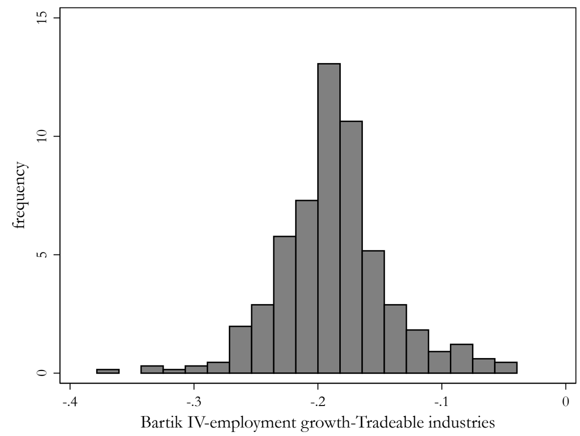
Notes: The distribution of Bartik IV employment growth rates within each year. The IV is constructed using employment growth for all industries. The data is taken from Quarterly Census of Employment and Wages (QCEW).

B.2.2 Histograms for Bartik IV - LQ-based-sector employment for MSAs

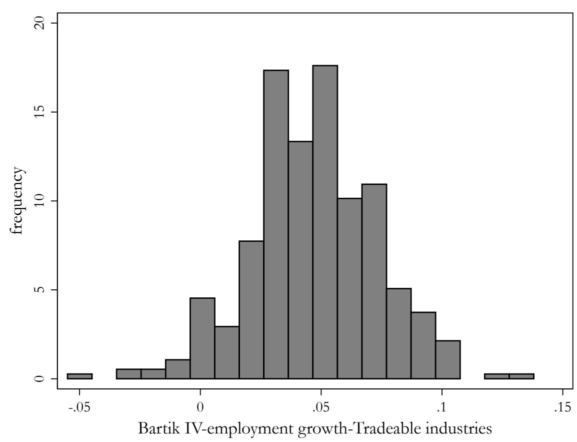
Figure B.11: **Within-year distribution of Bartik IV tradable-employment growth rates**



[a] County Employment Growth 1998-2000



[b] County Employment Growth 2008-2010

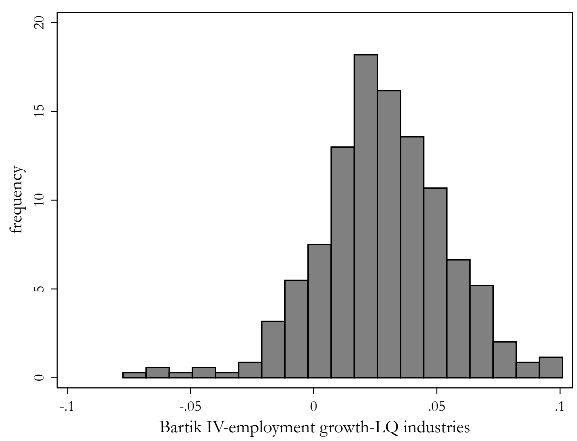


[c] County Employment Growth 2012-2014

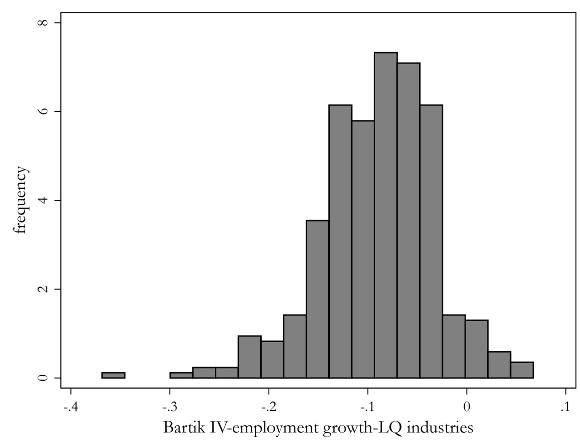
Notes: The distribution of Bartik IV employment growth rates within each year. The IV is constructed using employment growth for tradable industries. The data is taken from Quarterly Census of Employment and Wages (QCEW).

B.2.3 Histograms for Bartik IV - tradable-sector employment for MSAs

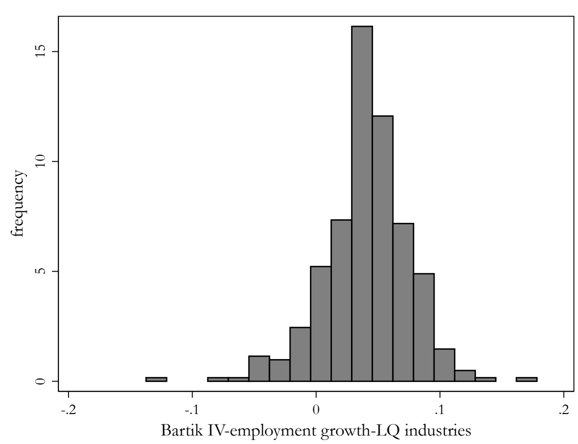
Figure B.12: **Within-year distribution of Bartik IV LQ-employment growth rates**



[a] County Employment Growth 1998-2000



[b] County Employment Growth 2008-2010

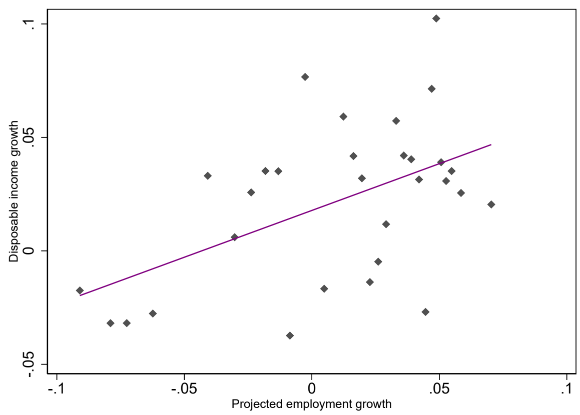


[c] County Employment Growth 2012-2014

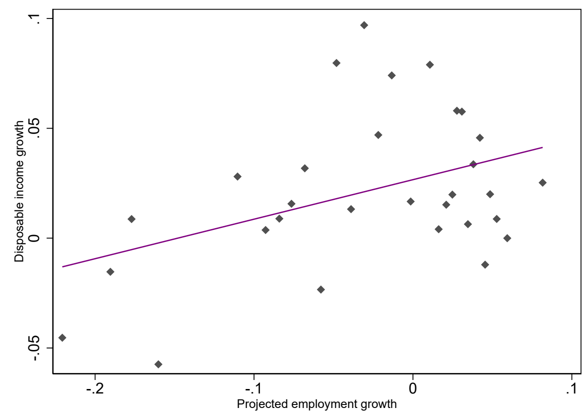
Notes: The distribution of Bartik IV employment growth rates within each year. The IV is constructed using employment growth for LQ industries. The data is taken from Quarterly Census of Employment and Wages (QCEW).

B.2.4 Strength of Instrument for MSA Estimations

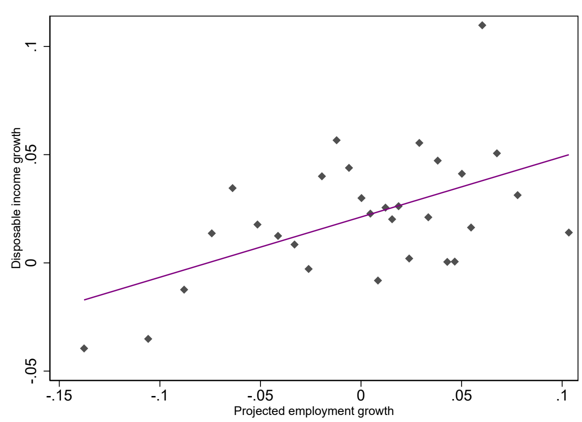
Figure B.13: **First stage relationship**



[a] Residualized IV and income growth for all industries



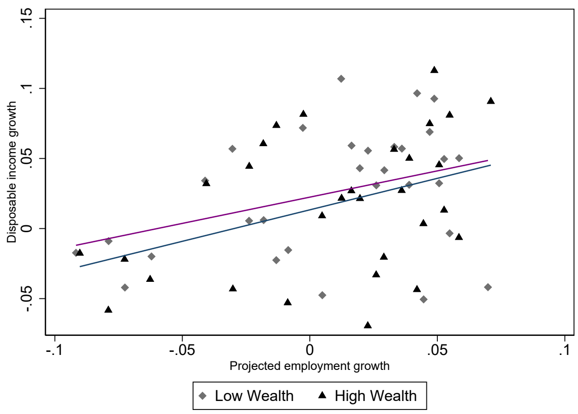
[b] Residualized IV and income growth for tradable industries



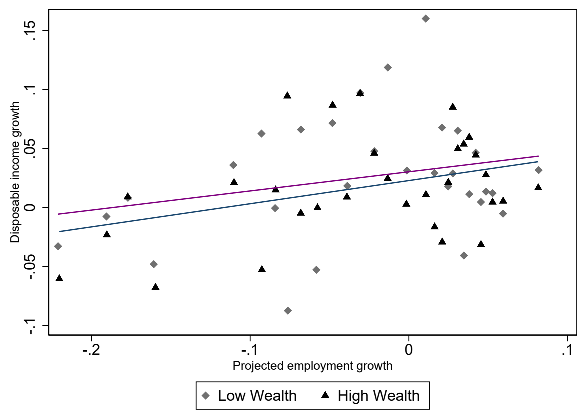
[c] Residualized IV and income growth for LQ-based industries

Notes: Residual plots of projected county employment growth and household disposable income growth. Each dot is an average of 885 observations. The covariates in equation 4 are partialed out.

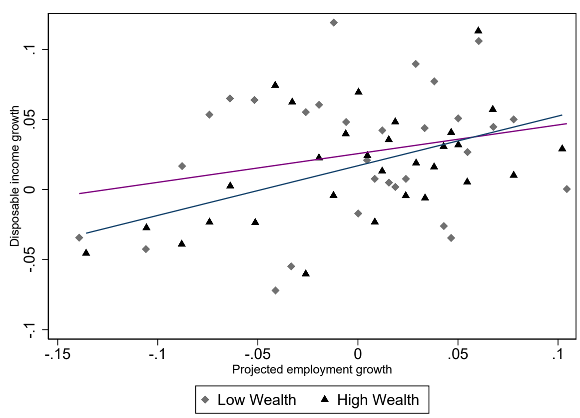
Figure B.14: **First stage relationship across wealth**



[a] Residualized IV and income growth for all industries



[b] Residualized IV and income growth for tradable industries



[c] Residualized IV and income growth for LQ-based industries

Notes: Residual plots of projected county employment growth and household disposable income growth. Each dot is an average of 437 observations for wealth group 1 and 447 observations for wealth group 2. The covariates in equation 4 are partialed out.

B.2.5 Elasticities for MSA Estimations

Table B.4: **OLS estimates of Income Elasticity of Expenditure with MSA industry controls**

	$\Delta Food$	$\Delta Healthcare$	$\Delta Total$	$\Delta Food$	$\Delta Healthcare$	$\Delta Total$
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta Household\ Income$	0.0546***	0.0904***	0.0462***	0.0546***	0.0904***	0.0462***
	(0.00452)	(0.0113)	(0.00452)	(0.00451)	(0.0114)	(0.00452)
$Manufacturing\ share$ 1998				-0.0319	-0.0835	-0.00269
				(0.0507)	(0.0856)	(0.0313)
$Tradable\ share$ 1998				0.0273	-0.119*	-0.0352
				(0.0398)	(0.0593)	(0.0276)
$Constant$	0.249***	0.703***	0.366***	0.243***	0.754***	0.378***
	(0.0453)	(0.128)	(0.0333)	(0.0405)	(0.129)	(0.0336)
Household controls	✓	✓	✓	✓	✓	✓
State FE	✓	✓	✓	✓	✓	✓
Observations	26550	26550	26550	26550	26550	26550
Adjusted R^2	0.0206	0.0139	0.0294	0.0205	0.0138	0.0294

Robust standard errors are clustered at state level.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table presents estimates of the change in log income on the change in log expenditure for food, healthcare and total household consumption. Healthcare expenditure includes out-of-pocket health spending and insurance premiums paid by the household. Household level control variables comprise size of the household, a quadratic in age, education, sex, race and marital status of head of the household, acute health index, chronic health index and hospitalization index. State fixed effects are also included. Columns 4-6 adds industry characteristics in the region to the covariates, namely manufacturing industry share and tradable industry share. Region is approximated as MSAs. Robust standard errors are clustered at state level.

Table B.5: **2SLS estimates of Income Elasticity of Expenditure with Bartik IV all employment**

	$\Delta Food$	$\Delta Healthcare$	$\Delta Total$	$\Delta Food$	$\Delta Healthcare$	$\Delta Total$
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta Household\ Income$	0.535**	4.446***	1.000***	0.544**	4.519***	1.018***
	(0.249)	(1.408)	(0.331)	(0.260)	(1.493)	(0.349)
$Manufacturing\ share$ 1998				0.0716	0.853	0.203
				(0.0819)	(0.560)	(0.135)
$Tradable\ share$ 1998				-0.0542	-0.855***	-0.197***
				(0.0585)	(0.330)	(0.0685)
$Constant$	-0.295	-3.503**	-0.396	-0.297	-3.442**	-0.384
	(0.308)	(1.440)	(0.371)	(0.310)	(1.485)	(0.377)
Household controls	✓	✓	✓	✓	✓	✓
State FE	✓	✓	✓	✓	✓	✓
Observations	26550	26550	26550	26550	26550	26550
First stage F-test	909.62	909.62	909.62	893.53	893.53	893.53

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table presents estimates of the change in log income on the change in log expenditure for food, healthcare and total household consumption using projected employment growth in the region as an instrument. Employment growth is constructed using employment in all industries. Region is approximated as MSAs. Healthcare expenditure includes out-of-pocket health spending and insurance premiums paid by the household. Household level control variables comprise size of the household, a quadratic in age, education, sex, race and marital status of head of the household, acute health index, chronic health index and hospitalization index. State fixed effects are also included. Columns 4-6 adds industry characteristics in the region to the covariates, namely manufacturing industry share and tradable industry share. Robust standard errors are clustered at state level.

Table B.6: **2SLS estimates of Income Elasticity of Expenditure with Bartik IV tradable employment**

	$\Delta Food$	$\Delta Healthcare$	$\Delta Total$	$\Delta Food$	$\Delta Healthcare$	$\Delta Total$
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta Household\ Income$	0.597*	5.435**	0.910**	0.624*	5.801**	0.973**
	(0.313)	(2.241)	(0.410)	(0.344)	(2.547)	(0.465)
$Manufacturing\ share$ 1998				0.0885	1.124	0.193
				(0.0991)	(0.789)	(0.145)
$Tradable\ share$ 1998				-0.0675	-1.069**	-0.189**
				(0.0728)	(0.481)	(0.0827)
$Constant$	-0.354	-4.435**	-0.312	-0.370	-4.619*	-0.343
	(0.355)	(2.144)	(0.433)	(0.372)	(2.378)	(0.469)
Household controls	✓	✓	✓	✓	✓	✓
State FE	✓	✓	✓	✓	✓	✓
Observations	26550	26550	26550	26550	26550	26550
First stage F-test	905.90	905.90	905.90	864.62	864.62	864.62

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table presents estimates of the change in log income on the change in log expenditure for food, healthcare and total household consumption using projected employment growth in the region as an instrument. Employment growth is constructed using employment in tradable industries. Region is approximated as MSAs. Healthcare expenditure includes out-of-pocket health spending and insurance premiums paid by the household. Household level control variables comprise size of the household, a quadratic in age, education, sex, race and marital status of head of the household, acute health index, chronic health index and hospitalization index. State fixed effects are also included. Columns 4-6 adds industry characteristics in the region to the covariates, namely manufacturing industry share and tradable industry share. Robust standard errors are clustered at state level.

Table B.7: **2SLS estimates of Income Elasticity of Expenditure with Bartik IV LQ employment**

	$\Delta Food$	$\Delta Healthcare$	$\Delta Total$	$\Delta Food$	$\Delta Healthcare$	$\Delta Total$
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta Household\ Income$	0.405	4.163**	0.760**	0.422	4.370**	0.799**
	(0.296)	(1.623)	(0.346)	(0.325)	(1.880)	(0.385)
$Manufacturing\ share$ 1998				0.0458	0.821	0.156
				(0.0887)	(0.621)	(0.125)
$Tradable\ share$ 1998				-0.0339	-0.831**	-0.160**
				(0.0666)	(0.354)	(0.0663)
$Constant$	-0.173	-3.236*	-0.171	-0.184	-3.305*	-0.183
	(0.358)	(1.752)	(0.388)	(0.375)	(1.960)	(0.414)
Household controls	✓	✓	✓	✓	✓	✓
State FE	✓	✓	✓	✓	✓	✓
Observations	26550	26550	26550	26550	26550	26550
First stage F-test	867.59	867.59	867.59	821.50	821.50	821.50

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table presents estimates of the change in log income on the change in log expenditure for food, healthcare and total household consumption using projected employment growth in the region as an instrument. Employment growth is constructed using employment in LQ-based industries. Region is approximated as MSAs. Healthcare expenditure includes out-of-pocket health spending and insurance premiums paid by the household. Household level control variables comprise size of the household, a quadratic in age, education, sex, race and marital status of head of the household, acute health index, chronic health index and hospitalization index. State fixed effects are also included. Columns 4-6 adds industry characteristics in the region to the covariates, namely manufacturing industry share and tradable industry share. Robust standard errors are clustered at state level.

Table B.8: **OLS estimates of Income Elasticity of Expenditure for MSAs**

	Δ*Food Consumption*		Δ*Healthcare Expenditures*		Δ*Total Consumption*		Δ*Food Consumption*		Δ*Healthcare Expenditures*		Δ*Total Consumption*	
	Low Wealth (1)	High Wealth (2)	Low Wealth (3)	High Wealth (4)	Low Wealth (5)	High Wealth (6)	Low Wealth (7)	High Wealth (8)	Low Wealth (9)	High Wealth (10)	Low Wealth (11)	High Wealth (12)
Δ*Household Income*	0.0720***	0.0261***	0.167***	0.0131	0.0611***	0.0254***	0.0761***	0.0306***	0.168***	0.00402	0.0634***	0.0267***
	(0.00600)	(0.00520)	(0.0153)	(0.0138)	(0.00420)	(0.00448)	(0.00606)	(0.00661)	(0.0174)	(0.0152)	(0.00643)	(0.00544)
Manufacturing share 1998							-0.0949	0.0723	-0.342**	0.238	-0.0462	0.0738
							(0.116)	(0.0542)	(0.150)	(0.151)	(0.0585)	(0.0481)
Tradable share 1998							0.0675	-0.0515	0.0330	-0.350**	0.0234	-0.131***
							(0.101)	(0.0434)	(0.0921)	(0.149)	(0.0441)	(0.0314)
Constant	1.061***	-0.509***	1.170**	-0.289	1.846***	-0.204	0.551***	-0.620***	1.530***	0.00574	0.896***	0.0631
	(0.0734)	(0.0860)	(0.448)	(0.826)	(0.0444)	(0.213)	(0.0713)	(0.107)	(0.419)	(0.817)	(0.0553)	(0.212)
Household controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
State FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Observations	17229	17095	17229	17095	17229	17095	13121	13429	13121	13429	13121	13429

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table presents estimates of the change in log income on the change in log expenditure for food, healthcare and total household consumption separately for low and high wealth households. The wealth variable used in this analysis is all assets net of debt, including home equity. Healthcare expenditure includes out-of-pocket health spending and insurance premiums paid by the household. Household level control variables comprise size of the household, a quadratic in age, education, sex, race and marital status of head of the household, acute health index, chronic health index and hospitalization index. State fixed effects are also included. Columns 7-12 adds industry characteristics in the region to the covariates, namely manufacturing industry share and tradable industry share. Region is approximated as MSAs. Robust standard errors are clustered at state level.

Table B.9: **2SLS estimates of Income Elasticity of Expenditure with Bartik IV all employment for MSAs**

	$\Delta Food\ Consumption$		$\Delta Healthcare\ Expenditures$		$\Delta Total\ Consumption$		$\Delta Food\ Consumption$		$\Delta Healthcare\ Expenditures$		$\Delta Total\ Consumption$	
	Low Wealth (1)	High Wealth (2)	Low Wealth (3)	High Wealth (4)	Low Wealth (5)	High Wealth (6)	Low Wealth (7)	High Wealth (8)	Low Wealth (9)	High Wealth (10)	Low Wealth (11)	High Wealth (12)
$\Delta Household\ Income$	0.563	0.476**	5.823*	3.108**	1.080*	0.905**	0.568	0.490**	5.973*	3.135**	1.116*	0.908**
	(0.385)	(0.223)	(3.134)	(1.305)	(0.580)	(0.383)	(0.401)	(0.235)	(3.332)	(1.334)	(0.613)	(0.393)
$Manufacturing\ share$ 1998							0.0769	0.0785	1.684	0.280	0.321	0.0855
							(0.174)	(0.0728)	(1.230)	(0.464)	(0.226)	(0.147)
$Tradable\ share$ 1998							-0.0864	-0.0342	-1.782	-0.232	-0.306	-0.0973
							(0.160)	(0.0679)	(1.105)	(0.293)	(0.199)	(0.0828)
$Constant$	0.0427	-0.774***	-5.813	-1.169	-0.401	-0.301	0.0470	-0.775***	-5.760	-1.145	-0.405	-0.287
	(0.501)	(0.123)	(3.927)	(0.898)	(0.740)	(0.259)	(0.503)	(0.132)	(4.045)	(0.901)	(0.758)	(0.261)
Household controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
State FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Observations	13121	13429	13121	13429	13121	13429	13121	13429	13121	13429	13121	13429
First stage F-test	607.66	6346.6	607.66	6346.6	607.66	6346.6	607.4	9693.07	607.4	9693.07	607.4	9693.07

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table presents estimates of the change in log income on the change in log expenditure for food, healthcare and total household consumption separately for low and high wealth households using projected employment growth in the region as an instrument. Employment growth is constructed using employment in all industries. Region is approximated as MSAs. The wealth variable used in this analysis is all assets net of debt, including home equity. Healthcare expenditure includes out-of-pocket health spending and insurance premiums paid by the household. Household level control variables comprise size of the household, a quadratic in age, education, sex, race and marital status of head of the household, acute health index, chronic health index and hospitalization index. State fixed effects are also included. Columns 7-12 adds industry characteristics in the region to the covariates, namely manufacturing industry share and tradable industry share. Robust standard errors are clustered at state level.

Table B.10: **2SLS estimates of Income Elasticity of Expenditure with Bartik IV tradable employment for MSAs**

	$\Delta Food\ Consumption$		$\Delta Healthcare\ Expenditures$		$\Delta Total\ Consumption$		$\Delta Food\ Consumption$		$\Delta Healthcare\ Expenditures$		$\Delta Total\ Consumption$	
	Low Wealth (1)	High Wealth (2)	Low Wealth (3)	High Wealth (4)	Low Wealth (5)	High Wealth (6)	Low Wealth (7)	High Wealth (8)	Low Wealth (9)	High Wealth (10)	Low Wealth (11)	High Wealth (12)
$\Delta Household\ Income$	0.624	0.518*	7.573	3.416*	1.004	0.804*	0.665	0.538*	8.527	3.491*	1.122	0.827*
	(0.485)	(0.293)	(5.000)	(1.912)	(0.648)	(0.462)	(0.567)	(0.303)	(6.377)	(1.954)	(0.809)	(0.477)
$Manufacturing\ share$ 1998							0.111	0.0791	2.576	0.285	0.323	0.0844
							(0.214)	(0.0777)	(2.291)	(0.511)	(0.286)	(0.137)
$Tradable\ share$ 1998							-0.117	-0.0324	-2.581	-0.219	-0.308	-0.100
							(0.203)	(0.0718)	(2.044)	(0.328)	(0.252)	(0.0756)
$Constant$	-0.0329	-0.791***	-7.976	-1.291	-0.307	-0.261	-0.0686	-0.794***	-8.811	-1.287	-0.412	-0.254
	(0.612)	(0.144)	(6.025)	(1.086)	(0.794)	(0.278)	(0.686)	(0.151)	(7.447)	(1.106)	(0.955)	(0.285)
Household controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
State FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Observations	13121	13429	13121	13429	13121	13429	13121	13429	13121	13429	13121	13429
First stage F-test	610.4	6706.76	610.4	6706.76	610.4	6706.76	611.27	10061.07	611.27	10061.07	611.27	10061.07

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table presents estimates of the change in log income on the change in log expenditure for food, healthcare and total household consumption separately for low and high wealth households using projected employment growth in the region as an instrument. Employment growth is constructed using employment in tradable industries. Region is approximated as MSAs. The wealth variable used in this analysis is all assets net of debt, including home equity. Healthcare expenditure includes out-of-pocket health spending and insurance premiums paid by the household. Household level control variables comprise size of the household, a quadratic in age, education, sex, race and marital status of head of the household, acute health index, chronic health index and hospitalization index. State fixed effects are also included. Columns 7-12 adds industry characteristics in the region to the covariates, namely manufacturing industry share and tradable industry share. Robust standard errors are clustered at state level.

Table B.11: **2SLS estimates of Income Elasticity of Expenditure with Bartik IV LQ employment for MSAs**

	$\Delta Food\ Consumption$		$\Delta Healthcare\ Expenditures$		$\Delta Total\ Consumption$		$\Delta Food\ Consumption$		$\Delta Healthcare\ Expenditures$		$\Delta Total\ Consumption$	
	Low Wealth (1)	High Wealth (2)	Low Wealth (3)	High Wealth (4)	Low Wealth (5)	High Wealth (6)	Low Wealth (7)	High Wealth (8)	Low Wealth (9)	High Wealth (10)	Low Wealth (11)	High Wealth (12)
$\Delta Household\ Income$	0.675	0.214	7.151	2.251**	1.144	0.502**	0.717	0.240	7.956	2.303**	1.287	0.505**
	(0.676)	(0.210)	(4.818)	(1.026)	(0.850)	(0.238)	(0.796)	(0.219)	(6.168)	(1.070)	(1.056)	(0.249)
$Manufacturing\ share$ 1998							0.129	0.0751	2.377	0.269	0.381	0.0801
							(0.298)	(0.0551)	(2.236)	(0.362)	(0.387)	(0.0967)
$Tradable\ share$ 1998							-0.133	-0.0436	-2.402	-0.263	-0.359	-0.113**
							(0.273)	(0.0513)	(1.908)	(0.221)	(0.335)	(0.0457)
$Constant$	-0.0957	-0.671***	-7.454	-0.830	-0.480	-0.142	-0.130	-0.675***	-8.129	-0.810	-0.609	-0.125
	(0.887)	(0.121)	(6.322)	(0.796)	(1.106)	(0.215)	(1.005)	(0.126)	(7.803)	(0.802)	(1.328)	(0.216)
Household controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
State FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Observations	13121	13429	13121	13429	13121	13429	13121	13429	13121	13429	13121	13429
First stage F-test	599.43	5930.92	599.43	5930.92	599.43	5930.92	609.26	9631.49	609.26	9631.49	609.26	9631.49

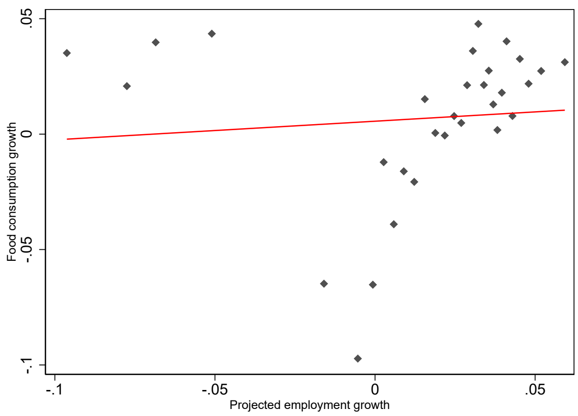
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table presents estimates of the change in log income on the change in log expenditure for food, healthcare and total household consumption separately for low and high wealth households using projected employment growth in the region as an instrument. Employment growth is constructed using employment in LQ-based industries. Region is approximated as MSAs. The wealth variable used in this analysis is all assets net of debt, including home equity. Healthcare expenditure includes out-of-pocket health spending and insurance premiums paid by the household. Household level control variables comprise size of the household, a quadratic in age, education, sex, race and marital status of head of the household, acute health index, chronic health index and hospitalization index. State fixed effects are also included. Columns 7-12 adds industry characteristics in the region to the covariates, namely manufacturing industry share and tradable industry share. Robust standard errors are clustered at state level.

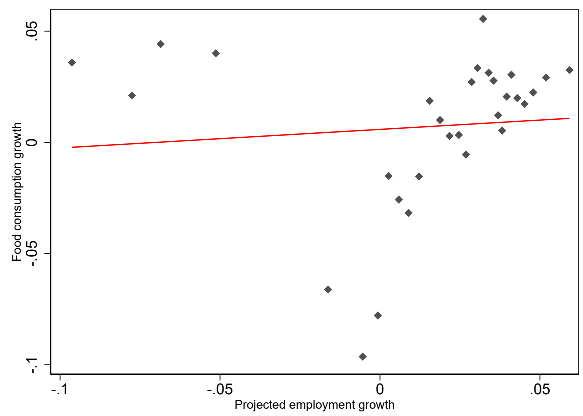
B.3 Additional Robustness Results

B.3.1 Outcome and Instrument Relation in trimmed samples

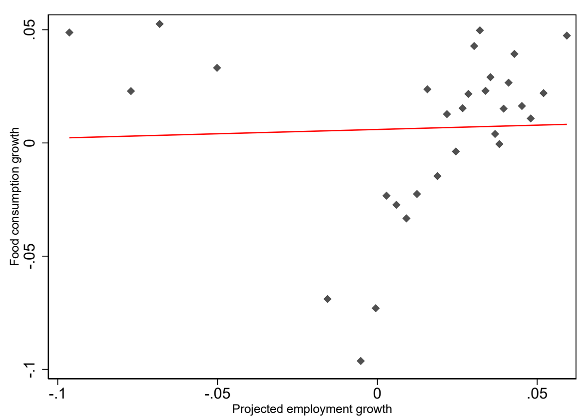
Figure B.15: **Food consumption and instrument relation**



[a] Scatterplot of residualized IV and food consumption growth for 300% trimmed sample



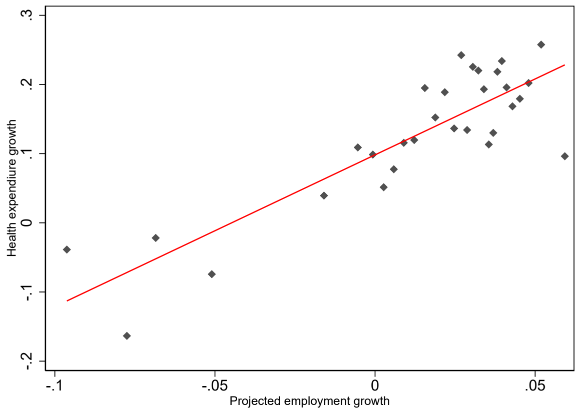
[b] Scatterplot of residualized IV and food consumption growth for 200% trimmed sample



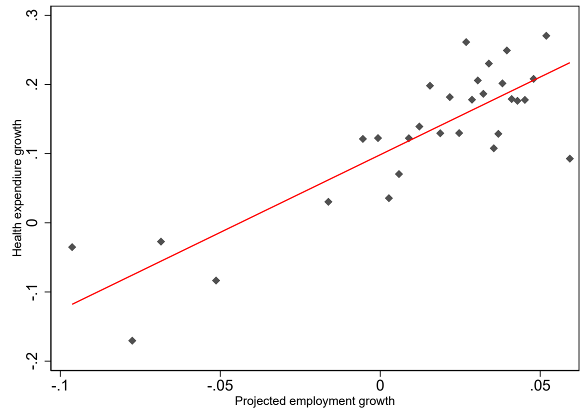
[c] Scatterplot of residualized IV and food consumption growth for 100% trimmed sample

Notes: Residual plots of projected county employment growth and household food consumption growth

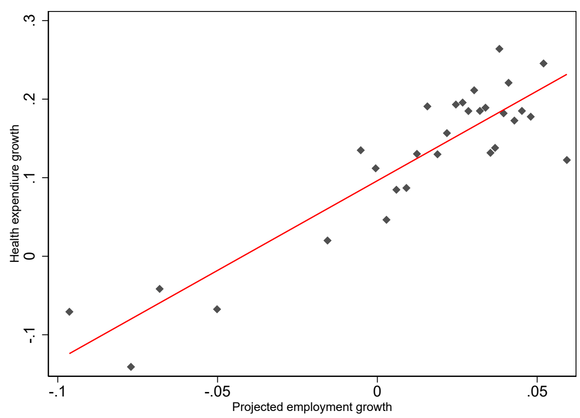
Figure B.16: **Health spending and instrument relation**



[a] Scatterplot of residualized IV and health spending growth for 300% trimmed sample



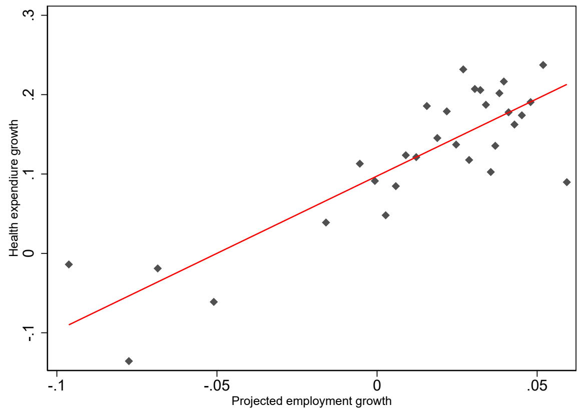
[b] Scatterplot of residualized IV and health spending growth for 200% trimmed sample



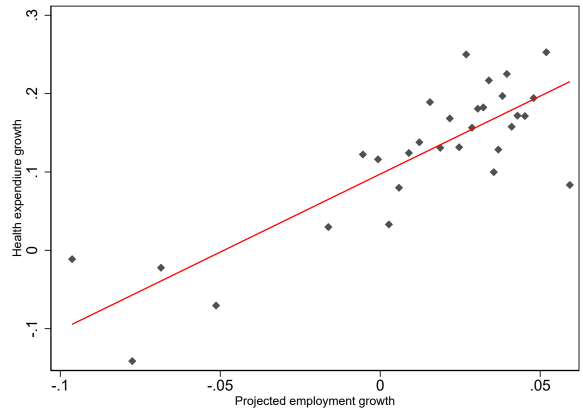
[c] Scatterplot of residualized IV and health spending growth for 100% trimmed sample

Notes: Residual plots of projected county employment growth and household health spending growth

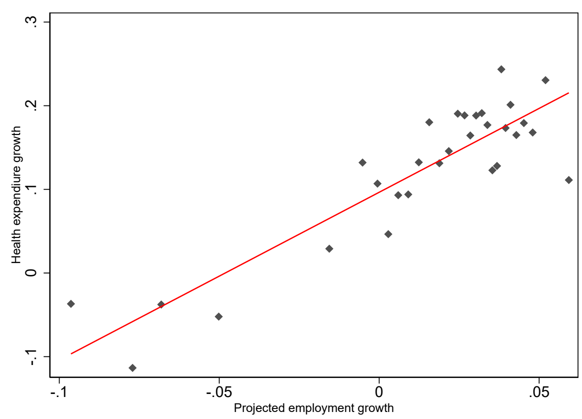
Figure B.17: **Health spending excluding insurance premiums and instrument relation**



[a] Scatterplot of residualized IV and health spending growth for 300% trimmed sample



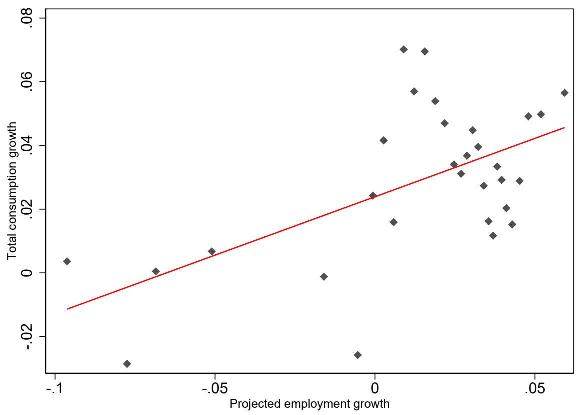
[b] Scatterplot of residualized IV and health spending growth for 200% trimmed sample



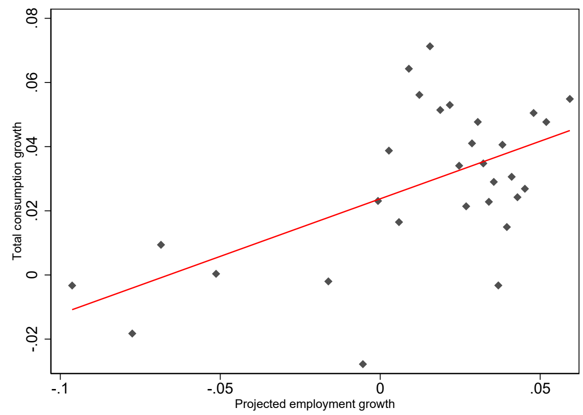
[c] Scatterplot of residualized IV and health spending growth for 100% trimmed sample

Notes: Residual plots of projected county employment growth and household health spending growth

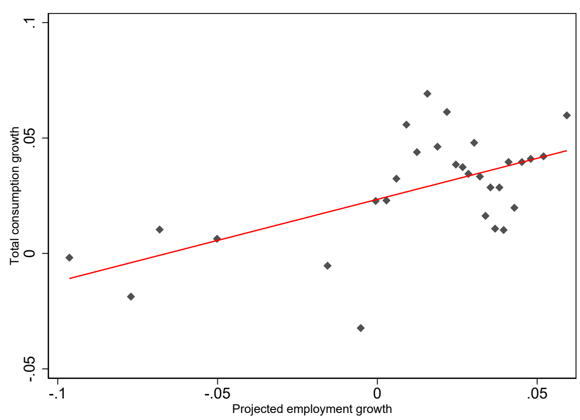
Figure B.18: **Total expenditures and instrument relation**



[a] Scatterplot of residualized IV and total expenditures growth for 300% trimmed sample



[b] Scatterplot of residualized IV and total expenditures growth for 200% trimmed sample

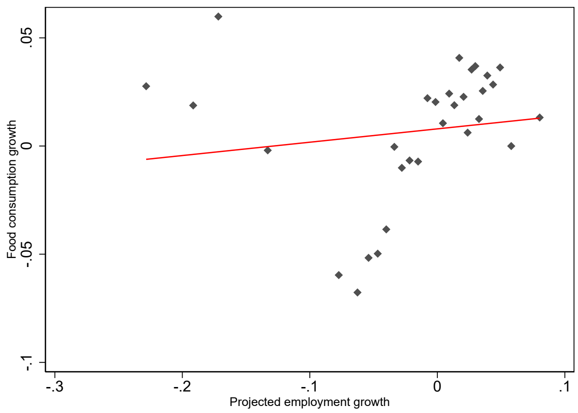


[c] Scatterplot of residualized IV and total expenditures growth for 100% trimmed sample

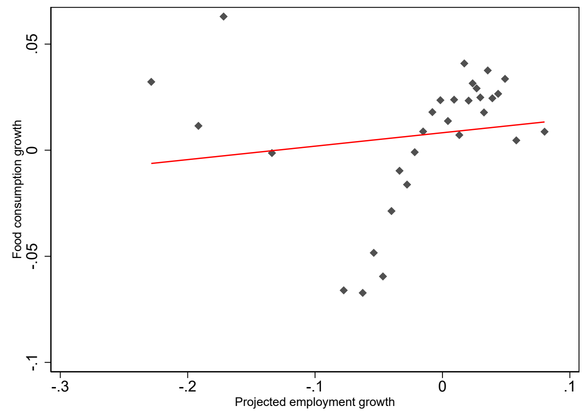
Notes: Residual plots of projected county employment growth and household total expenditures growth

B.3.2 Tradable industry IV in trimmed samples

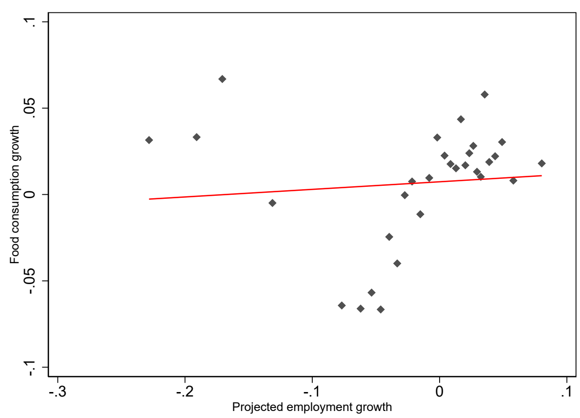
Figure B.19: **Food consumption and instrument relation**



[a] Scatterplot of residualized IV and food consumption growth for 300% trimmed sample



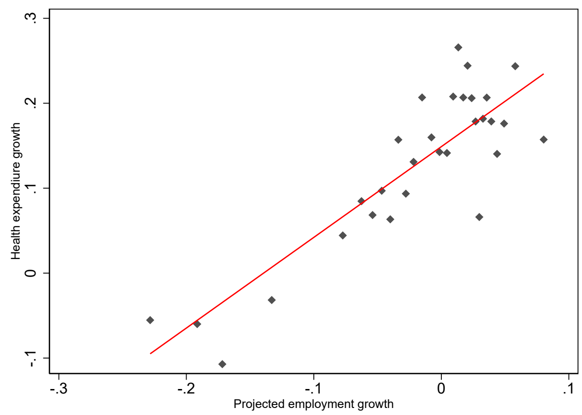
[b] Scatterplot of residualized IV and food consumption growth for 200% trimmed sample



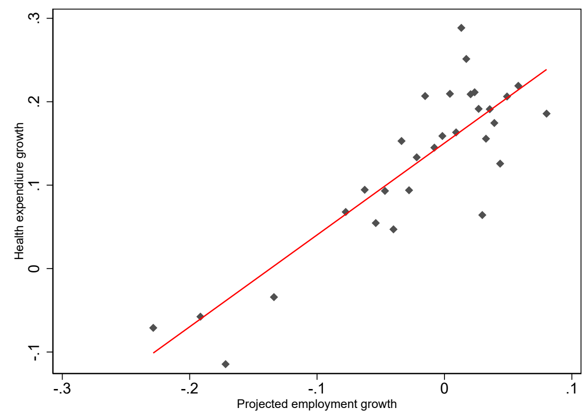
[c] Scatterplot of residualized IV and food consumption growth for 100% trimmed sample

Notes: Residual plots of projected county employment growth and household food consumption growth

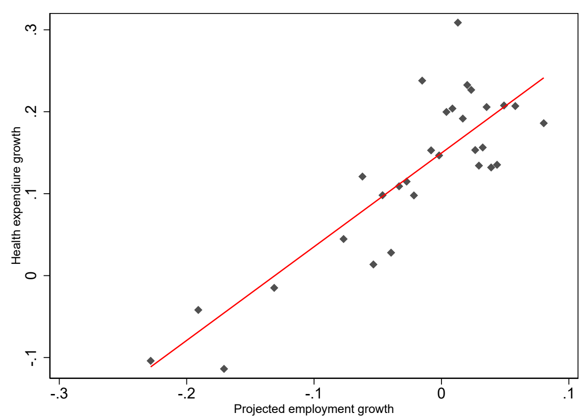
Figure B.20: **Health spending and instrument relation**



[a] Scatterplot of residualized IV and health spending growth for 300% trimmed sample



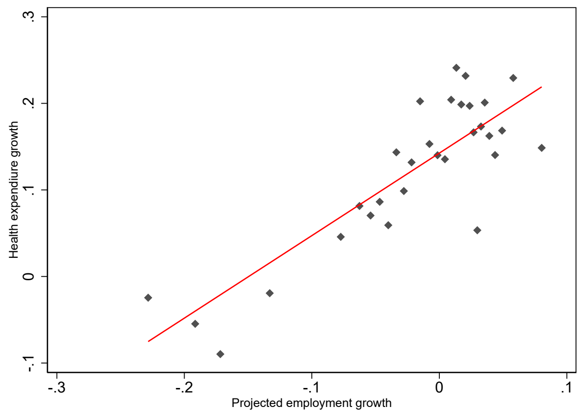
[b] Scatterplot of residualized IV and health spending growth for 200% trimmed sample



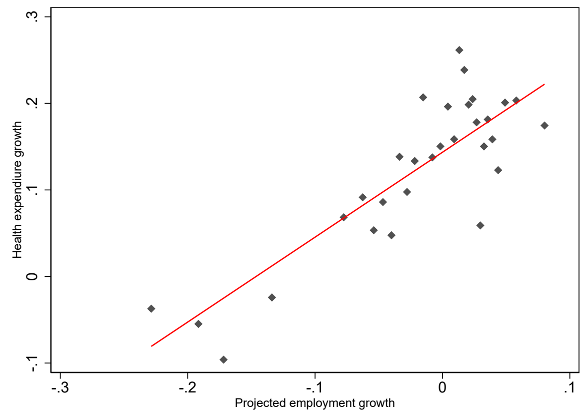
[c] Scatterplot of residualized IV and health spending growth for 100% trimmed sample

Notes: Residual plots of projected county employment growth and household health spending growth

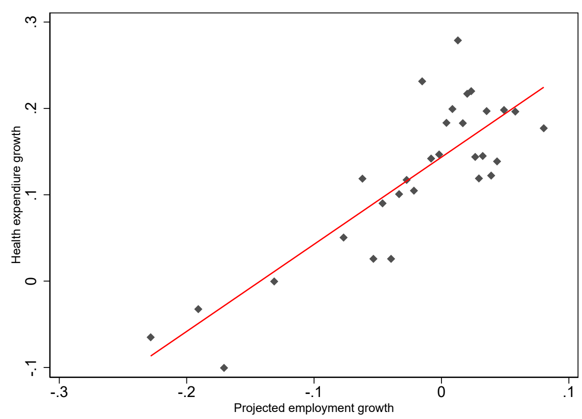
Figure B.21: **Health spending excluding insurance premiums and instrument relation**



[a] Scatterplot of residualized IV and health spending growth for 300% trimmed sample



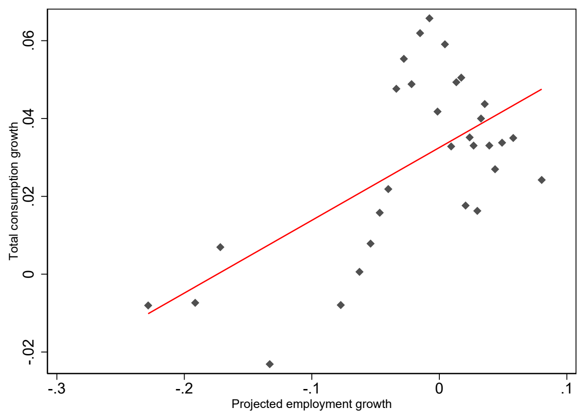
[b] Scatterplot of residualized IV and health spending growth for 200% trimmed sample



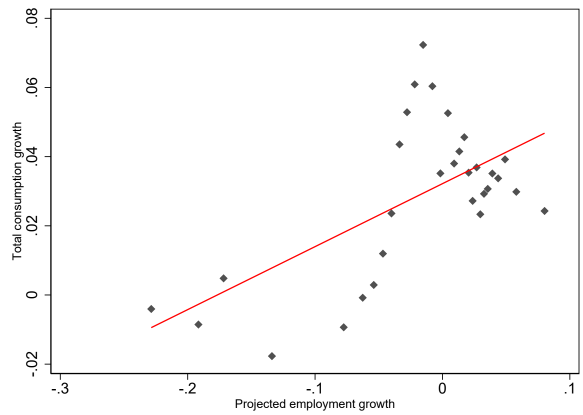
[c] Scatterplot of residualized IV and health spending growth for 100% trimmed sample

Notes: Residual plots of projected county employment growth and household health spending growth

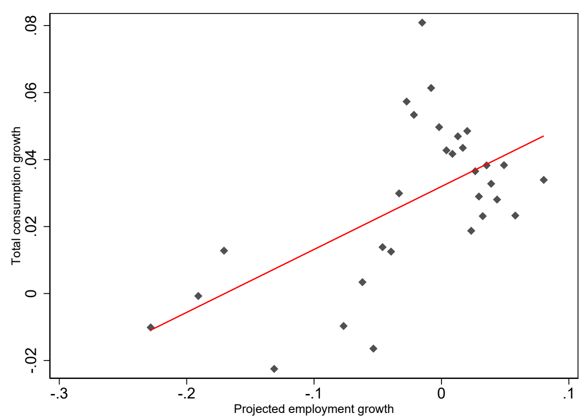
Figure B.22: **Total expenditures and instrument relation**



[a] Scatterplot of residualized IV and total expenditures growth for 300% trimmed sample



[b] Scatterplot of residualized IV and total expenditures growth for 200% trimmed sample

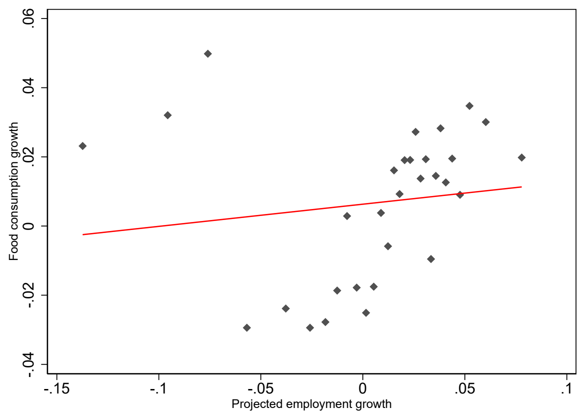


[c] Scatterplot of residualized IV and total expenditures growth for 100% trimmed sample

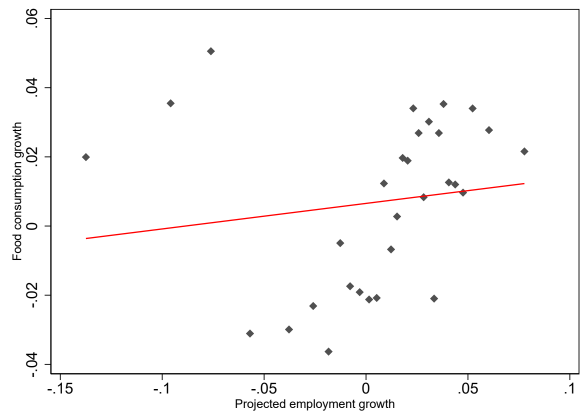
Notes: Residual plots of projected county employment growth and household total expenditures growth

B.3.3 LQ-based industry IV in trimmed samples

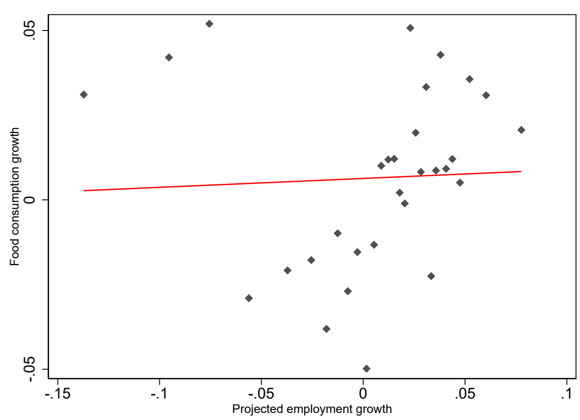
Figure B.23: **Food consumption and instrument relation**



[a] Scatterplot of residualized IV and food consumption growth for 300% trimmed sample



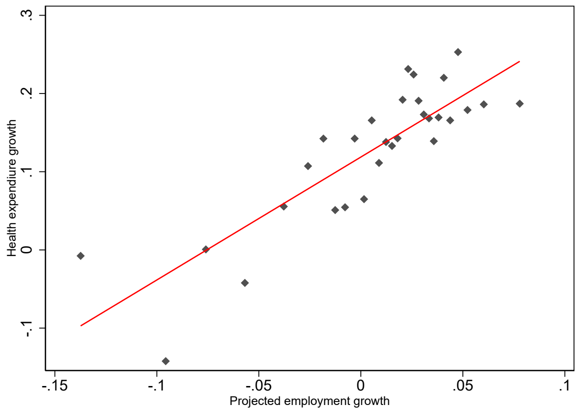
[b] Scatterplot of residualized IV and food consumption growth for 200% trimmed sample



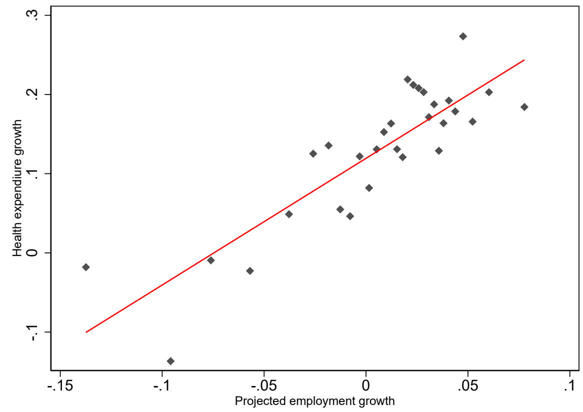
[c] Scatterplot of residualized IV and food consumption growth for 100% trimmed sample

Notes: Residual plots of projected county employment growth and household food consumption growth

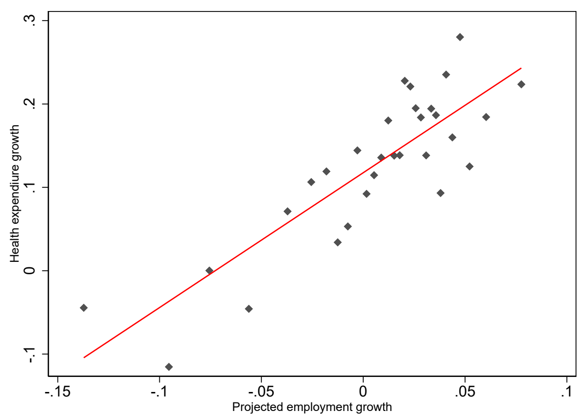
Figure B.24: **Health spending and instrument relation**



[a] Scatterplot of residualized IV and health spending growth for 300% trimmed sample



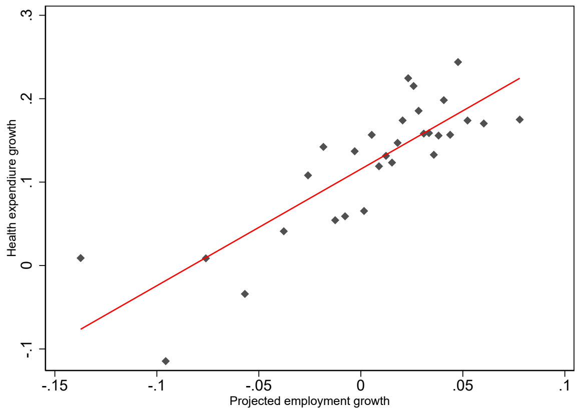
[b] Scatterplot of residualized IV and health spending growth for 200% trimmed sample



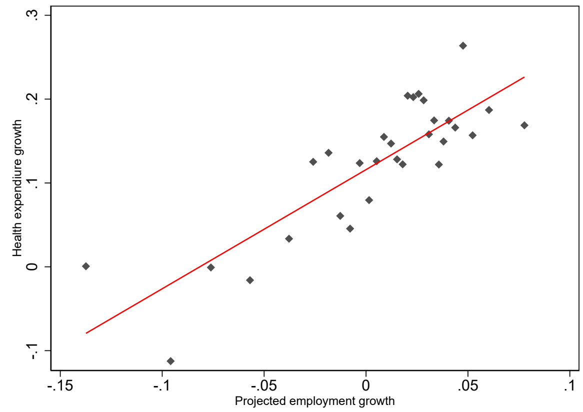
[c] Scatterplot of residualized IV and health spending growth for 100% trimmed sample

Notes: Residual plots of projected county employment growth and household health spending growth

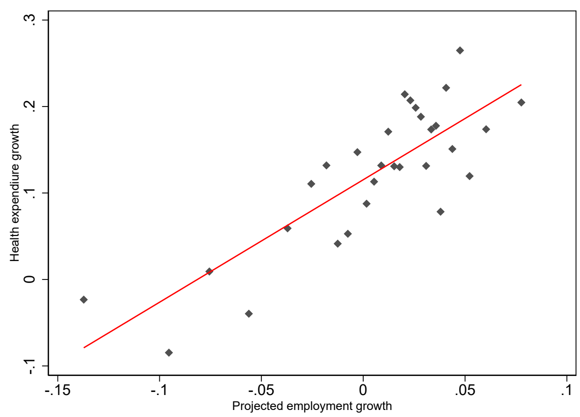
Figure B.25: **Health spending excluding insurance premiums and instrument relation**



[a] Scatterplot of residualized IV and health spending growth for 300% trimmed sample



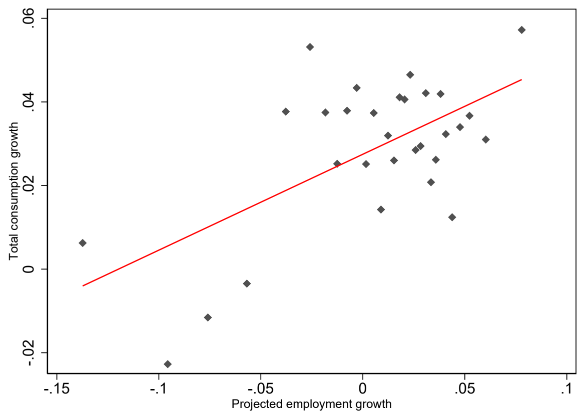
[b] Scatterplot of residualized IV and health spending growth for 200% trimmed sample



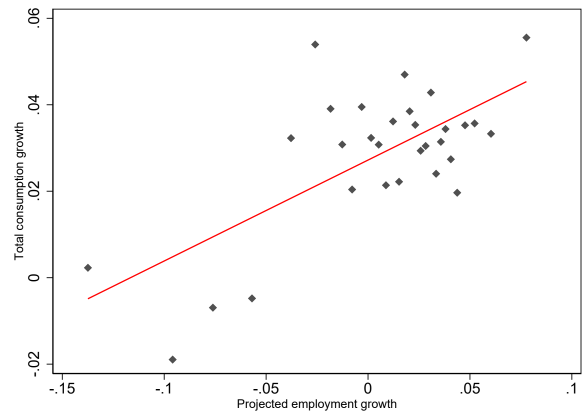
[c] Scatterplot of residualized IV and health spending growth for 100% trimmed sample

Notes: Residual plots of projected county employment growth and household health spending growth

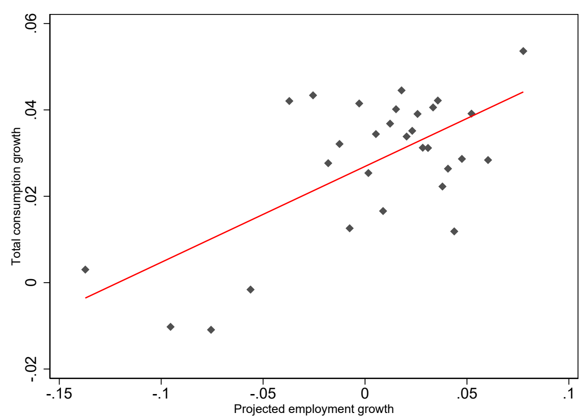
Figure B.26: **Total expenditures and instrument relation**



[a] Scatterplot of residualized IV and total expenditures growth for 300% trimmed sample



[b] Scatterplot of residualized IV and total expenditures growth for 200% trimmed sample

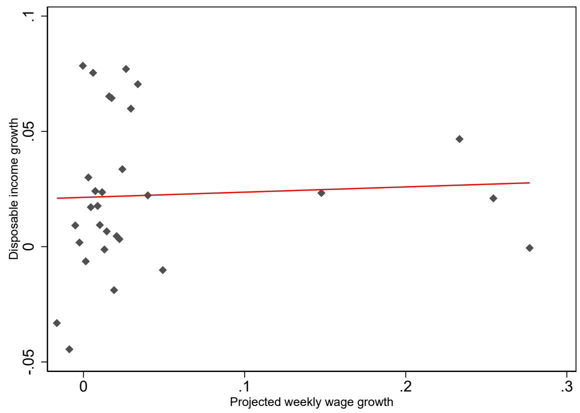


[c] Scatterplot of residualized IV and total expenditures growth for 100% trimmed sample

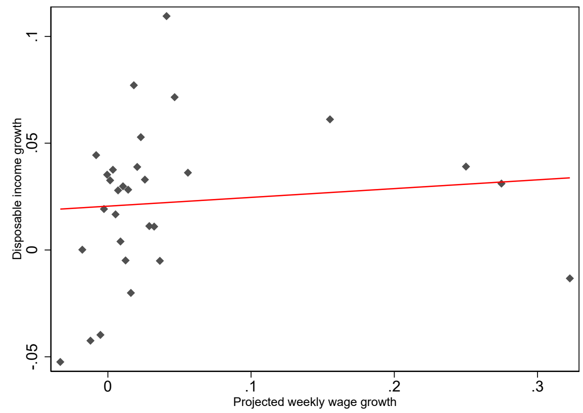
Notes: Residual plots of projected county employment growth and household total expenditures growth

B.3.4 Ir-relevance of Alternative Instrument at County Level

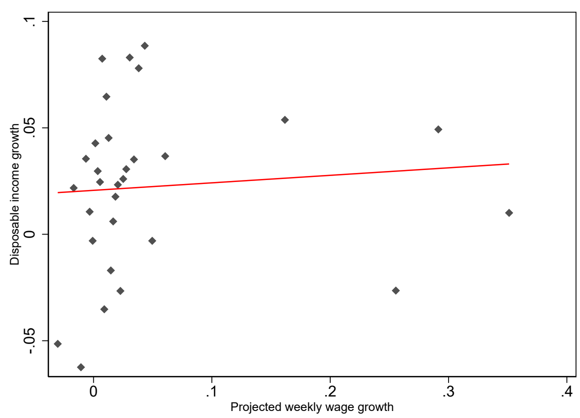
Figure B.27: **Relationship between household disposable income growth and county average weekly wage growth**



[a] Residualized IV and income growth for all industries



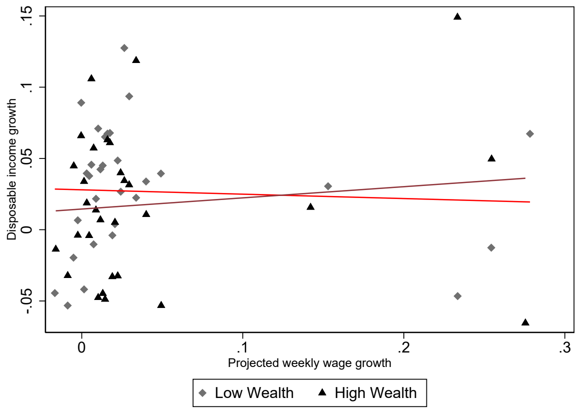
[b] Residualized IV and income growth for tradable industries



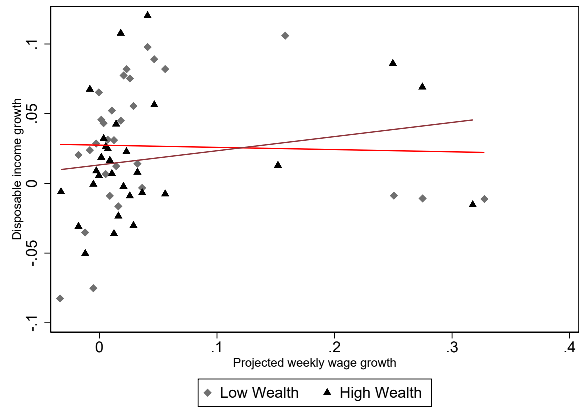
[c] Residualized IV and income growth for LQ-based industries

Notes: Residual plots of projected county average weekly wage growth and household disposable income growth. Each dot is an average of 1,117 observations. The covariates in equation 4 are partialed out.

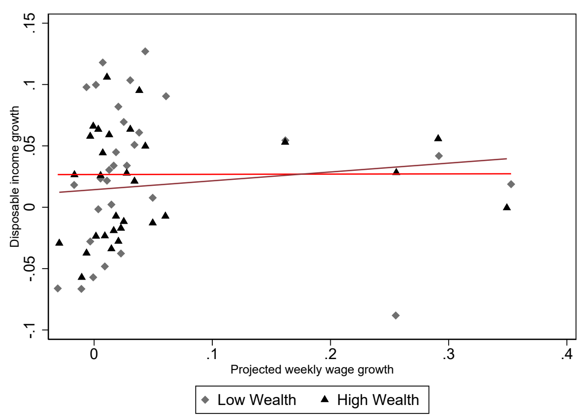
Figure B.28: **Relationship between household disposable income growth and county average weekly wage growth across wealth**



[a] Residualized IV and income growth for all industries



[b] Residualized IV and income growth for tradable industries



[c] Residualized IV and income growth for LQ-based industries

Notes: Residual plots of projected county average weekly wage growth and household disposable income growth. Each dot is an average of 571 observations for wealth group 1 and 566 observations for wealth group 2. The covariates in equation 4 are partialed out

Appendix C

Appendix C: Chapter 3

C.1 Additional Tables

Table C.1: **Wealth to Income and Debt to Income ratios in PSID and SCF**

		PSID			
		PSID 1999-2015	PSID 2009	PSID 2011	SCF 2010
Networth to income	Mean	3.82	3.47	3.42	4.17
	Median	1.76	1.47	1.38	1.75
	Observations	44,784	5,215	5,234	30,457
Debt to income	Mean	0.55	0.53	0.69	1.28
	Median	0.03	0.04	0.05	0.44
	Observations	49,558	5,740	5,737	31,922

Notes: This table presents wealth to income and debt to income ratios in PSID and SCF samples. Income in PSID is disposable income, income after tax. Income in SCF is income before tax. Debt in SCF includes all debt. Debt in PSID only includes debt other than mortgage and vehicle loans. Therefore debt to income ratios are not comparable. All samples are trimmed such that the ratios are between -30 and 30.

Table C.2: **Networth across time**

	Mean	Median	90th	99th
Networth:				
1999	281891.5	70898.16	590666	2942943
2001	288956.8	74268.2	626816.1	2982125
2003	283007.6	74069.34	630377.3	2704561
2005	332118.6	82717.51	775872.5	3160885
2007	369188.2	84613.63	830722.5	4019486
2009	329979.7	52664.91	668439.2	3722396
2011	271504.3	42000	659000	3283000
2013	258325.7	40839.08	638704.3	3200644
2015	289213.7	46054.68	679306.5	3606081
Total	300532.5	61121.24	680889.9	3301000
Nonhome net wealth:				
1999	26754.03	418700.5	2694130	281891.5
2001	25642.47	444469.6	2443950	288956.8
2003	24730.19	412169.8	2428780	283007.6
2005	23608.51	488621	2722195	332118.6
2007	23553.36	553815	3417861	369188.2
2009	18230.16	445626.1	3314851	329979.7
2011	15500	450000	2781000	271504.3
2013	15195.94	432134.5	2863485	258325.7
2015	14737.5	474363.2	3186984	289213.7
Total	20472.69	458398.8	2864601	300532.5

Notes: This table presents the distribution of networth including and excluding home equity for years 1999-2015. The table shows mean, median, 90th and 99th percentiles of networth of US households in the PSID sample for each year. The amounts are deflated to 2010 dollars.

Table C.3: **Networth by education and by sex of the household**

	Education		Sex	
	High	Low	Male	Female
Mean Networth:				
1999	392838	176917.9	327767.3	147609.2
2001	425515.3	152003.6	337671.1	139670.8
2003	394623.3	167365.1	329069.2	146425.3
2005	465999	187258.9	386028	170170.6
2007	505585.7	213601.6	421922.6	215351.1
2009	404637.4	232379.8	392543	148495.7
2011	370833.6	136310.3	320735.8	138490.4
2013	351852.7	124270.4	307645.4	124148.6
2015	398565.5	125230.3	341904.5	147407.1
Total	410368	169294.8	352098	152696.2
Median Networth:				
1999	120794.4	42902.75	90896.8	25215.67
2001	123843.7	44320.32	92882.74	26592.2
2003	120014.1	45278.06	95768.86	22911.79
2005	134493.4	48025.13	108518.3	24243.45
2007	135822	44889.3	113575.3	20713.98
2009	89125.23	25319.67	76262.84	13166.23
2011	72000	20450	61000	10500
2013	67811.88	19006.79	63632.99	8167.816
2015	77371.86	19849.57	67838.54	10776.79
Total	101007.2	34080.46	84688.25	16145.68

Notes: This table presents mean and median networth by education and sex of the household head for PSID sample in years 1999-2015. The amounts are deflated to 2010 dollars.

Table C.4: **Networth over time and by race**

	Mean			Median			90th percentile			99th percentile		
	White	Black	Other	White	Black	Other	White	Black	Other	White	Black	Other
Years												
1999	325077.1	48590.01	132949.5	94976.79	10567.84	18727.82	676876.8	150265.3	276904.2	3108818	473546.3	2086814
2001	328007.7	69708.67	174799.8	98137.87	15195.54	24946.01	715456.7	164618.4	351396.9	3165738	823724.9	2229946
2003	322885.6	103473.4	143696.5	96130.12	14547.17	31761.32	719018.1	150922	357295.4	3012476	1200141	1914526
2005	362375.6	96192.69	262546.6	100437.2	12698.95	53393.32	842171.4	176630.9	622248.6	3521074	1290675	2992912
2007	400571.1	85571.18	349573.9	99513.63	11087.12	78961.91	889132.7	220660.7	772312.3	4030519	1283401	4256371
2009	363710.9	92523.48	233552.3	68869.49	5671.605	19242.95	728193.6	137637.7	522597.9	3842513	1764274	3479935
2011	306802.6	36992.32	167869.3	54750	5000	16000	758000	116000	395000	3505000	517160	2420000
2013	288826.2	45165.02	188500.1	53874.35	5950.159	22793.91	729405	121567.5	413139.6	3457076	559495.4	3288021
2015	325254.8	43284.4	217022.5	58949.99	6447.655	18744.25	776942.4	128953.1	468836.6	3967150	543445.2	3636478
Total	336110.2	68146.07	199403.3	79214.05	8485.013	26546.1	761330.8	147147.1	443967.1	3571330	722685.8	2917544

Notes: This table presents mean and median networth by race of the household head for PSID sample in years 1999-2015. The amounts are deflated to 2010 dollars.

Table C.5: **Income and Consumption across time**

	Mean	Median	90th	99th
Disposable Income				
1999	36907	25794.16	77204.95	212180.8
2001	39279.28	27600.69	80913.9	240376.2
2003	38666.79	27122.92	80785.11	209544.4
2005	40935.43	28353.04	83942.96	230714
2007	40179.89	27935.84	85060.08	231495.6
2009	39316.36	27096.61	82249.16	227027.9
2011	36527.2	25776.2	78799.02	197951.9
2013	37671.03	25423.66	81054.68	197910.3
2015	36888.72	25221.02	80737.13	202109
Total	38476.8	26608.75	81209.61	215452
Total Consumption:				
1999	37191.74	31732.11	65595.05	126598.2
2001	39661.42	33749.29	70423.2	139042.3
2003	39320.89	33880.13	70680.89	125770.8
2005	746535.41	39193.6	82321.96	168386
2007	47291.71	40324.92	84863.05	168356.7
2009	43438.73	37000.41	77431.22	148205.8
2011	42736.41	36672	75936	148430
2013	41315.85	35570.2	74785.34	137206.2
2015	40797.06	35530.79	73223.23	135284.4
Total	42126.09	35878.47	75483.85	145975.7

Notes: This table presents the distribution of disposable income and total consumption for years 1999-2015. The table shows mean, median, 90th and 99th percentiles of disposable income and total consumption of US households in the PSID sample for each year. The amounts are deflated to 2010 dollars.

Table C.6: **Poverty Thresholds**

	Family Size								
	1 person	2 persons	3 persons	4 persons	5 persons	6 persons	7 persons	8 persons	9 or more
Years									
1999	8,316	10,634	13,003	16,660	19,680	22,228	25,257	28,166	33,339
2001	8,794	11,239	13,738	17,603	20,819	23,528	26,753	29,701	35,060
2003	9,183	11,756	14,348	18,392	721,744	24,576	28,001	30,907	37,062
2005	9,646	12,335	15,066	19,307	22,830	25,787	29,233	32,641	39,062
2007	10,294	13,167	16,079	20,614	24,382	27,560	31,205	34,774	41,499
2009	10,991	14,051	17,163	22,025	26,049	29,456	33,529	37,220	44,346
2011	11,139	14,218	17,374	22,314	26,439	29,897	34,009	37,934	45,220
2013	11,720	14,937	18,284	23,492	27,827	31,471	35,743	39,688	47,297
2015	12,071	15,379	18,850	24,230	28,695	32,473	36,927	40,968	49,021

Notes: This table presents poverty thresholds for years 1999-2015. Each threshold refers to the threshold for the previous year to be compatible with the PSID timing. The amounts are deflated to 2010 dollars. Source:U.S. Census Bureau.

Table C.7: **Poverty Rates for 1999 PSID sample**

		Asset Poverty		
		Above Poverty Line	Below Poverty Line	Total
Income	Above Poverty Line	44.18	19.69	63.87
Poverty	Below Poverty Line	13.00	23.13	36.13
	Total	57.18	42.82	100.00
	Observations	5278		

Notes: This table presents percent of household below or above poverty lines for disposable income and household networth for year 1999. The data is taken from 1999 wave of PSID.

Table C.8: **Poverty Rates for 2001 PSID sample**

		Asset Poverty		
		Above Poverty Line	Below Poverty Line	Total
Income	Above Poverty Line	43.78	22.20	65.98
Poverty	Below Poverty Line	12.43	21.59	34.02
	Total	56.20	43.80	100.00
	Observations	5544		

Notes: This table presents percent of household below or above poverty lines for disposable income and household networth for year 2001. The data is taken from 2001 wave of PSID.

Table C.9: **Poverty Rates for 2003 PSID sample**

		Asset Poverty		
		Above Poverty Line	Below Poverty Line	Total
Income	Above Poverty Line	44.38	21.19	65.58
Poverty	Below Poverty Line	12.33	22.09	34.42
	Total	56.72	43.28	100.00
	Observations	5813		

Notes: This table presents percent of household below or above poverty lines for disposable income and household networth for year 2003. The data is taken from 2003 wave of PSID.

Table C.10: **Poverty Rates for 2005 PSID sample**

		Asset Poverty		
		Above Poverty Line	Below Poverty Line	Total
Income	Above Poverty Line	43.45	22.17	65.62
Poverty	Below Poverty Line	12.00	22.38	34.38
	Total	55.45	44.55	100.00
	Observations	5890		

Notes: This table presents percent of household below or above poverty lines for disposable income and household networth for year 2005. The data is taken from 2005 wave of PSID.

Table C.11: **Poverty Rates for 2007 PSID sample**

		Asset Poverty		
		Above Poverty Line	Below Poverty Line	Total
Income	Above Poverty Line	43.77	22.61	66.38
Poverty	Below Poverty Line	11.05	22.57	33.62
	Total	54.82	45.18	100.00
	Observations	6056		

Notes: This table presents percent of household below or above poverty lines for disposable income and household networth for year 2007. The data is taken from 2007 wave of PSID.

Table C.12: **Poverty Rates for 2009 PSID sample**

		Asset Poverty		
		Above Poverty Line	Below Poverty Line	Total
Income	Above Poverty Line	40.53	24.57	65.10
Poverty	Below Poverty Line	10.79	24.11	34.90
	Total	51.32	48.68	100.00
	Observations	6292		

Notes: This table presents percent of household below or above poverty lines for disposable income and household networth for year 2009. The data is taken from 2009 wave of PSID.

Table C.13: **Poverty Rates for 2011 PSID sample**

		Asset Poverty		
		Above Poverty Line	Below Poverty Line	Total
Income	Above Poverty Line	38.50	24.42	62.92
Poverty	Below Poverty Line	10.82	26.26	37.08
	Total	49.32	50.68	100.00
	Observations	6356		

Notes: This table presents percent of household below or above poverty lines for disposable income and household networth for year 2011. The data is taken from 2011 wave of PSID.

Table C.14: **Poverty Rates for 2013 PSID sample**

		Asset Poverty		
		Above Poverty Line	Below Poverty Line	Total
Income	Above Poverty Line	38.45	24.03	62.48
Poverty	Below Poverty Line	10.50	27.02	37.52
	Total	48.95	51.05	100.00
	Observations	6351		

Notes: This table presents percent of household below or above poverty lines for disposable income and household networth for year 2013. The data is taken from 2013 wave of PSID.

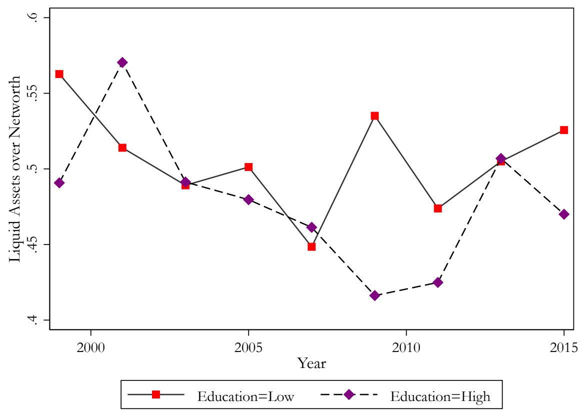
Table C.15: **Poverty Rates for 2015 PSID sample**

		Asset Poverty		
		Above Poverty Line	Below Poverty Line	Total
Income	Above Poverty Line	37.86	24.39	62.25
Poverty	Below Poverty Line	10.80	26.95	37.75
	Total	48.66	51.34	100.00
	Observations	6194		

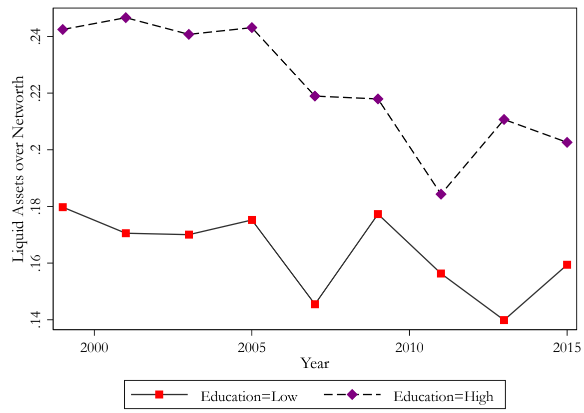
Notes: This table presents percent of household below or above poverty lines for disposable income and household networth for year 2015. The data is taken from 2015 wave of PSID.

C.2 Additional Figures

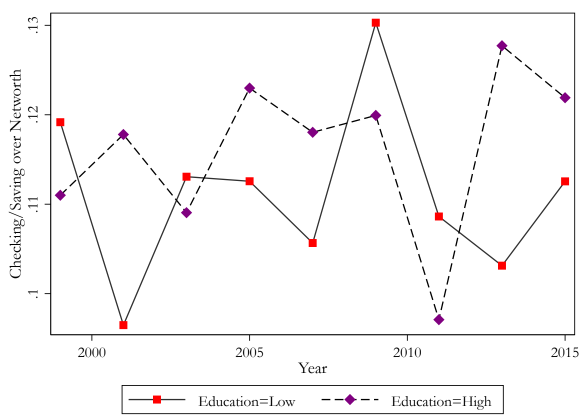
Figure C.1: **Liquidity by education over the business cycle**



[a] Liquid assets to networth (broad)



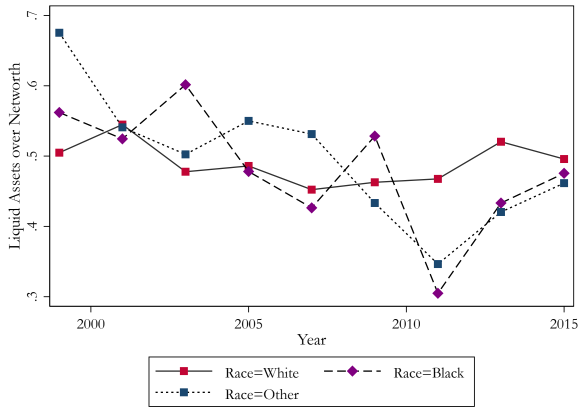
[b] Liquid assets to networth (narrow)



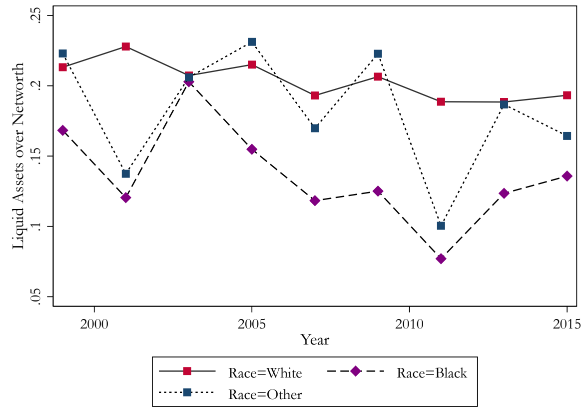
[c] Checking/Saving to networth

Notes: The figure plots ratios of liquid assets, and checking/saving to net wealth by education for years 1999-2015. The data is taken from 1999-2015 waves of PSID. Broad definition of liquid assets for PSID data is the sum of checking/savings account, stocks, value of vehicles, other assets and annuity/IRA. Narrow definition of liquid assets is the sum of checking/savings account, stocks, and other assets.

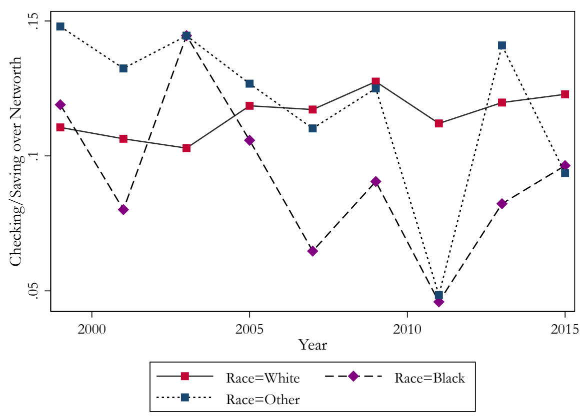
Figure C.2: **Liquidity by race over the business cycle**



[a] Liquid assets to networth (broad)



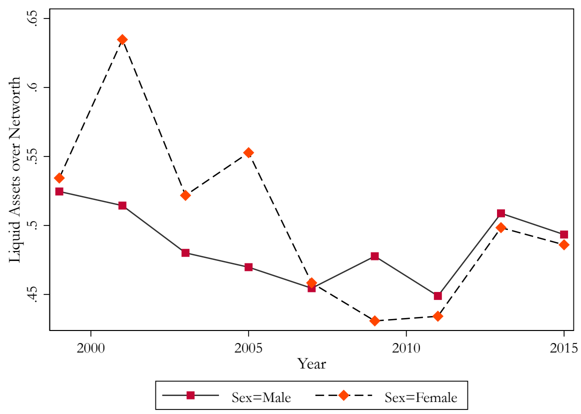
[b] Liquid assets to networth (narrow)



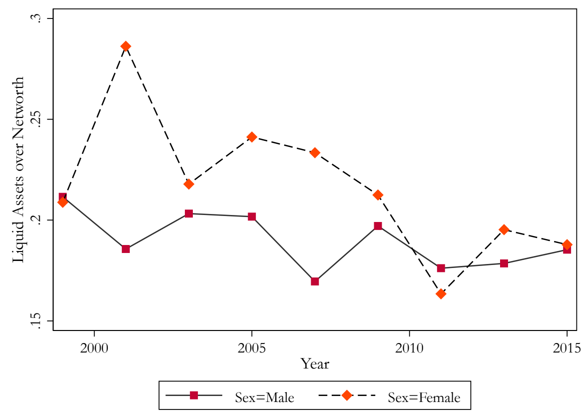
[c] Checking/Saving to networth

Notes: The figure plots ratios of liquid assets, and checking/saving to net wealth by race for years 1999-2015. The data is taken from 1999-2015 waves of PSID. Broad definition of liquid assets for PSID data is the sum of checking/savings account, stocks, value of vehicles, other assets and annuity/IRA. Narrow definition of liquid assets is the sum of checking/savings account, stocks, and other assets.

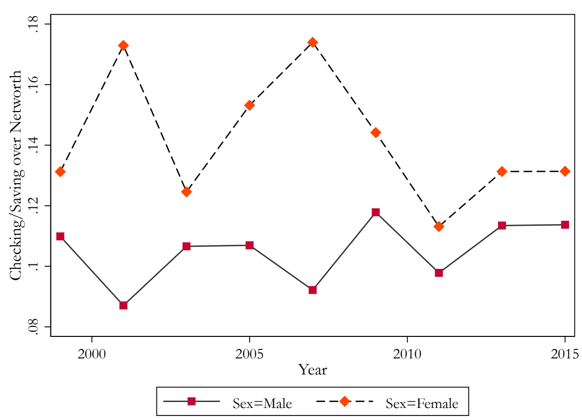
Figure C.3: **Liquidity by sex over the business cycle**



[a] Liquid assets to networth (broad)



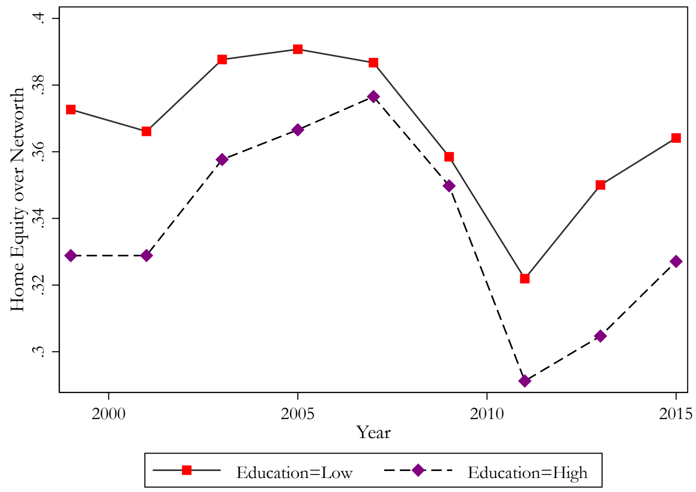
[b] Liquid assets to networth (narrow)



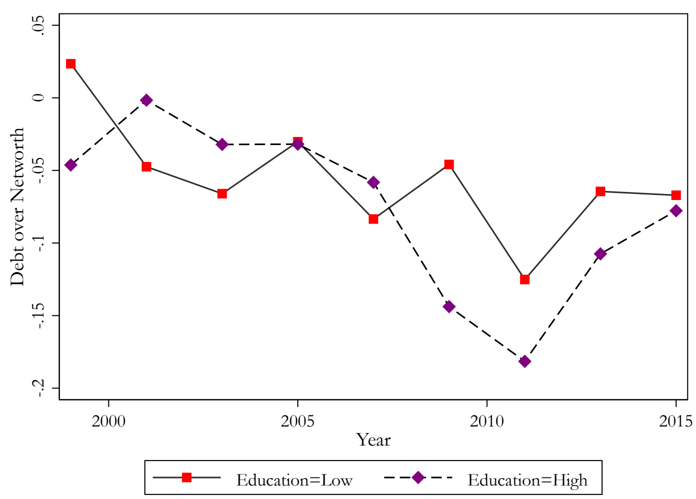
[c] Checking/Saving to networth

Notes: The figure plots ratios of liquid assets, and checking/saving to net wealth by sex for years 1999-2015. The data is taken from 1999-2015 waves of PSID. Broad definition of liquid assets for PSID data is the sum of checking/savings account, stocks, value of vehicles, other assets and annuity/IRA. Narrow definition of liquid assets is the sum of checking/savings account, stocks, and other assets.

Figure C.4: **Portfolio by education over the business cycle**



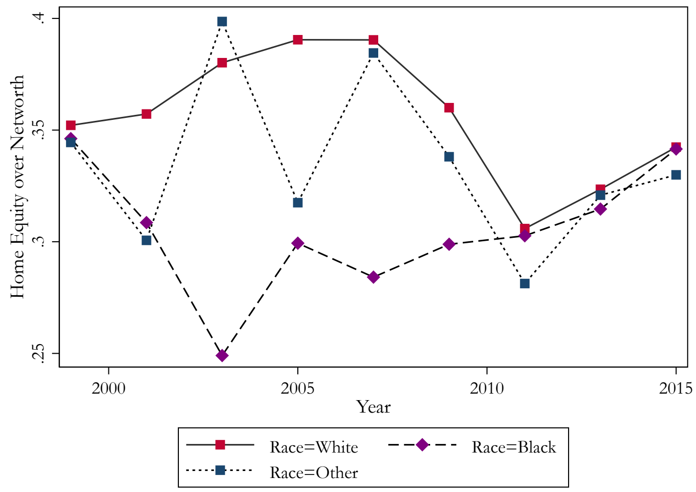
[a] Home equity to networth



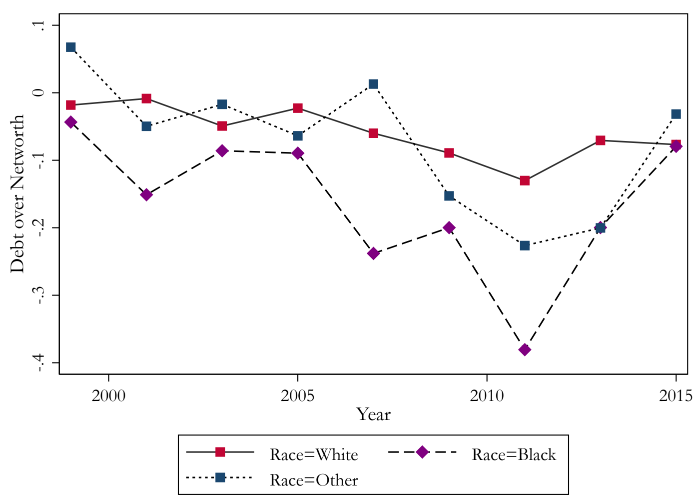
[b] Debt to networth

Notes: The figure plots ratios of home equity and debt to household net wealth by education for years 1999-2015. The data is taken from 1999-2015 waves of PSID.

Figure C.5: **Portfolio by race over the business cycle**



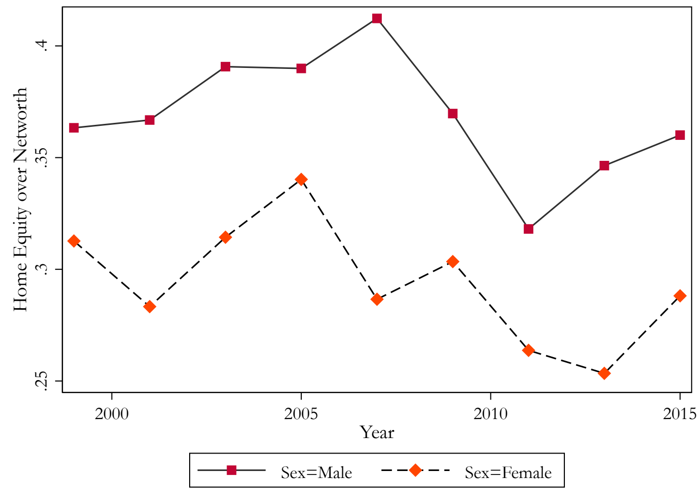
[a] Home equity to networth



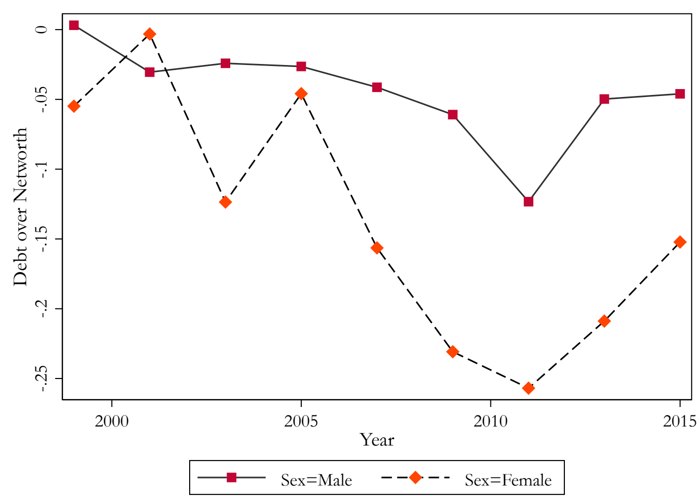
[b] Debt to networth

Notes: The figure plots ratios of home equity and debt to household net wealth by race for years 1999-2015. The data is taken from 1999-2015 waves of PSID.

Figure C.6: **Portfolio by sex over the business cycle**



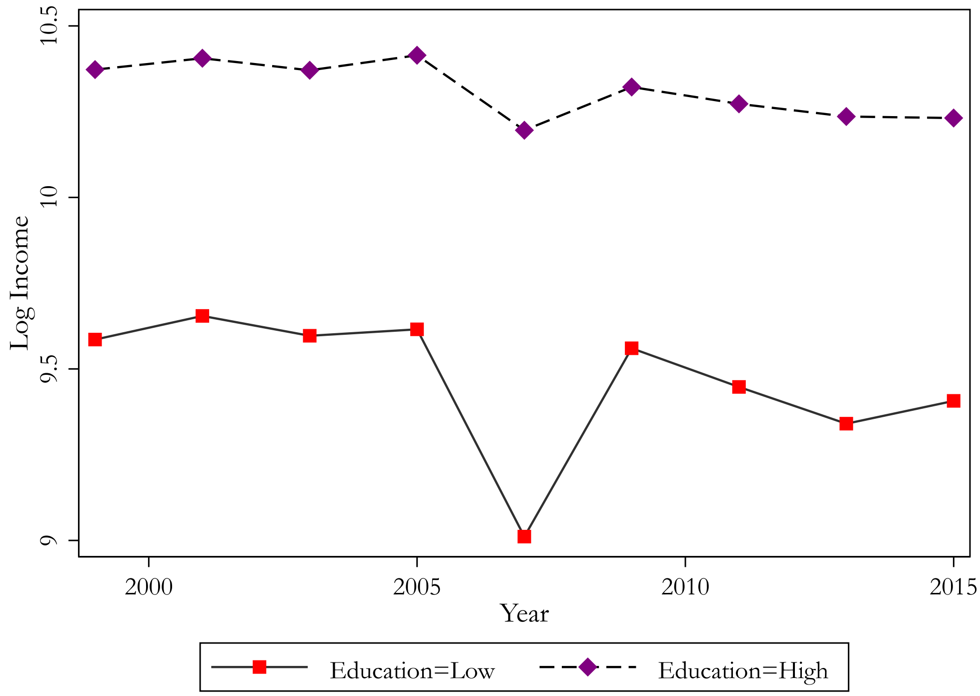
[a] Home equity to networth



[b] Debt to networth

Notes: The figure plots ratios of home equity and debt to household net wealth by sex for years 1999-2015. The data is taken from 1999-2015 waves of PSID.

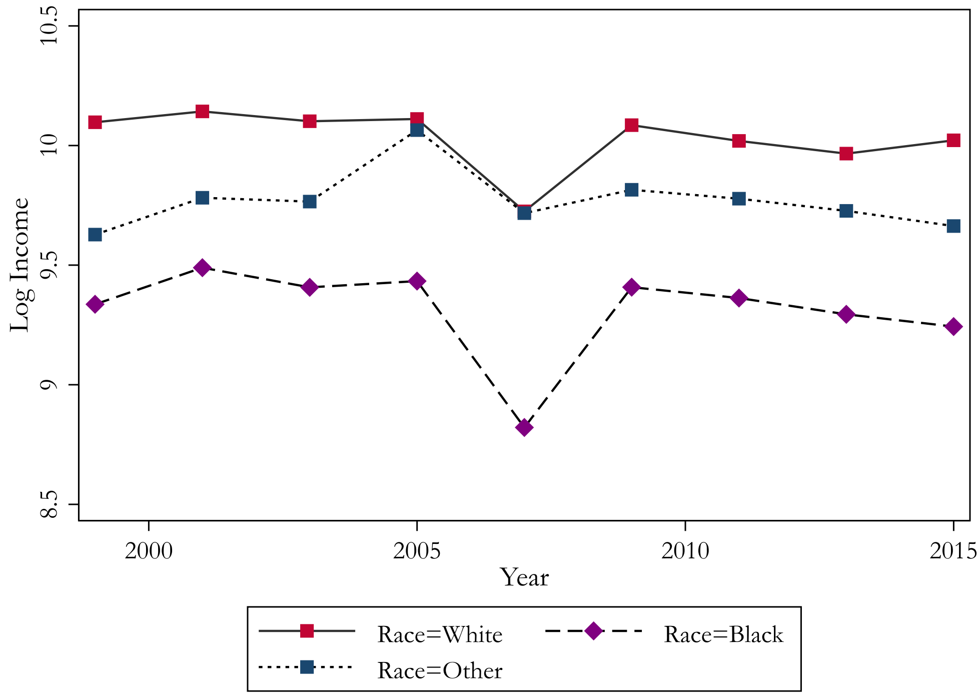
Figure C.7: **Income by education over the business cycle**



[b] Disposable Income

Notes: The figure plots log disposable income by education for years 1999-2015. The data is taken from 1999-2015 waves of PSID.

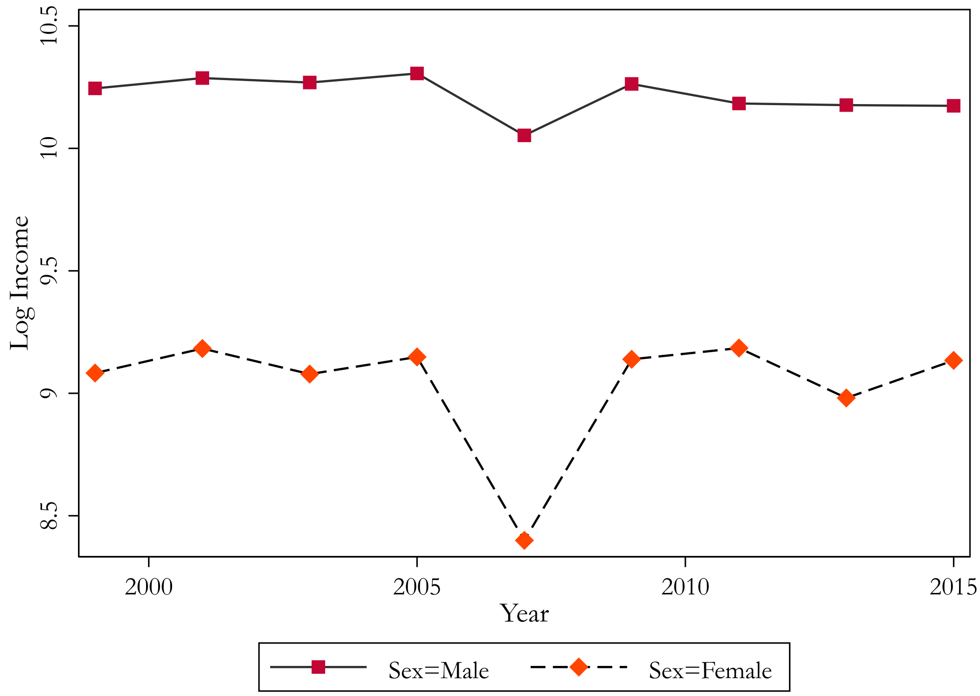
Figure C.8: **Income by race over the business cycle**



[b] Disposable Income

Notes: The figure plots log disposable income by race for years 1999-2015. The data is taken from 1999-2015 waves of PSID.

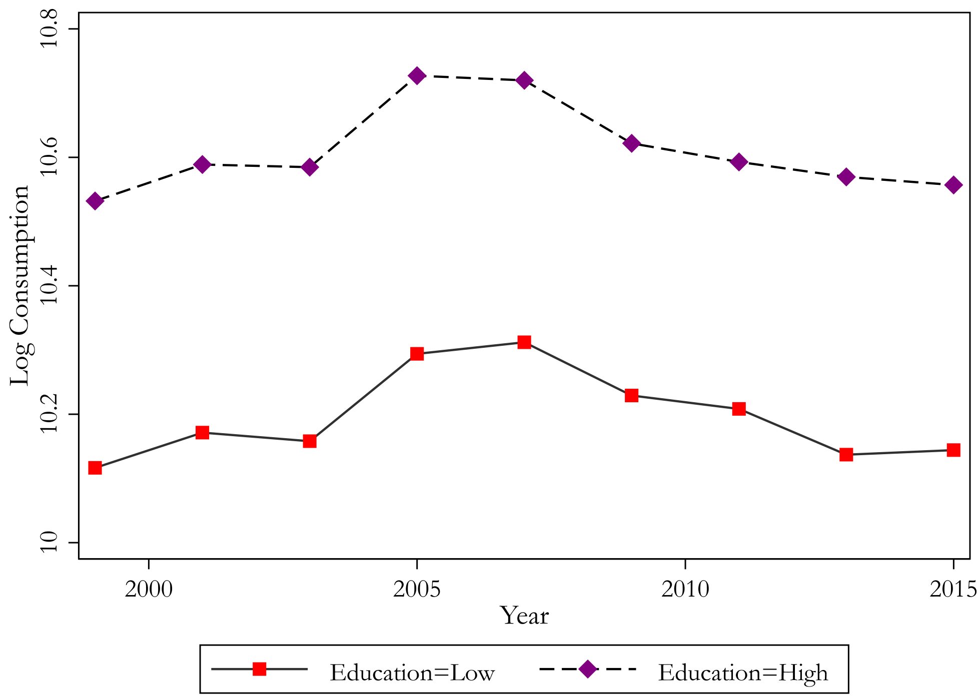
Figure C.9: **Income by sex over the business cycle**



[b] Disposable Income

Notes: The figure plots log disposable income by sex for years 1999-2015. The data is taken from 1999-2015 waves of PSID.

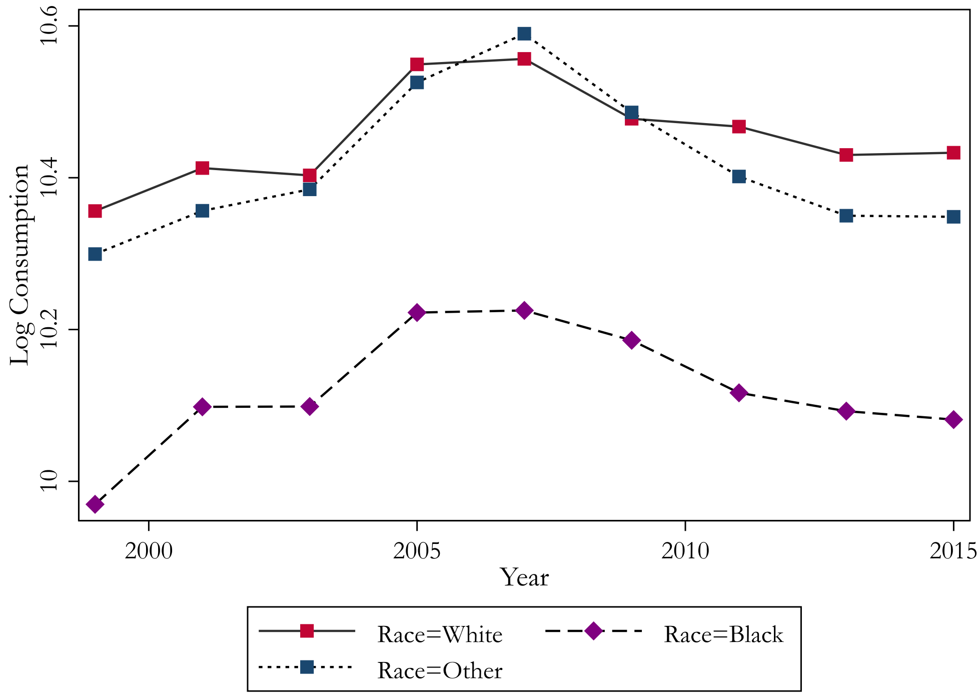
Figure C.10: **Consumption by education over the business cycle**



[b] Total Consumption

Notes: The figure plots log consumption by education for years 1999-2015. The data is taken from 1999-2015 waves of PSID.

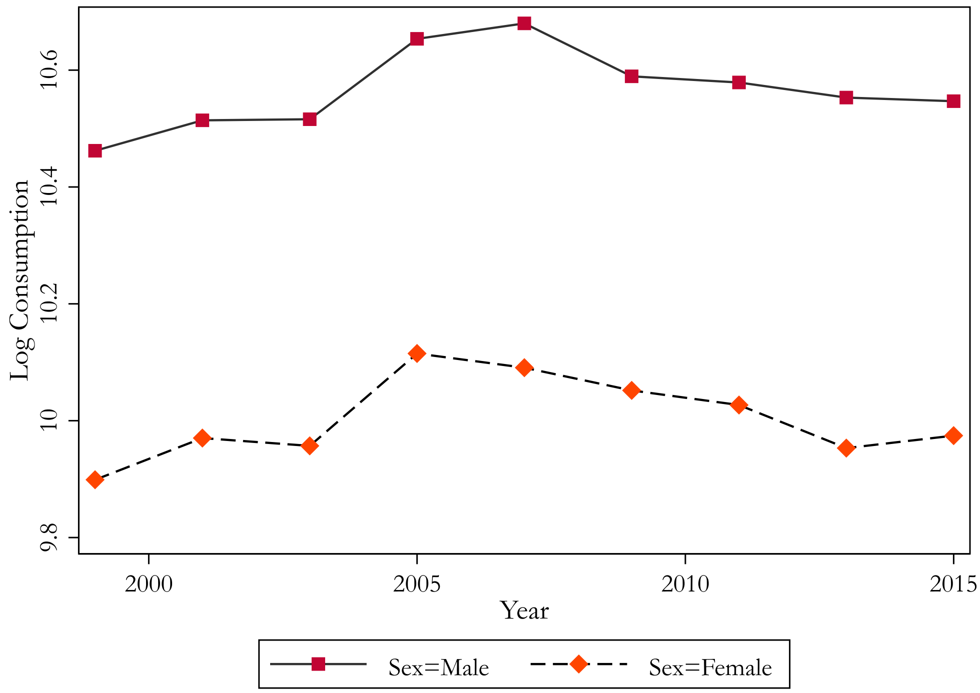
Figure C.11: **Consumption by race over the business cycle**



[b] Total Consumption

Notes: The figure plots log consumption by race for years 1999-2015. The data is taken from 1999-2015 waves of PSID.

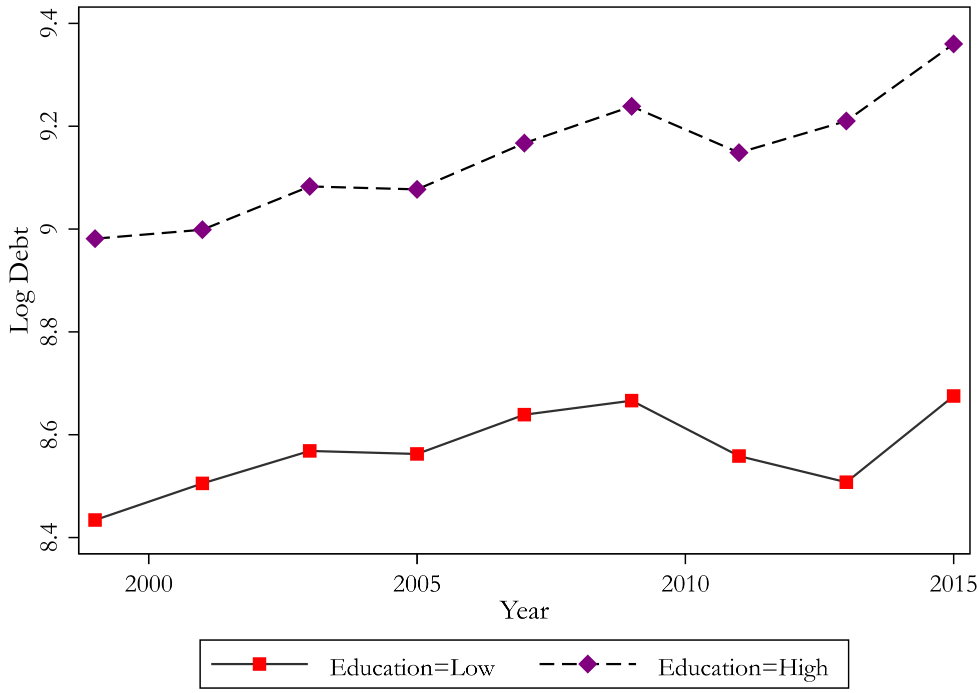
Figure C.12: **Consumption by sex over the business cycle**



[b] Total Consumption

Notes: The figure plots log consumption by sex for years 1999-2015. The data is taken from 1999-2015 waves of PSID.

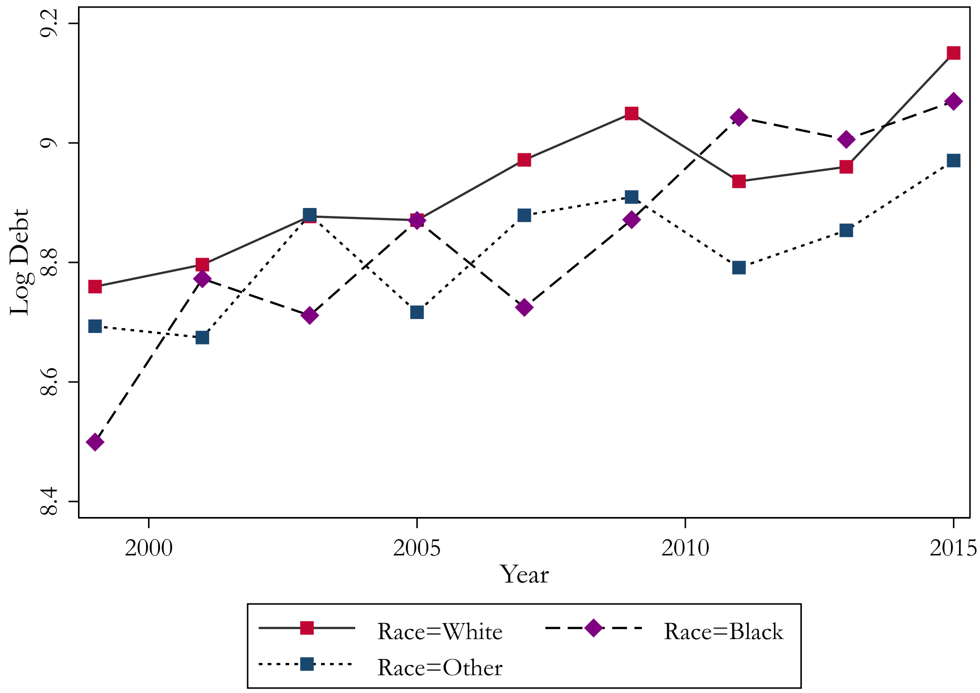
Figure C.13: **Debt by education over the business cycle**



[b] Debt

Notes: The figure plots log consumption by education for years 1999-2015. The data is taken from 1999-2015 waves of PSID.

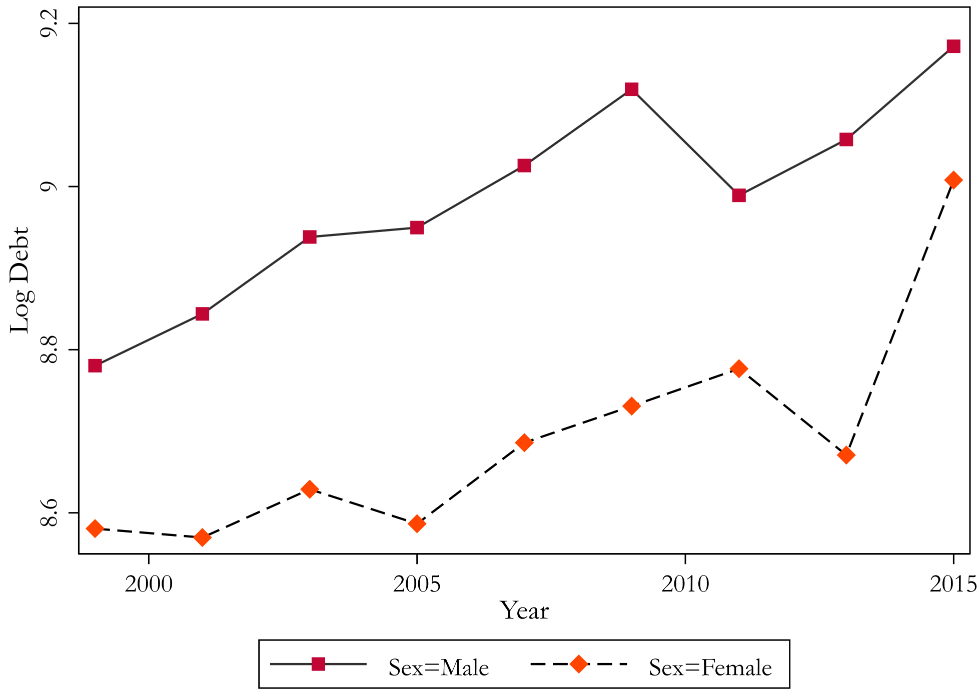
Figure C.14: **Debt by race over the business cycle**



[b] Debt

Notes: The figure plots log debt by race for years 1999-2015. The data is taken from 1999-2015 waves of PSID.

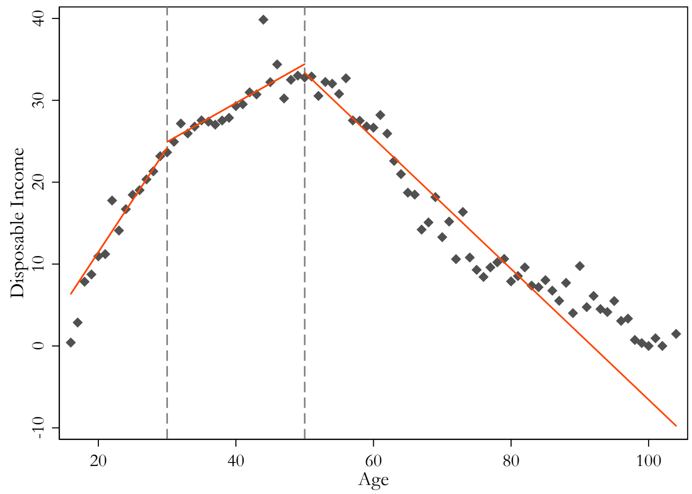
Figure C.15: **Debt by sex over the business cycle**



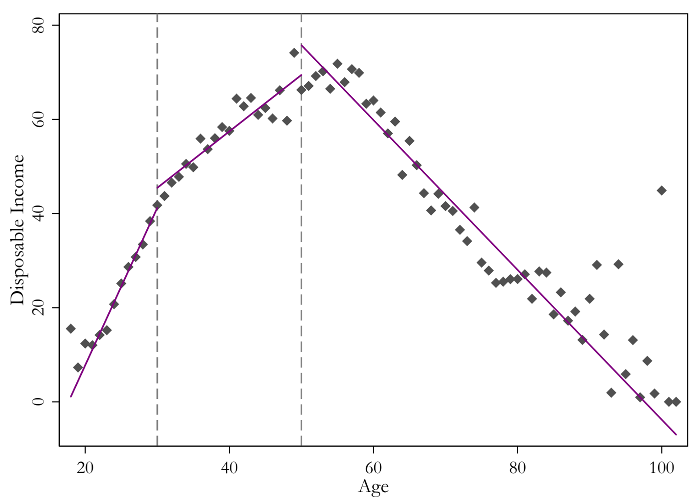
[b] Debt

Notes: The figure plots log debt by sex for years 1999-2015. The data is taken from 1999-2015 waves of PSID.

Figure C.16: **Disposable Income over the lifecycle by education**



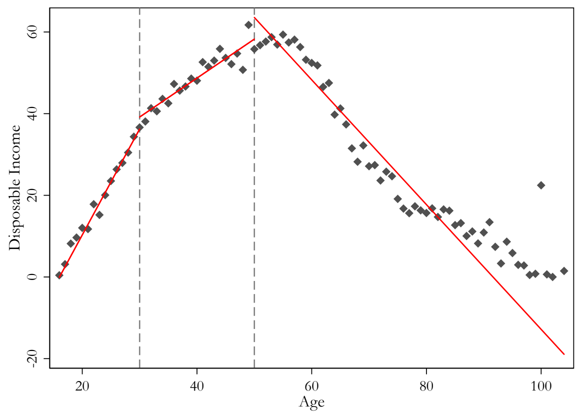
[a] Disposable Income - Low education



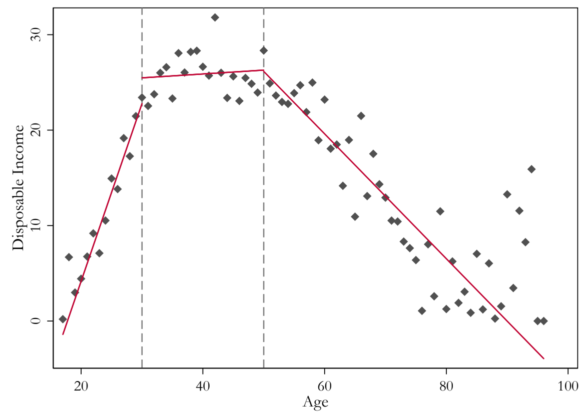
[b] Disposable Income - High education

Notes: The figure plots disposable income over the lifecycle by education. The data is taken from 1999-2015 waves of PSID. The amounts are plotted in thousand 2010 dollars.

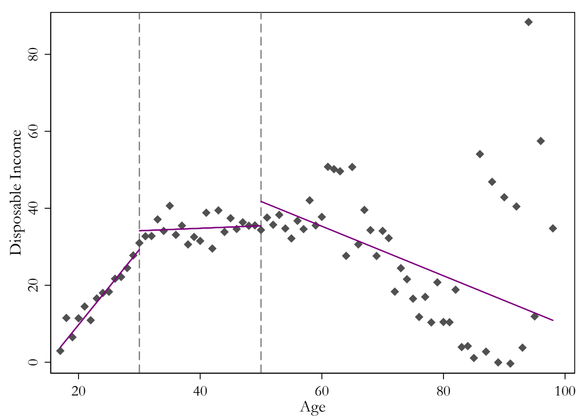
Figure C.17: **Disposable Income over the lifecycle by race**



[a] Disposable Income - White



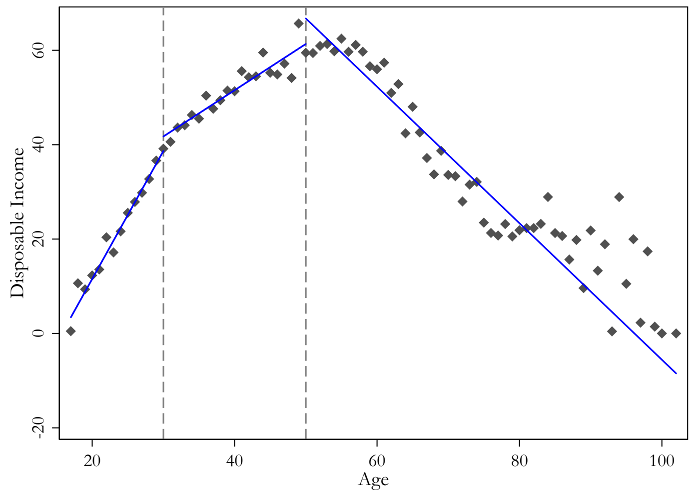
[b] Disposable Income - Black



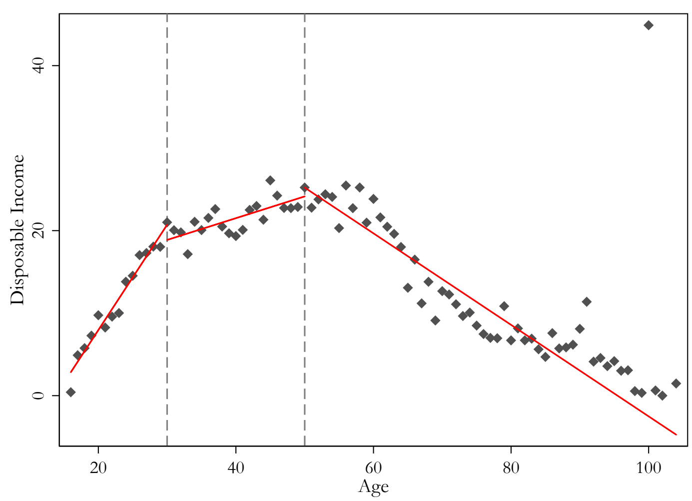
[c] Disposable Income - Other

Notes: The figure plots disposable income over the lifecycle by race. The data is taken from 1999-2015 waves of PSID. The amounts are plotted in thousand 2010 dollars.

Figure C.18: **Disposable Income over the lifecycle by sex**



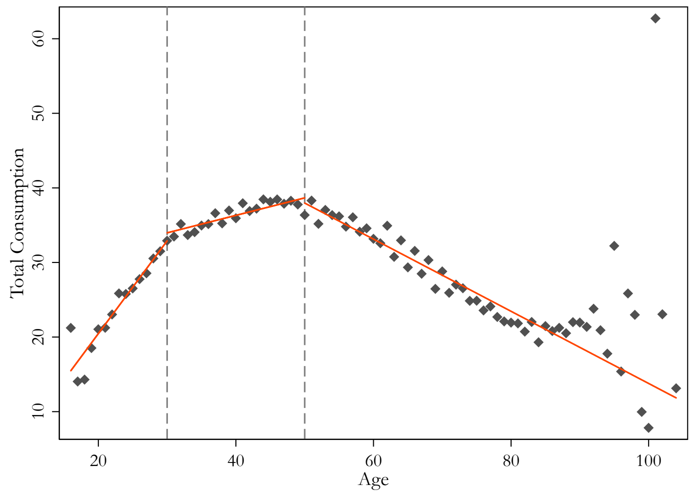
[a] Disposable Income - Male



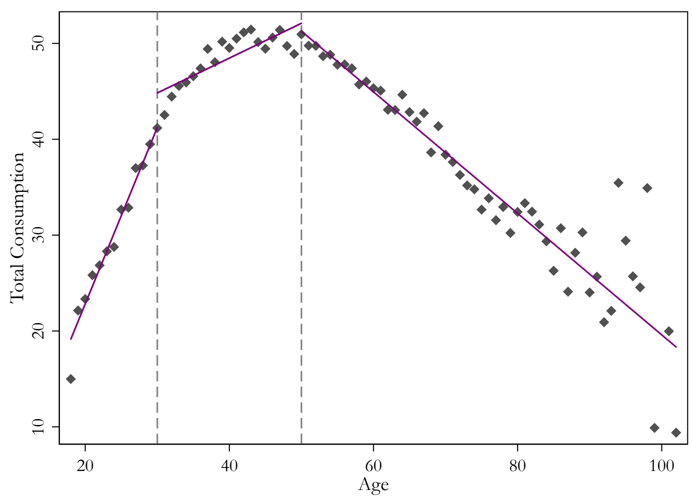
[b] Disposable Income - Female

Notes: The figure plots disposable income over the lifecycle by sex. The data is taken from 1999-2015 waves of PSID. The amounts are plotted in thousand 2010 dollars.

Figure C.19: **Total Consumption over the lifecycle by education**



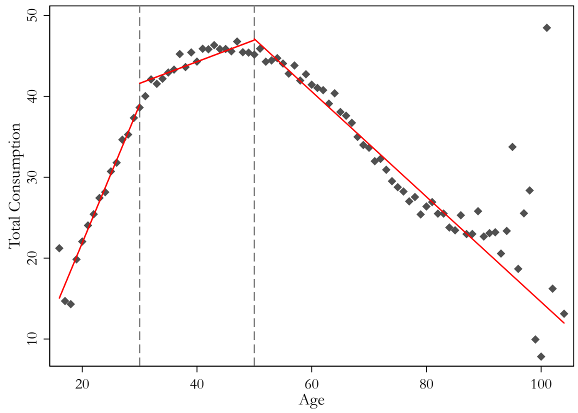
[a] Total Consumption - Low education



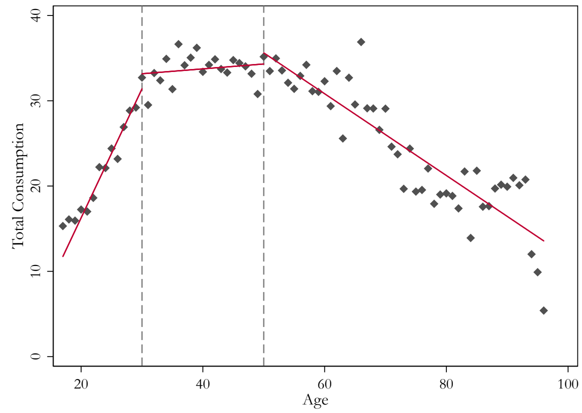
[b] Total Consumption - High education

Notes: The figure plots total household consumption over the lifecycle by education. The data is taken from 1999-2015 waves of PSID. The amounts are plotted in thousand 2010 dollars.

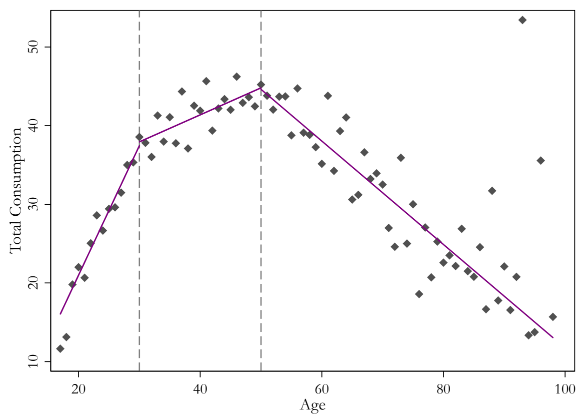
Figure C.20: **Total Consumption over the lifecycle by race**



[a] Total Consumption - White



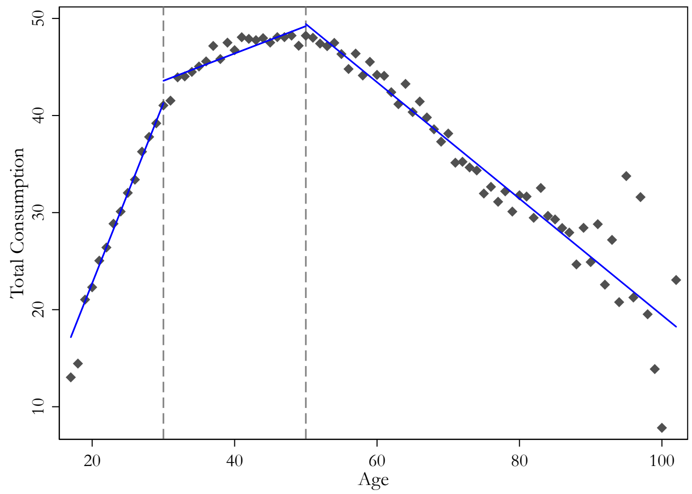
[b] Total Consumption - Black



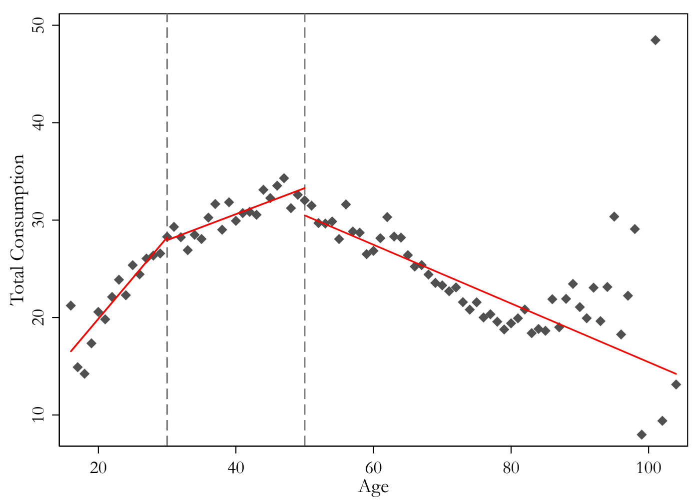
[c] Total Consumption - Other

Notes: The figure plots total household consumption over the lifecycle by race. The data is taken from 1999-2015 waves of PSID. The amounts are plotted in thousand 2010 dollars.

Figure C.21: **Total Consumption over the lifecycle by sex**



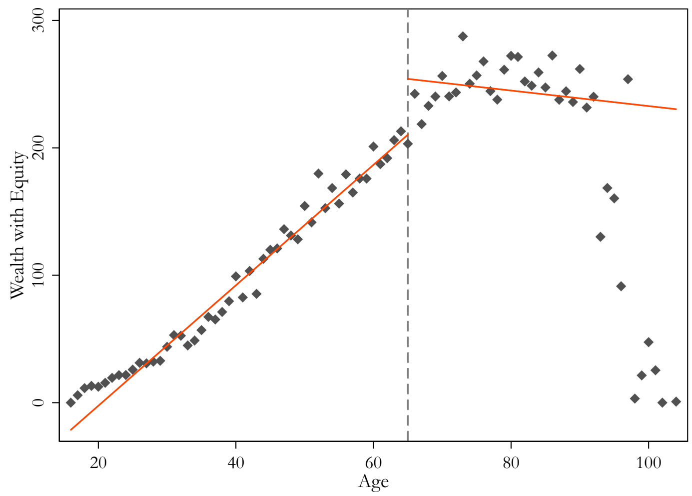
[a] Total Consumption - Male



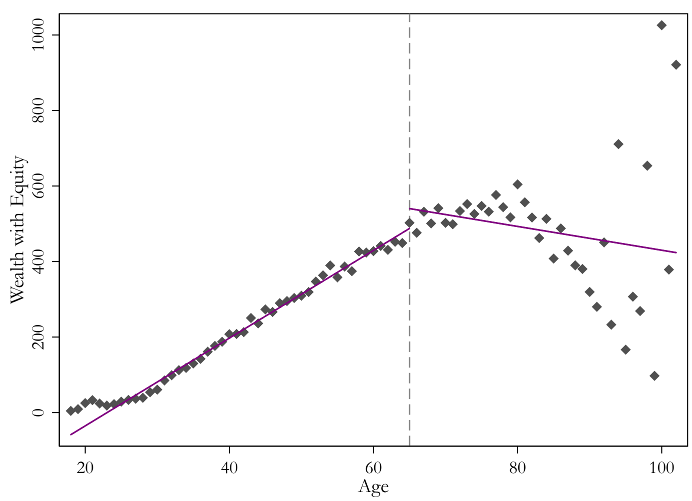
[b] Total Consumption - Female

Notes: The figure plots total household consumption over the lifecycle by sex. The data is taken from 1999-2015 waves of PSID. The amounts are plotted in thousand 2010 dollars.

Figure C.22: **Networth over the lifecycle by education**



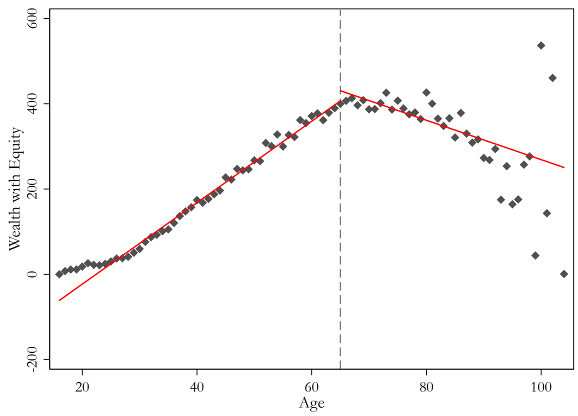
[a] Networth - Low education



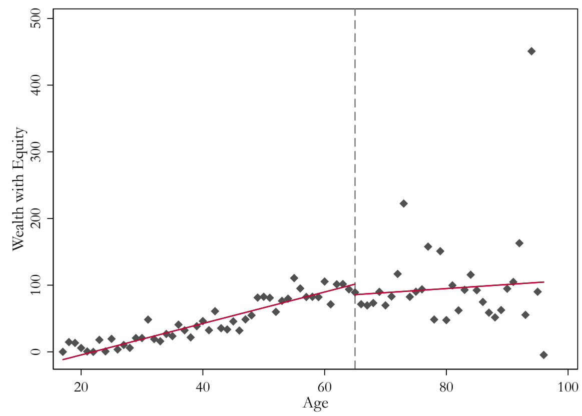
[b] Networth - High education

Notes: The figure plots total household networth over the lifecycle by education. The data is taken from 1999-2015 waves of PSID. The amounts are plotted in thousand 2010 dollars.

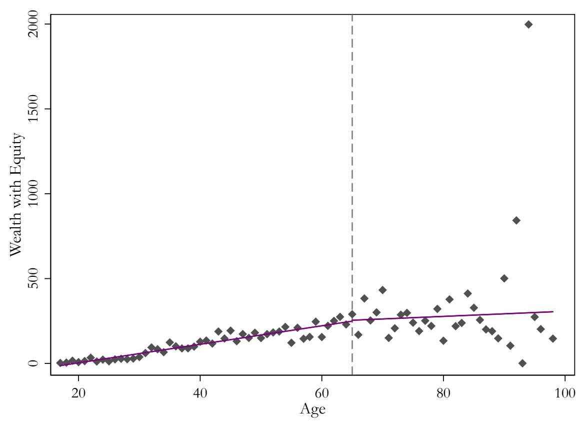
Figure C.23: **Networth over the lifecycle by race**



[a] Networth - White



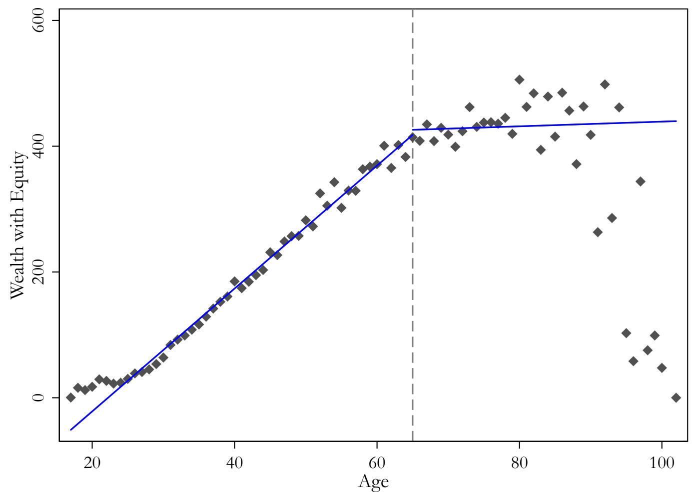
[b] Networth - Black



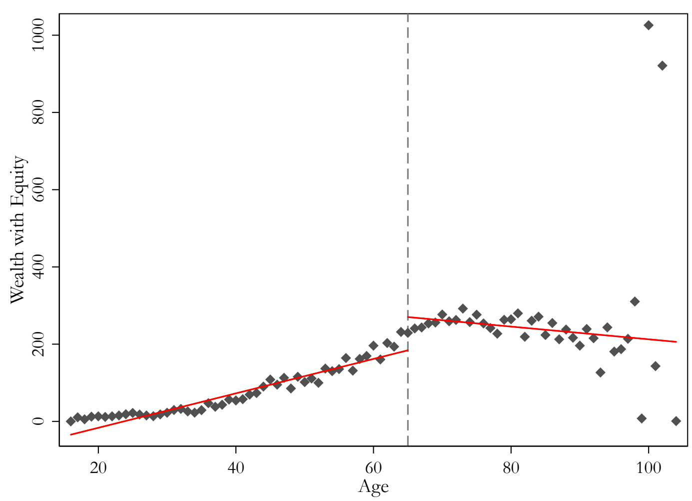
[c] Networth - Other

Notes: The figure plots total household networth over the lifecycle by race. The data is taken from 1999-2015 waves of PSID. The amounts are plotted in thousand 2010 dollars.

Figure C.24: **Networth over the lifecycle by sex**



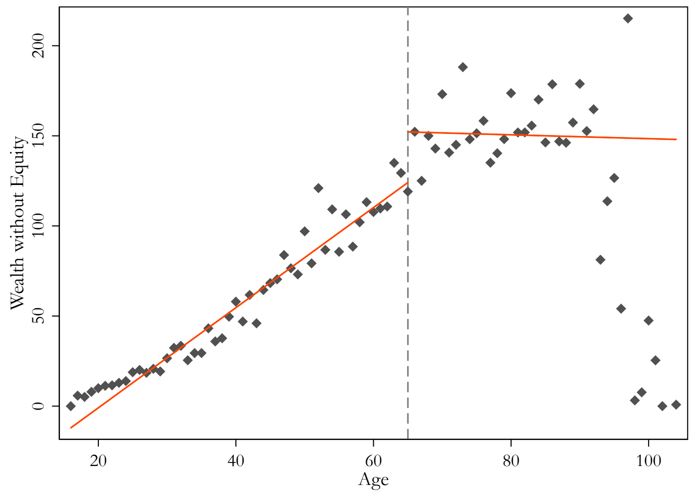
[a] Networth - Male



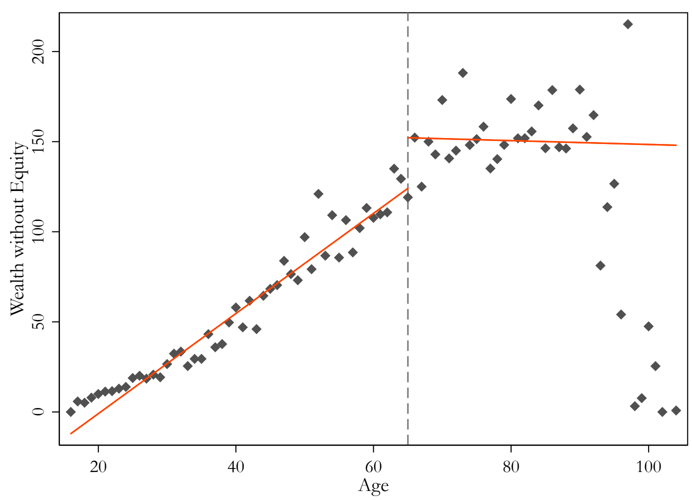
[b] Networth - Female

Notes: The figure plots total household networth over the lifecycle by sex. The data is taken from 1999-2015 waves of PSID. The amounts are plotted in thousand 2010 dollars.

Figure C.25: **Net Wealth without Home Equity over the lifecycle by education**



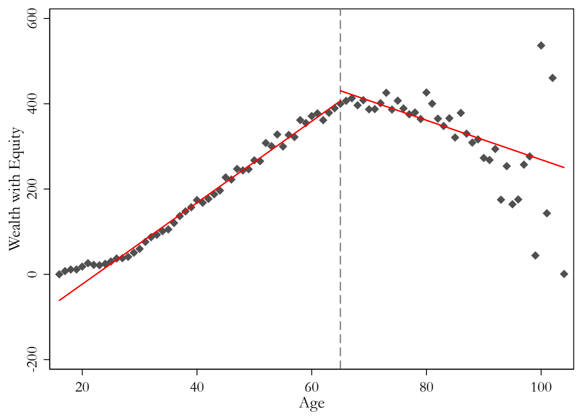
[a] Net Wealth without Home Equity - Low education



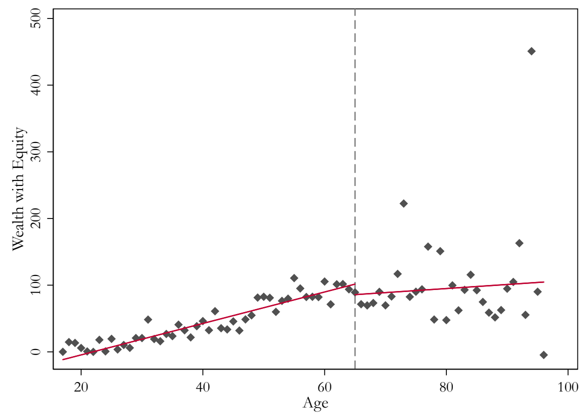
[b] Net Wealth without Home Equity - High education

Notes: The figure plots total household net wealth without home equity over the lifecycle by education. The data is taken from 1999-2015 waves of PSID. The amounts are plotted in thousand 2010 dollars.

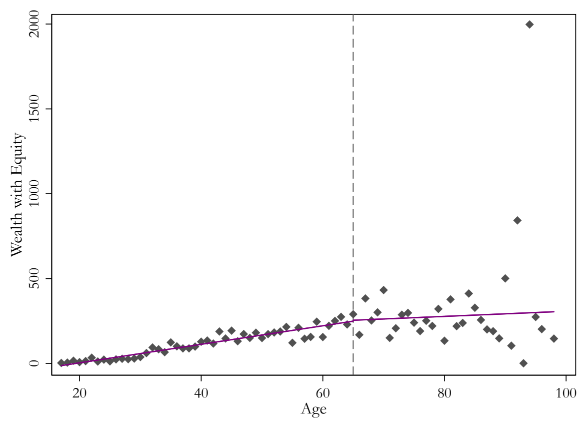
Figure C.26: **Net Wealth without Home Equity over the lifecycle by race**



[a] Net Wealth without Home Equity - White



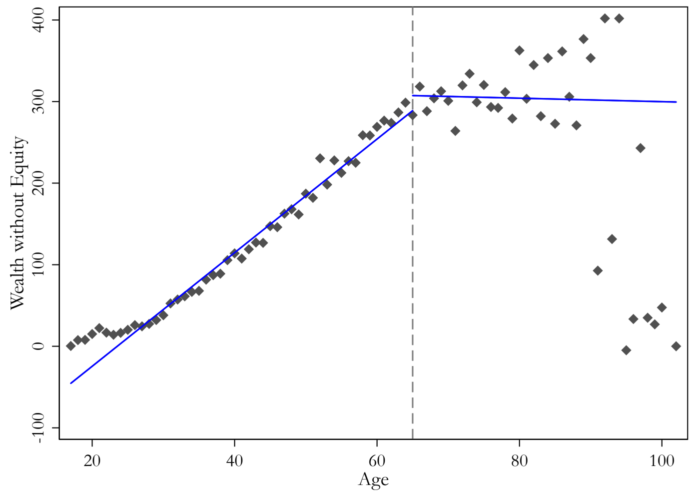
[b] Net Wealth without Home Equity - Black



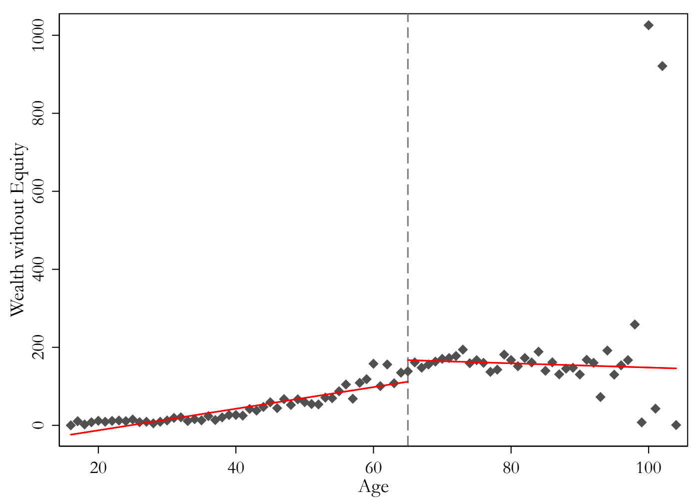
[c] Net Wealth without Home Equity - Other

Notes: The figure plots total household net wealth without home equity over the lifecycle by race. The data is taken from 1999-2015 waves of PSID. The amounts are plotted in thousand 2010 dollars.

Figure C.27: **Net Wealth without Home Equity over the lifecycle by sex**



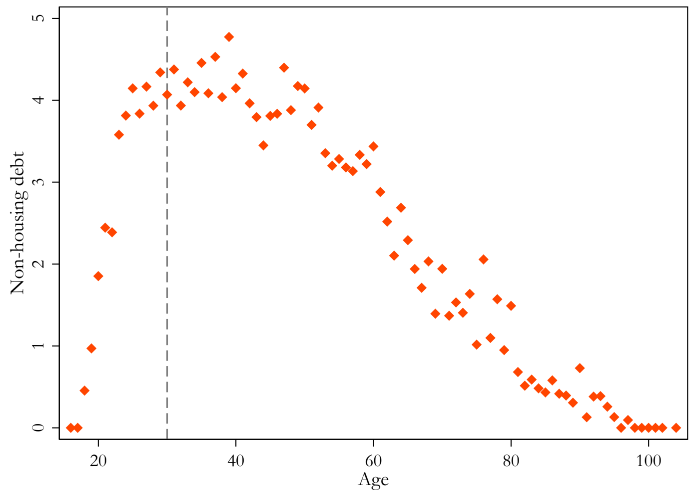
[a] Net Wealth without Home Equity - Male



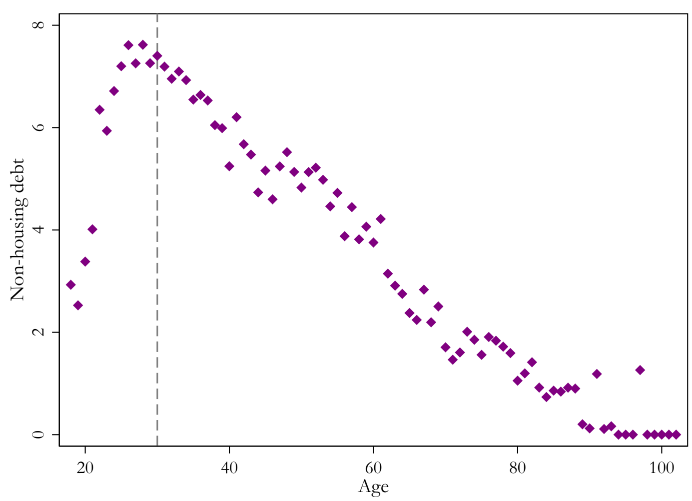
[b] Net Wealth without Home Equity - Female

Notes: The figure plots total household net wealth without home equity over the lifecycle by sex. The data is taken from 1999-2015 waves of PSID. The amounts are plotted in thousand 2010 dollars.

Figure C.28: **Debt over the lifecycle by education**



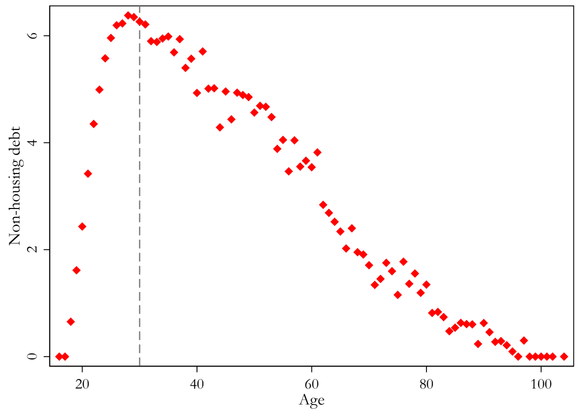
[a] Debt - Low education



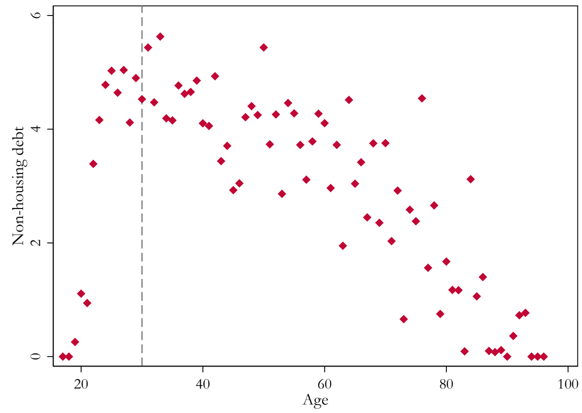
[b] Debt - High education

Notes: The figure plots debt over the lifecycle by education. The data is taken from 1999-2015 waves of PSID. The amounts are plotted in thousand 2010 dollars. Debt is defined as all household debt other than mortgage and vehicle loans.

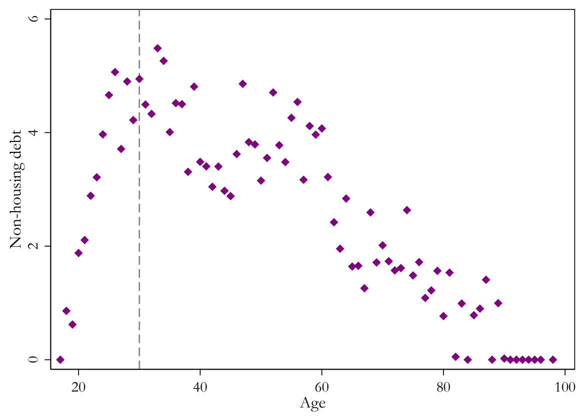
Figure C.29: **Debt over the lifecycle by race**



[a] Debt - White



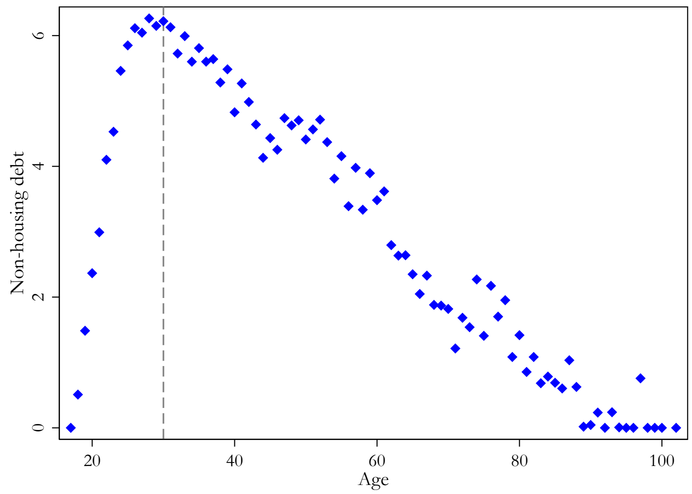
[b] Debt - Black



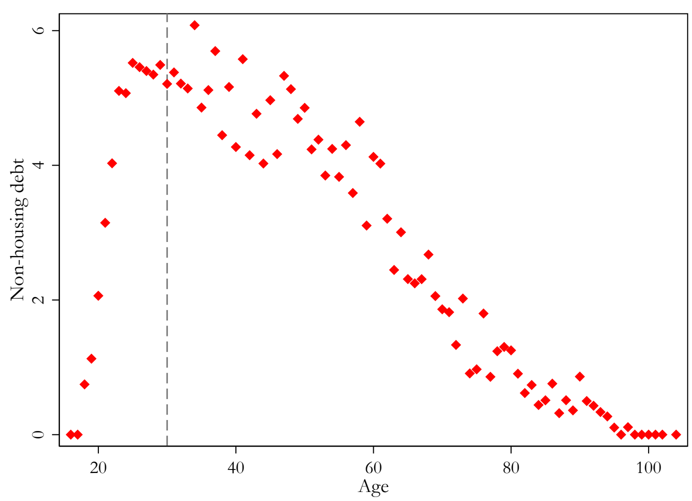
[c] Debt - Other

Notes: The figure plots debt over the lifecycle by race. The data is taken from 1999-2015 waves of PSID. The amounts are plotted in thousand 2010 dollars. Debt is defined as all household debt other than mortgage and vehicle loans.

Figure C.30: **Debt over the lifecycle by sex**



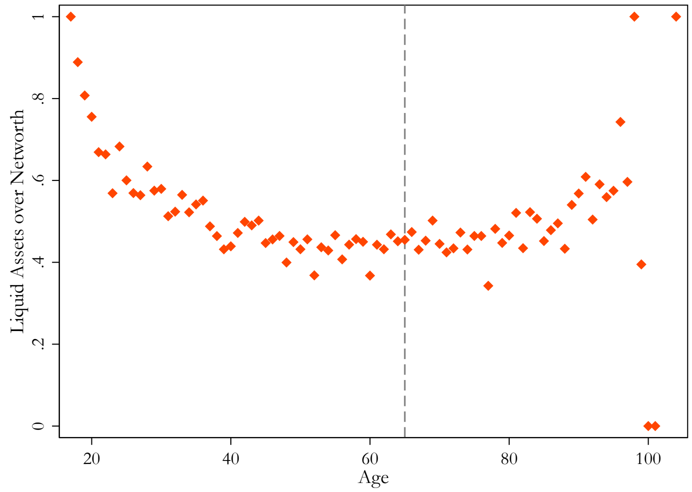
[a] Debt - Male



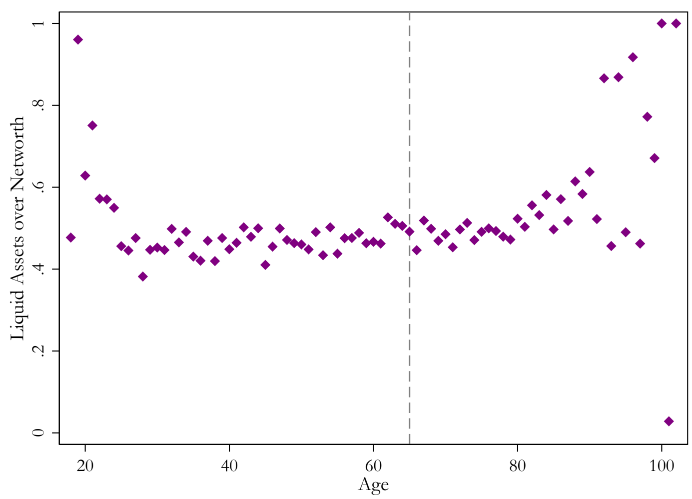
[b] Debt - Female

Notes: The figure plots debt over the lifecycle by sex. The data is taken from 1999-2015 waves of PSID. The amounts are plotted in thousand 2010 dollars. Debt is defined as all household debt other than mortgage and vehicle loans.

Figure C.31: **Liquid Assets to Networth (broad) over the lifecycle by education**



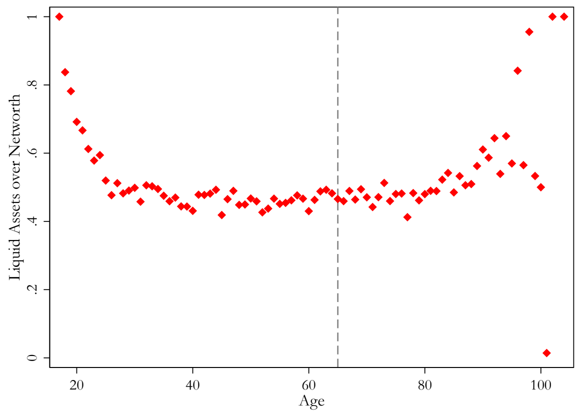
[a] Liquid Assets to Networth (broad) - Low education



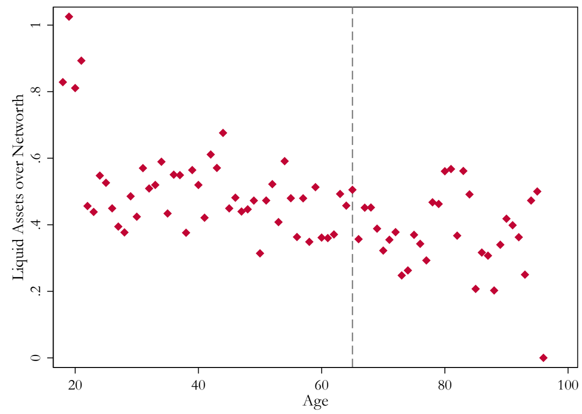
[b] Liquid Assets to Networth (broad) - High education

Notes: The figure plots liquid assets to networth over the lifecycle by education. The data is taken from 1999-2015 waves of PSID. Broad definition of liquid assets for PSID data is the sum of checking/savings account, stocks, value of vehicles, other assets and annuity/IRA.

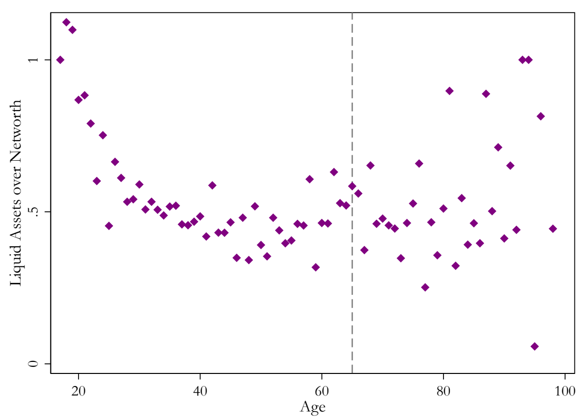
Figure C.32: **Liquid Assets to Networth (broad) over the lifecycle by race**



[a] Liquid Assets to Networth (broad) - White



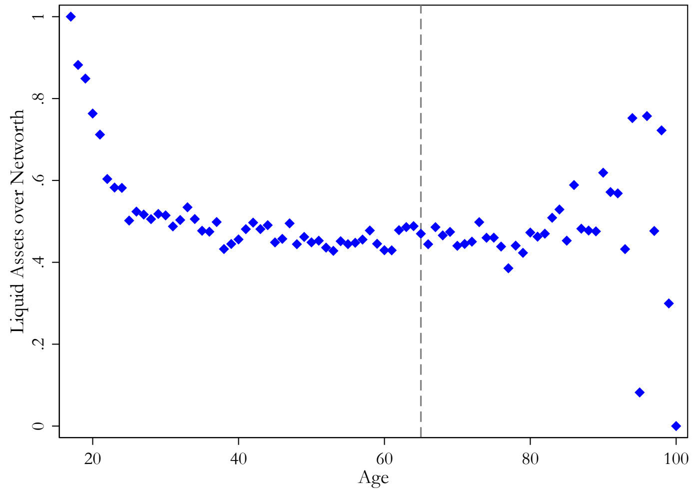
[b] Liquid Assets to Networth (broad) - Black



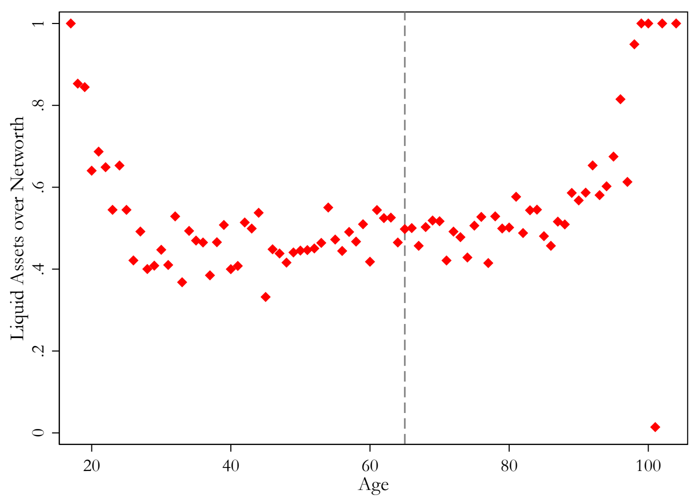
[c] Liquid Assets to Networth (broad) - Other

Notes: The figure plots liquid assets to networth over the lifecycle by race. The data is taken from 1999-2015 waves of PSID. Broad definition of liquid assets for PSID data is the sum of checking/savings account, stocks, value of vehicles, other assets and annuity/IRA.

Figure C.33: **Liquid Assets to Networth (broad) over the lifecycle by sex**



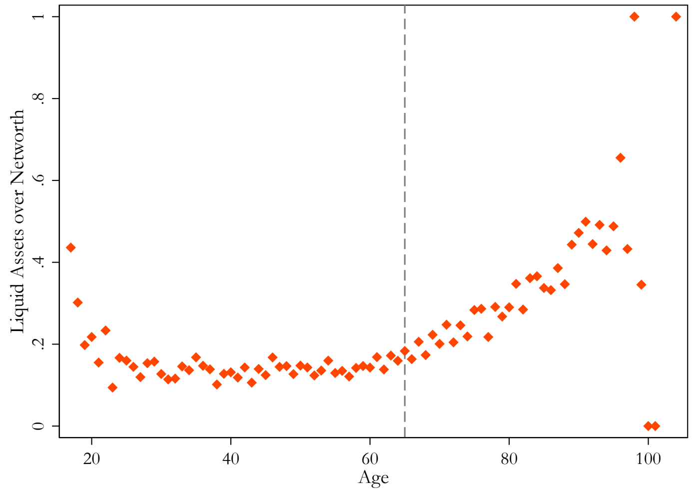
[a] Liquid Assets to Networth (broad) - Male



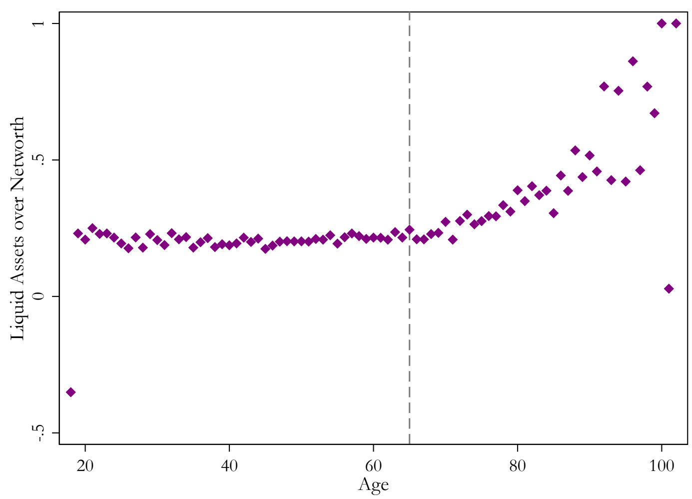
[b] Liquid Assets to Networth (broad) - Female

Notes: The figure plots liquid assets to networth over the lifecycle by sex. The data is taken from 1999-2015 waves of PSID. Broad definition of liquid assets for PSID data is the sum of checking/savings account, stocks, value of vehicles, other assets and annuity/IRA.

Figure C.34: **Liquid Assets to Networth (narrow) over the lifecycle by education**



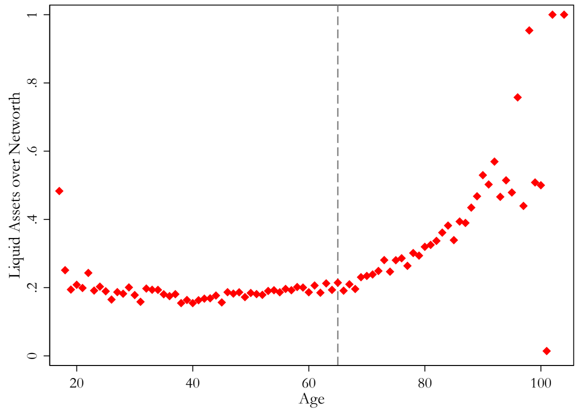
[a] Liquid Assets to Networth (narrow) - Low education



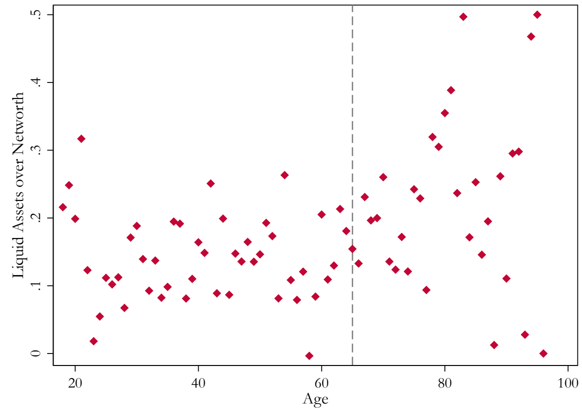
[b] Liquid Assets to Networth (narrow) - High education

Notes: The figure plots liquid assets to networth over the lifecycle by education. The data is taken from 1999-2015 waves of PSID. Narrow definition of liquid assets is the sum of checking/savings account, stocks, and other assets.

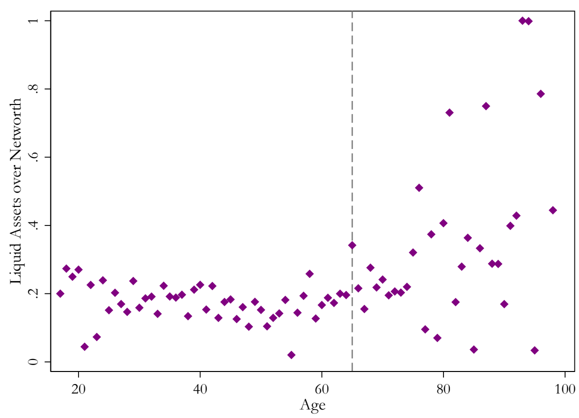
Figure C.35: **Liquid Assets to Networth (narrow) over the lifecycle by race**



[a] Liquid Assets to Networth (narrow) - White



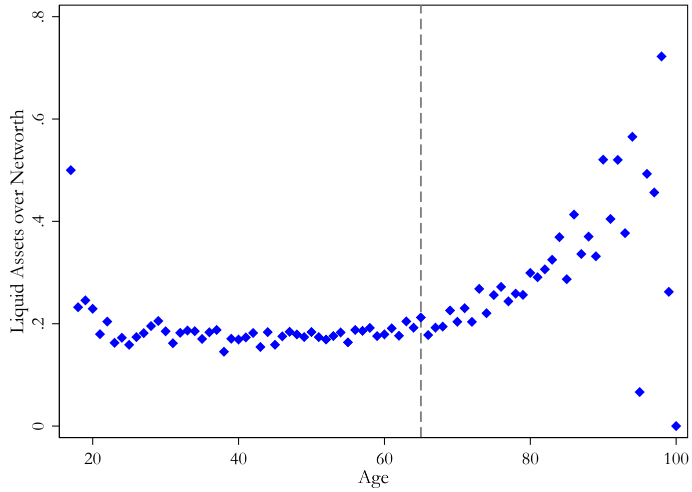
[b] Liquid Assets to Networth (narrow) - Black



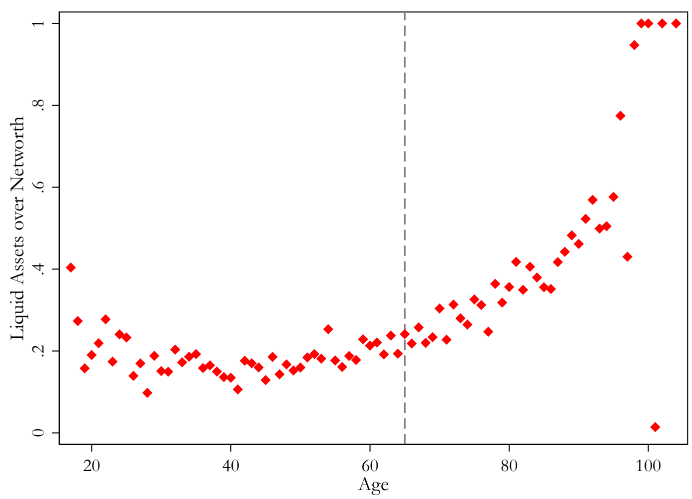
[c] Liquid Assets to Networth (narrow) - Other

Notes: The figure plots liquid assets to networth over the lifecycle by race. The data is taken from 1999-2015 waves of PSID. Narrow definition of liquid assets is the sum of checking/savings account, stocks, and other assets.

Figure C.36: **Liquid Assets to Networth (narrow) over the lifecycle by sex**



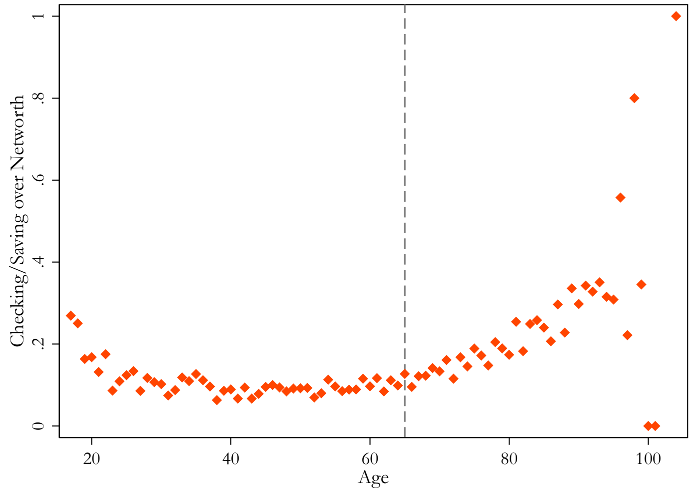
[a] Liquid Assets to Networth (narrow) - Male



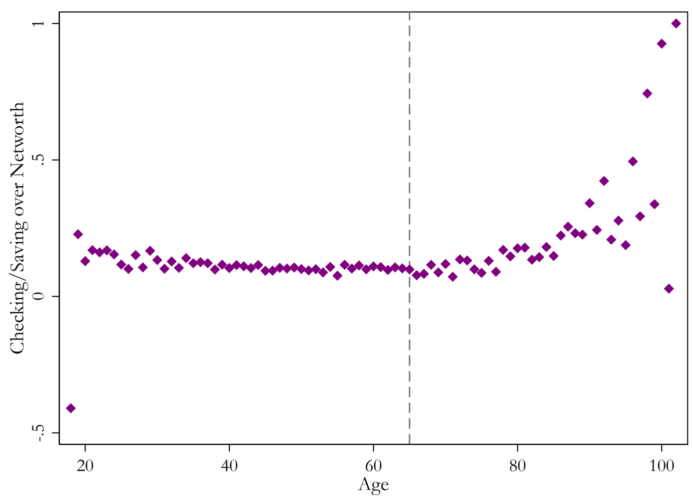
[b] Liquid Assets to Networth (narrow) - Female

Notes: The figure plots liquid assets to networth over the lifecycle by sex. The data is taken from 1999-2015 waves of PSID. Narrow definition of liquid assets is the sum of checking/savings account, stocks, and other assets.

Figure C.37: **Checking/Savings to Networth over the lifecycle by education**



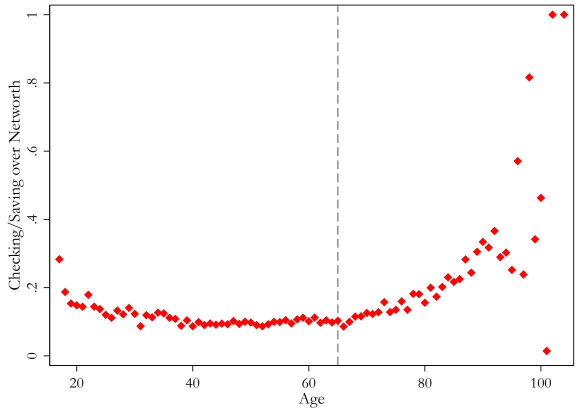
[a] Checking/Savings to Networth - Low education



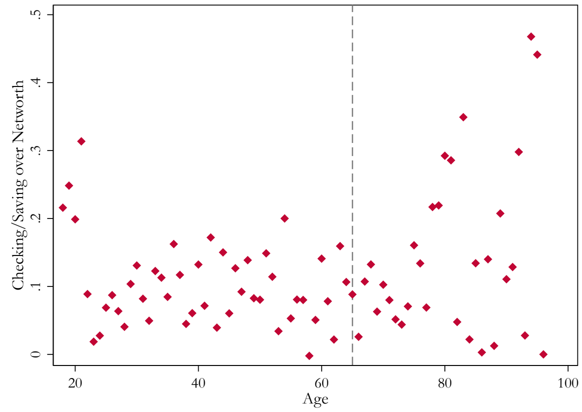
[b] Checking/Savings to Networth - High education

Notes: The figure plots checking/savings to networth over the lifecycle by education. The data is taken from 1999-2015 waves of PSID.

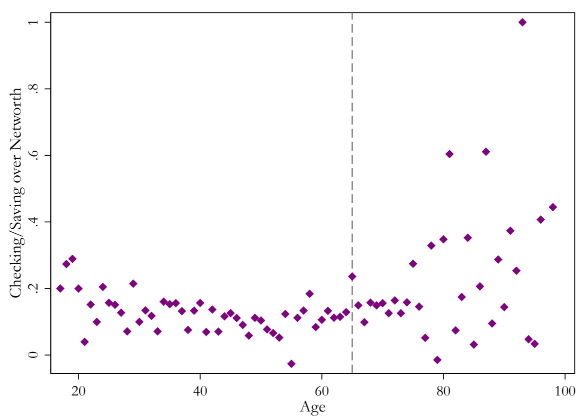
Figure C.38: **Checking/Savings to Networth over the lifecycle by race**



[a] Checking/Savings to Networth - White



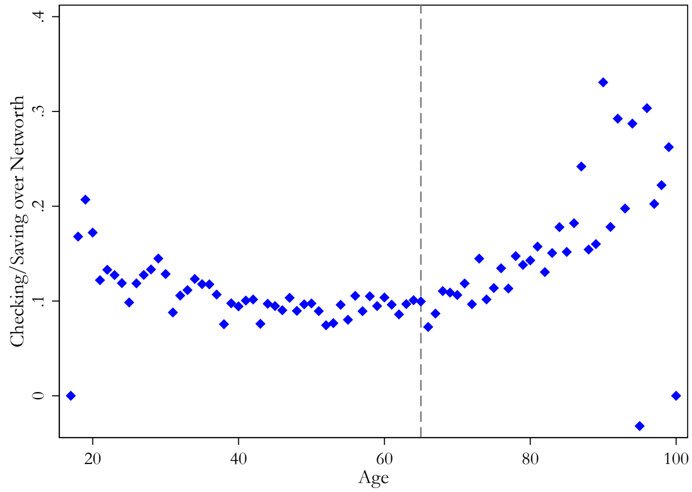
[b] Checking/Savings to Networth - Black



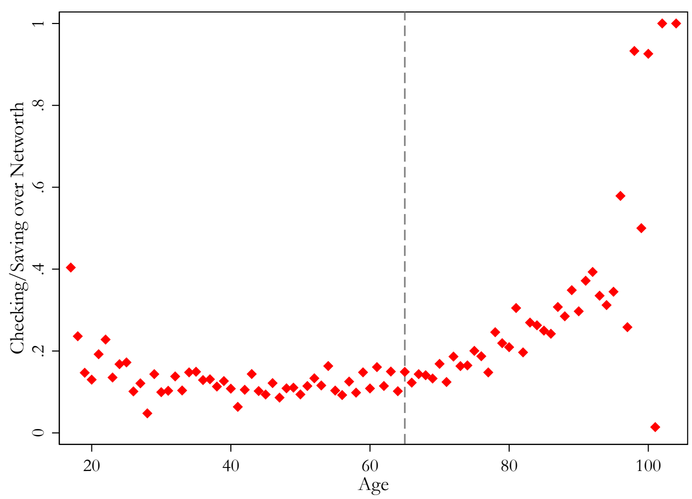
[c] Checking/Savings to Networth - Other

Notes: The figure plots checking/savings to networth over the lifecycle by race. The data is taken from 1999-2015 waves of PSID.

Figure C.39: **Checking/Savings to Networth over the lifecycle by sex**



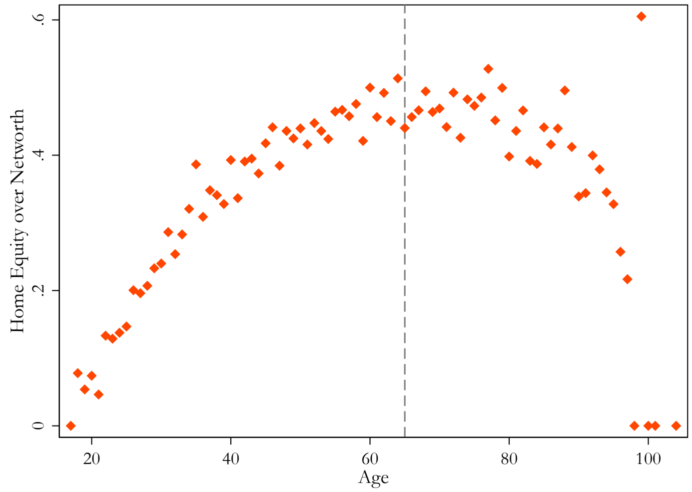
[a] Checking/Savings to Networth - Male



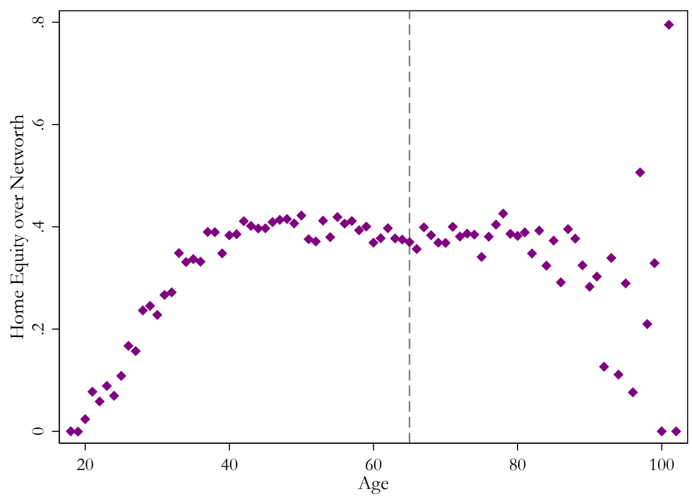
[b] Checking/Savings to Networth - Female

Notes: The figure plots checking/savings to networth over the lifecycle by sex. The data is taken from 1999-2015 waves of PSID.

Figure C.40: **Home Equity to Networth over the lifecycle by education**



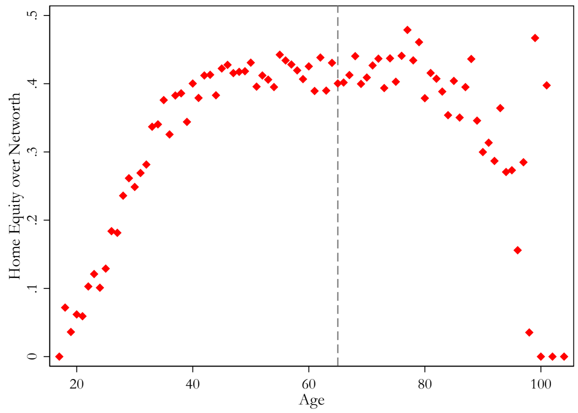
[a] Home Equity to Networth - Low education



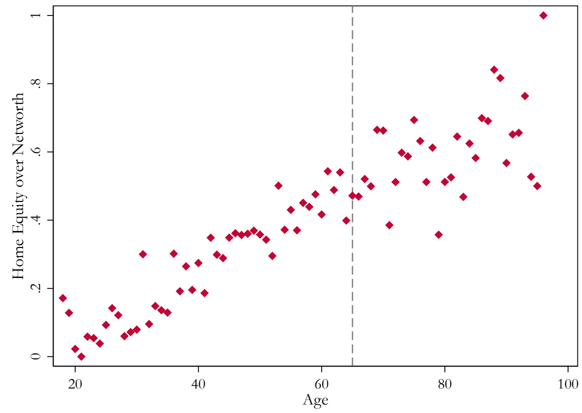
[b] Home Equity to Networth - High education

Notes: The figure plots home equity to networth over the lifecycle by education. The data is taken from 1999-2015 waves of PSID.

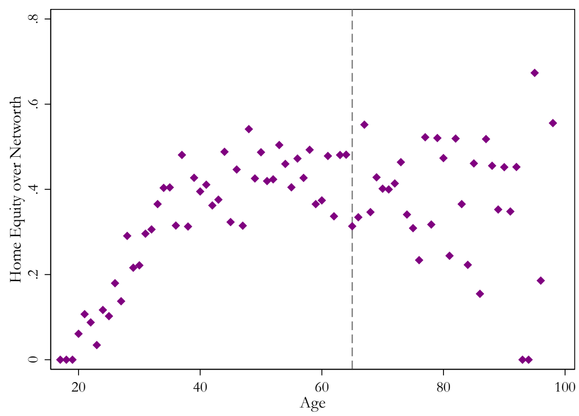
Figure C.41: **Home Equity to Networth over the lifecycle by race**



[a] Home Equity to Networth - White



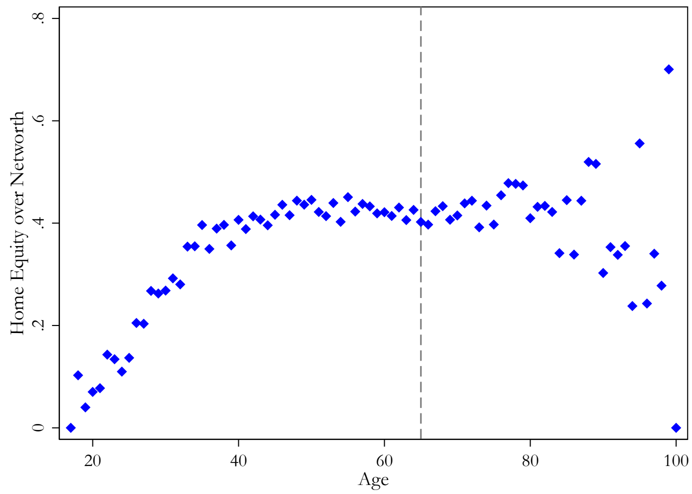
[b] Home Equity to Networth - Black



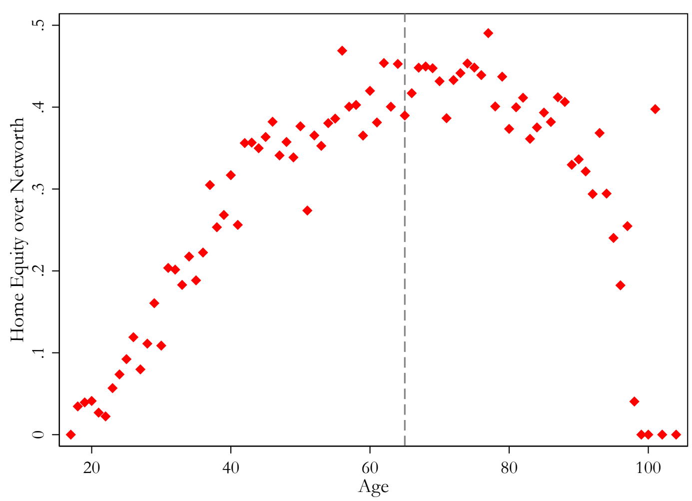
[c] Home Equity to Networth - Other

Notes: The figure plots home equity to networth over the lifecycle by race. The data is taken from 1999-2015 waves of PSID.

Figure C.42: **Home Equity to Networth over the lifecycle by sex**



[a] Home Equity to Networth - Male



[b] Home Equity to Networth - Female

Notes: The figure plots home equity to networth over the lifecycle by sex. The data is taken from 1999-2015 waves of PSID.

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