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# Health Heterogeneity, Portfolio Choice and Wealth Inequality\*

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## Abstract

Poor health raises medical expenditures and reduces earnings, but it also limits access to high-return assets. Using PSID and HRS panel data, we document large and persistent differences in stock market participation by health status that persist within education groups and emerge in midlife, widening toward retirement. To interpret these patterns, we develop a quantitative life-cycle model with health risk, health insurance, and portfolio choice between risky and safe assets. The model highlights a health–wealth portfolio channel through which better health facilitates participation in high-return risky assets, generating return heterogeneity that compounds into large and persistent wealth gaps. Quantitatively, eliminating health-driven differences in portfolio choice reduces the top-to-median wealth gap by approximately 47 percent. Expanding public and private health insurance reduces this gap by 18–25 percent, in part by inducing greater risky-asset participation among previously uninsured households. These findings underscore the importance of health and health insurance in shaping access to high-return assets and reducing wealth inequality.

**Keywords:** Keywords: Health and income risks, Health insurance, Heterogeneity, Life cycle savings, Risky and safe assets, Asset portfolio, Inequality.

**JEL Codes:** G41, G51, G52, E21, H21, I13, I14

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# Health Heterogeneity, Portfolio Choice and Wealth Inequality\*

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April 1, 2026

## Abstract

Poor health raises medical expenditures and reduces earnings, but it also limits access to high-return assets. Using PSID and HRS panel data, we document large and persistent differences in stock market participation by health status that persist within education groups and emerge in midlife, widening toward retirement. To interpret these patterns, we develop a quantitative life-cycle model with health risk, health insurance, and portfolio choice between risky and safe assets. The model highlights a health–wealth portfolio channel through which better health facilitates participation in high-return risky assets, generating return heterogeneity that compounds into large and persistent wealth gaps. Quantitatively, eliminating health-driven differences in portfolio choice reduces the top-to-median wealth gap by approximately 47 percent. Expanding public and private health insurance reduces this gap by 18–25 percent, in part by inducing greater risky-asset participation among previously uninsured households. These findings underscore the importance of health and health insurance in shaping access to high-return assets and reducing wealth inequality.

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# 1 Introduction

A growing literature identifies health shocks as an important source of economic inequality (e.g., [Mahler and Yum, 2024](#); [De Nardi, Pashchenko and Porapakkarm, 2025](#); [Capatina and Keane, 2025](#); [Hosseini, Kopecky and Zhao, 2025](#)). Most of this literature focuses on the effects of poor health through medical expenditures and labor earnings, typically within life-cycle models that restrict households to a single risk-free asset. As a result, these frameworks abstract from how health influences access to high-return, risky assets. In this paper, we study a complementary channel through which health shapes wealth inequality—through its effect on the rate of return on savings. While heterogeneity in returns is central to existing theories of wealth inequality (e.g., [Benhabib, Bisin and Zhu, 2015](#); [Gabaix, Lasry, Lions and Moll, 2016](#); [Benhabib, Bisin and Luo, 2019](#)), we show that such heterogeneity arises endogenously from differences in exposure to health shocks over the life cycle. Individuals in better health are more likely to participate in risky asset markets and earn higher returns, generating health-driven heterogeneity in returns that compounds into wealth disparities over the life cycle.

We begin by documenting the empirical relationship between health shocks and life cycle patterns of stock market participation, portfolio composition, and wealth accumulation. We exploit the panel structure of the Panel Study of Income Dynamics (PSID) and the Health and Retirement Study (HRS) to compare the trajectories of two groups: individuals who experience poor health during their peak earning years (ages 45–55)—our treatment group—and those who consistently report good health over the same period—our control group. This quasi-experimental comparison reveals large and persistent differences in stock market participation and wealth accumulation between treated and control groups. These gaps emerge in midlife and widen continuously toward retirement within education groups. Panel regressions with education fixed effects and controls for income, labor market history, and insurance status confirm that the participation gap is statistically significant and robust to alternative specifications. The extensive margin, the probability of holding any stocks, is the primary margin of response. We do not find strong evidence of differences in risky asset holdings on the intensive margin. Conditional on participation, portfolio shares differ little by health status, suggesting that the key barrier is market entry rather than portfolio rebalancing. Overall, sick individuals experience systematically lower upward mobility throughout the life cycle, indicating that early health shocks have compounding consequences that extend well beyond the period of illness.

These empirical results imply that variation in the timing and severity of health shocks affects access to high-return investments and contributes to the buildup of wealth inequality over time. To interpret these patterns, we develop a heterogeneous-agent life-cycle model with elastic labor supply, endogenous portfolio choice, and idiosyncratic shocks to health status, medical expenditures, health insurance, and investment returns. Households are heterogeneous along four dimensions: education, labor productivity, health status, and health insurance status. In each period, households choose consumption, leisure, and

the allocation of savings between a risk-free bond and a risky equity asset.

Health is a central source of heterogeneity, as it directly shapes age- and health-dependent survival probabilities (health–longevity channel), labor productivity and wage profiles (health–income channel), and out-of-pocket medical expenditures (health–medical expenditure channel). Through these channels, health affects both the resources available to households and the risks they face over the life cycle. These mechanisms have been identified as important sources of inequality in standard single-asset models (e.g., [De Nardi, Pashchenko and Porapakkarm, 2025](#); [Capatina and Keane, 2025](#); [Hosseini, Kopecky and Zhao, 2025](#)).

A novel channel arises in our two-asset model with health shocks and endogenous portfolio choice which we refer to as the health–wealth portfolio channel. It highlights that exposure to health shocks increases background risk and depletes liquidity buffers, strengthening precautionary motives and reducing demand for risky assets. At the same time, limited resources make it more difficult to cover the (health-independent) costs of stock market participation, which vary by education level. The interaction between health shocks, background risk, liquidity constraints and participation cost jointly shapes portfolio decisions. As a result, households in poor health, particularly those with low education and limited wealth, move from high-return risky assets toward safer assets. This generates systematic, health-driven heterogeneity in investment returns that compounds into large wealth disparities over the life cycle.

To assess the quantitative importance of the health–wealth portfolio channel, we discipline the model through a combination of calibration and estimation using U.S. data. The benchmark model replicates key life-cycle moments, including stock market participation, asset holdings, and the distribution of financial wealth, as observed in the PSID and HRS. It also matches profiles of health expenditures and insurance take-up constructed with data from the Medical Expenditure Panel Survey (MEPS). We then use the estimated structural model to quantify the adverse effects of health shocks.

First, we calculate the value of good health by considering several counterfactual scenarios in which individuals unexpectedly enjoy good health during their peak earning years between ages 45–55, akin to the analysis in [De Nardi, Pashchenko and Porapakkarm \(2025\)](#). Our results indicate that remaining in best health during the prime earning years of 45–55 generates an average annual monetary benefit of approximately USD 3,280, accompanied by welfare gains expressed as consumption equivalent variation (CEV) of 9.7, 8.1 and 5.5 percent for low, medium and high skill types, respectively. Importantly, eliminating adverse health states increases stock market participation and subsequently reduces the wealth gap. Specifically, the 90th-to-50th percentile wealth ratio falls by 47 percent, and the 50th-to-25th percentile ratio declines by 13 percent relative to the benchmark. These wealth effects of health shocks align with prior studies such as [Hosseini, Kopecky and Zhao \(2025\)](#) and [De Nardi, Pashchenko and Porapakkarm \(2025\)](#) but are relatively larger in our two-asset model. This confirms that better health enables participation in high-return risky assets, generating endogenous heterogeneity in returns that compounds into large wealth disparities.

In order to isolate the quantitative importance of the health–wealth portfolio channel we decompose its effects by running three counterfactual experiments. In the first we eliminate only bad health shocks from the model, in the second we remove only portfolio choice, and in the third we remove both. By comparing outcomes across these scenarios, we can infer the relative strengths of the health shock vs. asset choice components that make up the health-wealth portfolio channel. More specifically, for the first experiment we assume that all individuals experience excellent health realizations from age 40 until death. In the second scenario, we remove the risky asset from the model so that households can only invest in a single risk-free asset. Finally, we remove both bad health shocks and the risky asset from the model.<sup>1</sup>

Our simulation results show that healthy individuals participate in the stock market earlier, hold riskier portfolios with higher expected returns, and accumulate wealth at a substantially faster pace over the life cycle. By contrast, early exposure to health shocks raises medical expenditures, reduces labor productivity and survival probabilities, and induces sick households to save less and concentrate their wealth holdings in the lower-return risk-free asset. The interaction between compounding returns and health-driven portfolio reallocation amplifies these disparities substantially. This is an effect not operational in single-asset frameworks where all households earn a common rate of return. Importantly, examining each feature of the channel in isolation reveals that neither health risk nor portfolio choice alone can account for the full magnitude of the wealth gap. The interaction between the two is the quantitative signature of the health–wealth portfolio channel.

Finally, we examine whether better access to health insurance can reduce wealth inequality during retirement. We investigate to what extent public health insurance can safeguard the capacity of individuals in poor health to partake in wealth accumulation via risky assets, which in the absence of insurance might be perceived as either too risky or too costly. We therefore simulate an experiment in which the government extends Medicare to all workers, thereby mitigating the financial repercussions of medical shocks. Doing so aligns the healthy and sick types with respect to their financial investment decisions to some extent. Our findings indicate that the expansion of Medicare reduces wealth inequality by inducing more individuals to hold risky assets with higher returns. A similar experiment where we extend private health insurance—such as employer-sponsored health insurance—to all workers show comparable outcomes. The additional welfare benefits generated by the health–wealth channel after expanding health insurance are absent in models without portfolio choice. Our findings underscore the significance of explicitly incorporating the institutional features of the U.S. health insurance system into a more realistic investment environment for a better understanding of the wealth inequality dynamics in the U.S. context. These insights suggest a new role of health insurance in insuring against non-health risks, including labor productivity and investment risks, and that health insurance reforms could play an important role in

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<sup>1</sup>The single-asset model with health risk from our second scenario is comparable to the frameworks in prior studies (e.g., De Nardi, French and Jones, 2010; Hosseini, Kopecky and Zhao, 2025; Capatina and Keane, 2025).

reducing wealth inequality in the U.S.

Our paper is organized as follows. Section 2 provides empirical evidence on the relationship between health and wealth accumulation. Section 3 presents the quantitative model. Section 4 describes our calibration and estimation strategy. Section 5 describes our experiments and quantitative results. Section 6 presents extensions. Section 7 concludes. The Appendix provides more details about the empirical results, calibration details and simulation results.<sup>2</sup>

**Related literature.** Our paper contributes to the growing macro-health literature that studies the relationships between health and inequality. Existing studies have predominantly focused on medical expenditures, access to health insurance (e.g., De Nardi, French and Jones, 2010; Prados, 2018; Jung and Tran, 2022; Nakajima and Telyukova, 2024; Chen, Feng and Gu, 2025), the effect of health on labor productivity and labor supply (Hosseini, Kopecky and Zhao, 2025), the role of lifestyle behaviors (Mahler and Yum, 2024), and medical treatment (Capatina and Keane, 2025). In contrast, our study identifies a new channel—the health-wealth portfolio channel—which amplifies the effect of health shocks on wealth concentration, primarily via health-induced variations in the rates of return on wealth. Furthermore, our work bridges the macro-health literature with research emphasizing the contribution of heterogeneous investment returns in driving wealth inequality (e.g., Benhabib, Bisin and Zhu, 2015; Gabaix et al., 2016; Benhabib, Bisin and Luo, 2019). Arguably, the rates of return of financial investments are driven by numerous factors including exogenous shocks, ability, knowledge, etc. Bach, Calvet and Sodini (2020) and Fagereng, Guiso, Malacrino and Pistaferri (2020) provide evidence of substantial heterogeneity in individual returns to wealth. Lusardi, Michaud and Mitchell (2017) build a structural model and demonstrate that heterogeneity in the rate of return of wealth portfolios is driven by endogenous differences in financial knowledge. In our framework, the rate of return is stochastic and endogenously determined by exposure to health shocks, access to health insurance and investment portfolio choices. We demonstrate that the heterogeneity in the rate of return is strongly influenced by the health-wealth portfolio channel which can account for 47 percent of the wealth gap observed in retirement. Most closely related is Daminato and Pistaferri (2024), who show that ex-ante ability heterogeneity accounts for part of the health–wealth gradient. Our approach is complementary as we allow for permanent heterogeneity through education-group differences in participation costs and earnings capacity.

Moreover, our paper aligns with the household finance and life cycle portfolio choice literature that originates with Samuelson (1969) and Merton (1971). Recent surveys of the theoretical and empirical household finance literature are provided in Gomes (2020) and Gomes, Haliassos and Ramadorai (2021), respectively. The composition of household savings portfolios is widely studied. While some papers identify a positive effect of wealth on the proportion of risky assets (i.e., stocks) held by a household (Wachter and Yogo, 2010), other studies find that wealth changes have only minor effects

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<sup>2</sup>A Supplementary Online Appendix is available from the authors' website and provides additional information about the data sources, empirical analysis and computational methods.

on the portfolio composition due to inertia (Brunnermeier and Nagel, 2008). Additional channels have been highlighted such as stock market entry/adjustment costs (Alan, 2006; Bonaparte, Cooper and Zhu, 2012; Fagereng, Gottlieb and Guiso, 2017), education (Cocco, Gomes and Maenhout, 2005; Ehrlich, Hamlen and Yin, 2008; Cooper and Zhu, 2016), unemployment (Bagliano, Fugazza and Nicodano, 2014; Bagliano, Fugazza and Nicodano, 2019), the introduction of the Pension Protection Act of 2006 (Parker, Schoar, Cole and Simester, 2022), the availability of reverse mortgages (Nakajima and Telyukova, 2017), and the cyclical nature of the skewness of income shocks (Catherine, 2022). We extend this literature by highlighting health as a pivotal determinant of portfolio choices and asset composition throughout the life cycle.

Our paper is also related to studies based on estimated structural life cycle models of portfolio choice and retirement (Yogo, 2016; Fagereng, Gottlieb and Guiso, 2017; Gomes and Smirnova, 2021). Yogo (2016) investigates the role of health, housing, and the investment portfolio composition of the retired. Campanale, Fugazza and Gomes (2015) and Tischbirek (2019) use a calibrated life cycle models to investigate the effects of liquidity costs of stocks and long-term bonds on household investment decisions. Distinguishing our approach from these life cycle models is our particular emphasis on the significance of accounting for health shocks occurring at younger ages as a pivotal factor in comprehending the composition of wealth portfolios and wealth gaps in retirement.

Lastly, our study relates to an empirical literature that investigates how health-related factors shape the wealth portfolio of households. For instance, Goldman and Maestas (2013) and Ayyagari and He (2016) offer insights into how spending and health insurance has affected the portfolio choice of the elderly. Rosen and Wu (2004), Edwards (2008), Bressan, Pace and Pelizzon (2014) and Böckerman, Conlin and Svento (2021) provide empirical evidence showing that realization of poor health lowers the probability of holding assets in the form of risky stocks. While observing similar contemporaneous effects in the HRS and PSID samples, we focus on the dynamic and long-term effects of poor health on portfolio composition and, by extension, on wealth accumulation over the life cycle. Our contribution goes beyond the mere presentation of empirical observations; instead, we construct a structural framework capable of identifying the intricate relationship between health, portfolio choice and wealth inequality.

## **2 Health and wealth portfolio channel: Empirical evidence**

In this section we document empirical patterns describing the long-run relationship between health status and the asset composition of wealth portfolios at retirement age.

## 2.1 Data and construction of variables

**Data.** The Health and Retirement Study (RAND-HRS) is a longitudinal survey that collects data every two years and is available from 1992–2018. New cohorts were added regularly since 1992. We use all 14 waves of available HRS data in this study. The Panel Study of Income Dynamics (PSID) is a longitudinal survey that collects data annually from 1968–1997 and biennially since then. Wealth data was first available for the years 1984, 1989, 1994 and biennially from 1999 onward. We also limit the sample to heads of households and to the age group of 40–80 year olds and exclude the Latino sample. We only include head of households for whom we have wealth information when they are between 40–80 and health information when they were between 40–55.

**Wealth measures.** The HRS measures wealth in 20 components at the household level including holdings in checking/savings accounts, CDs, bonds, T-bills, stocks, mutual funds, and IRA/Keogh accounts which provides a good snapshot of a household’s asset portfolio. We collapse financial assets into two classes: (i) the safe assets (checking and savings accounts, money market funds, CDs, government savings bonds, T-bills, corporate, municipal and foreign bonds, as well as bond funds) and (ii) risky assets (stocks and mutual funds). The HRS also reports household holdings in retirement accounts such as IRAs and Keogh plans and separately individuals report balances of their (and their spouse’s) defined contribution pension plans such as 401(k) plans. Unfortunately, the HRS does not report what kinds of assets are held in these retirement accounts. We follow the procedure in Tischbirek (2019) who uses data from the Employee Benefit Research Institute (EBRI) and attributes 45.8 percent of funds held in IRAs to stocks and similarly data from Agnew, Balduzzi and Sundén (2003) to assign 41 percent of funds in defined contribution pension plans to stocks.<sup>3</sup> PSID wealth data has similar information but do not contain information about assets in defined contribution plans such as 401(k)s. On the plus side, it is a deeper panel with wealth data from year 1984 which is also representative for individuals in their 40s.

**Health measures.** Both surveys contain health status information that is self reported and recorded as either (i) excellent, (ii) very good, (iii) good, (iv) fair, or (v) poor or as a binary variable indicating whether an individual has a work limiting health problem. If health state information is missing we interpolate health measures with health state information in the previous and next round of the interview. We use these health status variables and construct an indicator variable BAD-HEALTH that is set to equal one if an individual ever reports of being in either “fair” or “poor” health between the ages 45–55.

## 2.2 Stylized facts

We next highlight the empirical connections between health status and wealth portfolio over the life cycle.

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<sup>3</sup>The data in Agnew, Balduzzi and Sundén (2003) only considers 401(k) accounts. See Copeland and Fronstin (2011) for details on IRA holdings available at <https://www.ebri.org/content/'ira-asset-allocation'-and-'characteristics-of-the-cdhp-population-2005-2010'-4823>

**Savings, stock market participation and risky asset holdings by current health status.** Figure 1 shows the age profiles of average holdings of both safe and risky assets by current health status where healthy indicates a health status of either excellent, very good, or good and sick indicates a health status of either fair or poor. There are small differences in asset holdings/wealth by current health status in the early 40s. However, the wealth gap by health status subsequently widens after age 45, increases strongly until retirement time, and then remains relatively stable past age 70. The life cycle patterns of risky asset holdings follow a similar trend, with sick individuals holding substantially fewer risky assets.

Figure 2 shows age profiles of stock market participation by education and health status. It is well-established in the household finance literature that stock market participation is limited across ages and positively correlated with human capital. We observe a similar pattern in Figure 2 with substantially higher participation rates among more educated individuals—approximately 60, 40, and 20 percent for those with college, high school, and no high school education, respectively. The life cycle pattern of stock market participation for healthy individuals exhibits a hump shape, while that for sick individuals increases modestly with age. Importantly, conditional on education level, individuals in poor health are about 50 percent less likely to participate in the stock market than those in good health. This suggests that, holding other factors constant, health status is a strong determinant of whether individuals invest in risky assets.

**The long-term effects of health over the life cycle.** Figure 3a shows the age profiles of unconditional and conditional averages of asset holdings by health status at age 45–55. Similarly, we observe a persistent gap in asset holdings between healthy and sick types. This suggests that differences in risky asset holdings in later ages are strongly driven by health shocks occurring between ages 45 and 55.<sup>4</sup>

To better isolate the long-term effects of poor health over the life cycle we focus on a sample of individuals who report no bad health between 40–44 and follow them to the end of the life cycle. In this sample we also distinguish between two groups based on health status between ages 45–55: a treatment group—individuals who experienced poor health during this period, and a control group—those who remained healthy. Figure 3b shows the age profiles of unconditional and conditional averages of asset holdings by health status at age 45–55 of this subsample. Even when controlling for health status at 40–44 by only tracking individuals who were healthy, we still observe very similar risky asset profiles. This fact suggests that differences in the timing and realization of health shocks are important for the gap in asset accumulation over the life cycle.

**Regression results.** To confirm the descriptive results, we estimate the effects of bad health at age 45–55 on the level and composition of the wealth portfolios individuals at ages 60–70. We propose the following model

$$y_{it} = \beta + \gamma \times 1_{\{\text{Sick } 45-55, i\}} + \delta \times Z_{it} + \varepsilon_{it},$$

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<sup>4</sup>We observe similar trends in HRS data.

where  $y_{it}$  is the share of the value of stocks in the financial portfolio at ages 60–70,  $1_{\{\text{Sick } 45-55, i\}}$  is an indicator for being in bad health in at least one survey wave between the ages of 45–55, and  $Z_{it}$  is a vector of exogenous control variables including employment, health, health insurance, marital status, gender race, education, income and wealth. Finally,  $\varepsilon_{it}$  is a random error term. We also interact the sick indicator variable with a lagged unemployment indicator and a lagged uninsured indicator variable to highlight possible pathways of poor health and its effect on the wealth accumulation.

Table 1 reports the results of these regressions for the sick indicator variable using data from the PSID. Column (1) shows that being sick (in at least one wave) between ages 45–55 results in significantly lower share of asset holdings at the point of retirement when the individuals are between 60–70 years old. Column (2) uses weighted data, column (3) estimates a random effects model, column (4) is a random effects model on a smaller sample that only includes individuals that have positive stock holdings, and column (5) uses again population weights on this smaller sample of stock investors. Our regression results confirm that being exposed to poor health at ages 45–55 has a significant and negative effect on the level of stock holdings of 60–70 year old individuals. However, the effect vanishes once we concentrate on the smaller samples of stock holders. This implies that the health effect primarily works through the extensive margin and not the intensive margin.<sup>5</sup>

### 3 Life cycle model

In this section, we develop a stochastic life cycle model with portfolio choice and idiosyncratic shocks to labor productivity and investment returns, similar to [Cocco, Gomes and Maenhout \(2005\)](#) and [Gomes and Michaelides \(2005\)](#), and extend it to incorporate health and idiosyncratic shocks to health status, medical expenditures, and health insurance status, which generate substantial uninsured health-related risk over the life cycle. Labor supply is elastic, allowing households to partially insure against health and income shocks through labor adjustment in addition to saving and portfolio rebalancing. These features enable the model to capture the dynamic interaction between nonhealth- and health-related risks, insurance arrangements, and life cycle portfolio and labor supply decisions.

#### 3.1 Demographics

Individuals enter the model in period  $j = 1$  (age 40), works until period  $j = J_w$  (age 65), and lives in retirement up to a maximum age of  $J$  (age 94). In each period individuals of age  $j$  face an exogenous survival probability  $\pi_j(\varepsilon^h)$  that depends on their exogenous health state  $\varepsilon^h$ . Due to the mortality risk, individuals will leave accidental bequests.

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<sup>5</sup>Appendix C shows estimation results from two-part and selection model specifications that both confirm these results.

## 3.2 Preferences

The period utility function  $u(c_j, \ell_j; \omega_{j,\vartheta}; \bar{n}_j(\vartheta, \varepsilon^h); \bar{u})$  depends on consumption ( $c$ ), leisure ( $\ell$ ), and labor-force participation status which is only equal to one if labor supply is positive. The parameter  $\omega_{j,\vartheta}$  is an equivalence scale capturing changes in household size by age  $j$  and permanent income type  $\vartheta$  while  $\bar{n}_j(\vartheta, \varepsilon^h)$  denotes the fixed cost of working which depends on age, income type, and health status. The additive constant  $\bar{u} > 0$  ensures that the continuation value of being alive exceeds the utility from dying. Individuals value leaving bequests via function  $u^{\text{beq}}(\vartheta, W_j)$  which is increasing in wealth  $W_j$  and depends on the permanent income type. Individuals use a fixed time discount factor  $\beta(\vartheta, \varepsilon^h)$  that depends on education and health to discount future periods.

## 3.3 Health status, health expenditure, and health insurance

The individual's health status  $\varepsilon_j^h$  evolves exogenously over the life cycle and follows a Markov process that depends on age and the permanent income group so that conditional transition probabilities are elements of matrix  $\Pi^h(j, \vartheta)$ . A specific level of health expenditures  $m(j, \vartheta, \varepsilon_j^h)$  is linked to health status and fluctuates accordingly. In addition, the permanent income type and age also affect health expenditures.<sup>6</sup>

For working age households the exogenous private health insurance state  $\varepsilon_{j,\vartheta}^{\text{ehi}}$  is defined as  $\varepsilon_{j,\vartheta}^{\text{ehi}} = 0$  if not privately insured, = 1 otherwise for  $j \leq J_w$ . It depends on age and the permanent skill type and follows a Markov switching process with age and skill type dependent transition probability matrix  $\Pi_{j,\vartheta}^{\text{ehi}}$ . Transition probabilities to next period's insurance state  $\varepsilon_{j+1,\vartheta}^{\text{ehi}}$  depend on the current insurance state  $\varepsilon_{j,\vartheta}^{\text{ehi}}$  so that an element of the transition matrix  $\Pi_{j,\vartheta}^{\text{ehi}}$  is the conditional probability  $P(\varepsilon_{j+1,\vartheta}^{\text{ehi}} | \varepsilon_{j,\vartheta}^{\text{ehi}})$ . The health insurance state evolves exogenously. If the household ends up with private insurance, the household only pays a fraction  $\gamma^{\text{ns}}$  of her medical expenses in addition to a premium  $\text{prem}_j^{\text{ehi}}$  which is paid at the beginning of the period. Finally, households will have Medicare once they reach retirement age  $J_w + 1$ . The Medicare coinsurance rate is  $\gamma^{\text{mcare}}$  and households will also pay Medicare Plan B premiums  $\text{prem}^{\text{mcare}}$  at the beginning of each period.

In addition, households can qualify for Medicaid insurance if they pass the Medicaid income and asset test. The Medicaid coinsurance rate is  $\gamma^{\text{maid}}$ . There is no Medicaid premium. The indicator variable for Medicaid  $1_{[\text{maid-yes}]}$  equals one if adjusted gross income is less than the earnings threshold  $y_j^{\text{agi}} < y_j^{\text{maid}}$  and the asset holdings are below the asset threshold  $a_j < a_j^{\text{maid}}$  and zero otherwise. We assume that individuals that qualify for Medicaid will use it as either their primary insurance (if they have not other insurance) or as secondary insurance in case they already have either private insurance or Medicare.

The out-of-pocket medical expenditures therefore depend on the exogenous insurance state (i.e., pri-

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<sup>6</sup>We undertake a similar approach to modeling health as in De Nardi, French and Jones (2010), Hosseini, Kopeccky and Zhao (2025) and De Nardi, Pashchenko and Porapakkarm (2025).

vate health insurance or Medicare) as well as the income/asset eligibility for Medicaid. We summarize out-of-pocket medical expenditures as  $o_j(m_j, \varepsilon_{j,\vartheta}^{\text{ehi}}, y_j^{\text{agi}}, a_j) = \gamma^i \times m(j, \vartheta, \varepsilon_j^h)$ , where  $\gamma^i$  is the corresponding health insurance policy's coinsurance rate.

### 3.4 Endowments

In each period households are endowed with one unit of time that can be used for work  $\ell$  or leisure. Conditional on labor force participation, a household earns before-tax wage income  $y_j = w \times e_j(\vartheta, \varepsilon^{\text{incP}}, \varepsilon^h) \times n_j$  at age  $j$ , where  $w$  is the wage rate, and  $e_j$  is a labor productivity endowment that depends on age  $j$ , a permanent income group  $\vartheta$ , an idiosyncratic persistent productivity shock  $\varepsilon^{\text{incP}}$ , and idiosyncratic health state  $\varepsilon^h$ . Labor shocks follow a Markov process with transition probability matrix  $\Pi^{\text{incP}}(j, \vartheta)$ .

### 3.5 Financial markets

The household can invest in two types of assets: a risk-free bond  $b$  which pays a fixed real return of  $r^b$  and a risky asset which pays a stochastic real return of  $\tilde{r}^s$ . Similar to [Gomes, Michaelides and Polkovnichenko \(2009\)](#) asset returns are taxed and taxes are paid on nominal returns. The nominal returns are taxed at rate  $\tau_d$ . Assuming a constant rate of inflation  $\pi$ , the after-tax real returns on the risk free assets are  $\tilde{r}_{\text{net}}^b = \frac{1 + [(r^b + 1)(1 + \pi) - 1](1 - \tau^d)}{1 + \pi} - 1$ . The risky stock  $s$  pays a real return of  $\tilde{r}^s = r^b + \mu^s + \varepsilon^s$ , where  $\mu^s > 0$  is a risk premium and  $\varepsilon^s$  is a stochastic rate of return and follows  $\varepsilon^s \sim N(0, \sigma_{\varepsilon^s}^2)$ . We assume that this random return comprises a constant nominal dividend yield  $d$  and a stochastic nominal capital gain  $\tilde{g}$ , deflated by the inflation rate  $\pi$  as  $\tilde{r}^s = \frac{1 + \tilde{g} + d}{1 + \pi} - 1$ . We can back out the stochastic capital gain  $\tilde{g}$ . Asset return taxes are paid on nominal returns at two different rates,  $\tau_g$  is the capital gains tax and  $\tau_d$  is the dividends tax. Assuming a constant rate of inflation  $\pi$ , the after-tax real return of the risky asset is:  $\tilde{r}_{\text{net}}^s = \frac{1 + \tilde{g}(1 - \tau^g) + d(1 - \tau^d)}{1 + \pi} - 1$ . Workers save for insuring themselves against shocks to income, health expenditure shocks, uncertainty related to their health insurance status, and for retirement. We allow workers to borrow using the risk-free bond with a borrowing limit so that  $b_{j+1} \geq \underline{b}$  and stock holdings cannot be negative  $s_{j+1} \geq 0$ . When households trade in the risky asset they incur a fixed transaction cost  $q_j(\vartheta)$  that can vary by age and permanent education status. The transaction cost is broadly defined to capture not only direct monetary costs but also non-monetary costs, such as the effort involved in portfolio management which can be shaped by household characteristics such as age and education ([Khorunzhina, 2013](#)).

### 3.6 Taxes and transfers

The government collects the following taxes: a progressive labor income tax on taxable income  $y_j^{\text{tax}}$  denoted  $\text{tax}^y(y_j^{\text{tax}})$ , payroll taxes  $\text{tax}^{\text{ss}}(y_j^{\text{ss}}; \bar{y}^{\text{ss}})$  and  $\text{tax}^{\text{mcare}}(y_j^{\text{ss}})$  for Social Security and Medicare re-

spectively collected on eligible labor income  $y_j^{ss}$ , and a consumption tax  $\tau^c$ . Payroll tax eligible labor income  $y_j^{ss}$  is essentially labor income minus employer HI premiums which are income and payroll tax deductible. In addition, the payroll tax for Social Security is proportional only up to the maximum taxable earnings of  $\bar{y}^{ss}$ . With these tax revenues, the government runs the following spending programs: Social Security, Medicare, Medicaid, lump-sum transfers  $tr_j^{si}$  to low income earners that guarantee a minimum consumption level  $c_{\min}$ , and residual (unproductive) government consumption. Households receive Social Security benefits  $tr_j^{ss}(\bar{y}^\vartheta)$  after the eligibility age ( $j > J_w$ ). The amount of benefits paid depends on the average earnings history of a permanent income type  $\bar{y}^\vartheta$ . In addition, households become eligible for Medicare after age  $j > J_w$  at which point they also start paying a Medicare premium  $prem^{mcare}$  every period. Households with sufficiently low income qualify are eligible for a transfer that guarantees a minimum consumption level  $c_{\min}$ . Households are eligible for Medicaid payments if they pass the income and asset tests  $y_j < \bar{y}^{maid}$  and  $a_j < \bar{a}^{maid}$ , respectively. Similar to [Hubbard, Skinner and Zeldes \(1995\)](#), low-skill and sick households in our model have an incentive to accumulate less assets to maintain eligibility for means-tested Medicaid. Finally, we assume that Social Security, Medicare, and Medicaid are part of the overall budget constraint.

### 3.7 Household optimization problem

Following [Campanale, Fugazza and Gomes \(2015\)](#) we cast the problem of stock and bond state variables into an equivalent variable pair consisting of current wealth  $a$  and current share  $\alpha$  invested in stock. This method allows us to reduce the state space as  $\alpha$  is simply a choice variable and does not need to be tracked over time.

**Working households.** The state vector of the working household is

$$x_j = \left\{ \vartheta, a_j, \varepsilon_j^{\text{incP}}, \varepsilon_j^h, \varepsilon_j^{\text{ehi}} \right\} \in \{1, 2, 3\} \times \mathbb{R} \times \{1, 2, 3, 4, 5\} \times \{1, 2, 3, 4, 5\} \times \{0, 1\},$$

where  $\vartheta$  denotes the permanent income group,  $a_j$  denotes current wealth,  $\varepsilon_j^{\text{incP}}$  denotes the labor productivity shock,  $\varepsilon_j^h$  denotes the exogenous health state, and  $\varepsilon_j^{\text{ehi}}$  is the private insurance state. After the realization of the state variables, agents simultaneously choose from their choice set

$$\mathcal{C}_j \equiv \left\{ (c_j, \ell_j, \alpha_j) \in \mathbb{R}^{++} \times [0, 1] \times [0, 1] \right\},$$

where  $c_j$  is consumption,  $\ell_j$  is leisure and  $\alpha_j$  is the fraction of stock holdings in the investment portfolio for the next period in order to maximize their lifetime expected utility. All choice variables in the optimization problem are functions of the state vector but we suppress this notation in order to not clutter the

exposition. The household problem of the working household can be recursively written as

$$V(x_j) = \max_{\mathcal{E}_j} \left\{ u(c_j, \ell_j) + \beta(\vartheta, \varepsilon^h) \mathbb{E} \left[ \pi_j(\varepsilon_j^h) V(x_{j+1}) + (1 - \pi_j(\varepsilon_j^h)) u^{\text{beq}}(\vartheta, a_{j+1}) \right] \right\} \quad (1)$$

s.t.

$$a_{j+1} = \tilde{R}_{j+1} \left( a_j + y_j(\ell_j, \vartheta, \varepsilon_j^h, \varepsilon_j^{\text{incP}}) + \text{tr}_j^{\text{si}} - o_j(m_j, \varepsilon_{j,\vartheta}^{\text{ehi}}, y_j^{\text{agi}}, a_j) - 1_{[\varepsilon_j^{\text{ehi}}=1]} \text{prem}_j^{\text{ehi}} - \text{tax}_j - (1 + \tau^c) c_j - 1_{[\alpha_j > 0]} q_j(\vartheta) \right),$$

$\underline{b} \leq b_{j+1}$ ,  $0 \leq s_{j+1}$  and  $\tilde{R}_{j+1} = \alpha_j (1 + \tilde{r}_{\text{net},j+1}^s) + (1 - \alpha_j) (1 + \tilde{r}_{\text{net}}^b)$ . Parameter  $\beta(\vartheta, \varepsilon^h)$  is a time preference factor that depends on education and health,  $\pi_j(\varepsilon^h)$  is the age and health state dependent survival probability,  $r$  is the interest rate,  $o(m_j)$  is out-of-pocket medical spending, and  $\text{prem}^{\text{ehi}}$  is the insurance premium paid. The indicator functions are defined as  $1_{[\text{true}]} = 1$  and  $1_{[\text{false}]} = 0$ . Labor income  $y_j$ , payroll tax eligible income  $y_j^{\text{ss}}$ , and total taxable income  $y_j^{\text{tax}}$  are defined as  $y_j = \hat{w} \times e_j(\vartheta, \varepsilon_j^{\text{incP}}, \varepsilon^h) \times (1 - \ell_j)$ ,  $y_j^{\text{ss}} = y_j - 1_{[\varepsilon_j^{\text{ehi}}=1]} \text{prem}_j^{\text{ehi}}$ , and

$$y_j^{\text{tax}} = \left( \max \left[ 0, o_j(m_j, \varepsilon_{j,\vartheta}^{\text{ehi}}, y_j^{\text{agi}}, a_j) - 0.075 \times (y_j + r_b \times b_j + r_s \times s_j) \right], y_j - 1_{[\varepsilon_j^{\text{ehi}}=1]} \text{prem}_j^{\text{ehi}} - \right), \quad (2)$$

where private HI premiums are tax deductible as are out-of-pocket health expenses that exceed 7.5 percent of adjusted gross income. For simplicity we assume that, adjusted gross income  $y_j^{\text{agi}}$  is equal to earnings  $y_j$  as we do not explicitly model many of the additional income categories—such as cancellation of debt, stock options, etc. or deductible categories such as educator expenses, IRA deductions, student loan deductions, etc.—that enter the calculation of adjusted gross income.

Consumption is taxed with rate  $\tau^c$  and the remaining taxes are defined as  $\text{tax}_j = \text{tax}^y(y_j^{\text{tax}}) + \text{tax}^{\text{ss}}(y_j^{\text{ss}}; \bar{y}^{\text{ss}}) + \tau^{\text{mcare}} \times y_j^{\text{ss}}$ , where  $\text{tax}^y$  is a progressive income tax function of taxable household income  $y_j^{\text{tax}}$ ,  $\tau^{\text{ss}}$  is the social security payroll tax levied on “social security wages”—essentially wages minus GHI premiums—and an upper contribution limit of  $\bar{y}^{\text{ss}}$ , and  $\text{tax}^{\text{mcare}}$  is a Medicare payroll function with the same tax base but without an upper limit. Social transfers are defined as  $\text{tr}_j^{\text{si}} = \max \left[ 0, c_{\text{min}} + o(m_j) - y_j^{\text{at}} - a_j \right]$ , where  $y_j^{\text{at}} = y_j - \text{tax}_j$ , and ensure a minimum consumption floor  $c_{\text{min}}$  after medical expenses and taxes are paid for. A household consuming at the lower bound cannot save into the next period or purchase private insurance. Average past labor earnings for each permanent income group  $\vartheta$  follow  $\bar{y}^\vartheta = \int_{j \leq J_w} y_j(x(\vartheta)) d\Lambda(x(\vartheta))$  where  $x(\vartheta)$  is the mass of households belonging to permanent income group  $\vartheta$ .

**Fully retired households.** Households stop working at age 65, or  $j > J_w$ . They then receive Social Security benefits and qualify for Medicare starting. The state vector of a retired household at a particular age is defined as  $x_j = \left\{ \vartheta, a_j, \varepsilon_j^h \right\} \in \{1, 2, 3\} \times R \times \{1, 2, 3, 4, 5\}$ . The household optimization problem

reduces to

$$V(x_j) = \max_{\{c_j, \alpha_j\}} \left\{ u(c_j) + \beta \left( \vartheta, \varepsilon^h \right) \mathbb{E} \left[ \pi_j \left( \varepsilon_j^h \right) V(x_{j+1}) + \left( 1 - \pi_j \left( \varepsilon_j^h \right) \right) u^{\text{beq}} \left( \vartheta, a_{j+1} \right) \right] \right\} \quad (3)$$

s.t.

$$a_{j+1} = \tilde{R}_{j+1} \left( \begin{array}{c} a_j + \text{tr}_j^{\text{ss}} \left( \bar{y}^\vartheta \right) + \text{tr}_j^{\text{si}} - o_j \left( m_j, \varepsilon_{j,\vartheta}^{\text{ehi}}, y_j^{\text{agi}}, a_j \right) - \text{prem}^{\text{mcare}} \\ - \text{tax}^y \left( y_j^{\text{tax}} \right) - \left( 1 + \tau^c \right) c_j - 1_{[\alpha_j > 0]} q_j \left( \vartheta \right) \end{array} \right), \quad (4)$$

$\underline{b} \leq b_{j+1}$ , and  $0 \leq s_{j+1}$ . Taxable income  $y_j^{\text{tax}}$  is defined as

$$y_j^{\text{tax}} = \text{tr}_j^{\text{ss}} \left( \bar{y}^\vartheta \right) - \max \left[ 0, \left( o_j \left( m_j \right) + \text{prem}^{\text{mcare}} \right) - 0.075 \times \left( r_b \times b_j + r_s \times s_j + \text{tr}_j^{\text{ss}} \right) \right].$$

For retirees out-of-pocket expenses plus Medicare premiums that exceed 7.5 percent of gross income are tax deductible. Social insurance transfers are defined as

$$\text{tr}_j^{\text{si}} = \max \left[ 0, c_{\min} + o_j \left( m_j \right) + \text{prem}^{\text{mcare}} + \text{tax}^y \left( y_j^{\text{tax}} \right) - a_j - \text{tr}_j^{\text{ss}} \right].$$

Since all retirees are assumed to have access to a combined Medicare–Medicaid program, social insurance transfers include the Medicare premium.

## 4 Mapping the model to data

In this section we follow a mixed calibration and estimation procedure to map the model to data. In the first step, we pick parameter values by either using established estimates from the previous literature or estimating them directly from the data. These calibrated parameters include medical expense shocks, health state transition matrices, productivity profiles, labor market shocks, risky asset return shocks, and survival probabilities. In the second step, we calibrate the parameters governing government taxes and transfers, including the tax scaling parameter, thresholds for Medicaid asset and income tests, and the consumption floor. Finally, we use a moment matching method to estimate the remaining parameters, including the fixed cost of work by skill and health state, time preference parameters, the weight on consumption, the strength of the bequest motive, and stock market participation costs by skill and health status.

### 4.1 External parameters

We first describe the set of external parameters that are estimated in previous studies outside our model and report them in Table 3.

### 4.1.1 Demographics and preferences

One model period is defined as one year. Households have a life span from age 40 to age 94 which results in  $J = 55$  periods. Once the individual enters age 65, i.e., period  $J_{w+1} = 26$ , she is forced to retire. We take the age and health specific survival probabilities from [İmrohoroğlu and Kitao \(2012\)](#). For the purpose of survival probabilities  $\pi(h(\varepsilon^h))$  we distinguish between healthy and sick individuals where

$$h(\varepsilon^h) = \begin{cases} \text{healthy} & \text{if } \varepsilon^h \in \{\text{excellent, very good, good}\}, \\ \text{sick} & \text{if } \varepsilon^h \in \{\text{fair, poor}\}. \end{cases}$$

These are standard definitions for healthy and sick in the health macro literature. We specify period utility as

$$u(c_j, \ell_j) = \frac{\left( \left( \frac{c_j}{\omega_{j,\vartheta}} \right)^\eta \times \left[ \ell_j - 1_{[0 < n_j]} \times \bar{n}_j(\vartheta, h(\varepsilon^h)) \right]^{1-\eta} \right)^{1-\sigma}}{1-\sigma} + \bar{u}.$$

The equivalence weight is calculated using data from the HRS as  $\omega_{j,\vartheta} = (\text{adults}_j + 0.7 \times \text{children}_j)^{0.7}$  following [Scholz, Seshadri and Khitatrakun \(2006\)](#), where  $\text{adults}_j$  and  $\text{children}_j$  are the number of adults and children (respectively) in the household associated with a household head of age  $j$ . We set the relative risk aversion parameter  $\sigma$  to 3. The warm-glow bequest function is  $u^{\text{beq}}(\vartheta, a) = \theta_1(\vartheta) \times \frac{(a + \theta_2)^{(1-\sigma)\eta}}{1-\sigma}$ , where parameter  $\theta_1(\vartheta)$  determines the strength of the bequest motive which depends on education, while parameter  $\theta_2$  is the threshold of wealth at which a household finds it valuable to leave a bequest. Similar to [French \(2005\)](#) we set the bequest parameter  $\theta_2$  to 500,000.<sup>7</sup> The remaining preference parameters  $\eta$ ,  $\theta_1(\vartheta)$ ,  $\beta(\vartheta, h(\varepsilon^h))$ , and  $\bar{n}_j(\vartheta, h(\varepsilon^h)) = \delta_{\ell,\vartheta,1} + \delta_{\ell,\vartheta,2}j$  will be estimated from within the model as described in Section 4.3.

### 4.1.2 Health status, health expenditures, and private health insurance

We use data from MEPS 1996–2018 to estimate the magnitude of the age dependent health expenditure shocks  $m(j, \vartheta, \varepsilon^h)$  as well as the Markov transition probability matrix  $\Pr(\varepsilon_{j+1}^h | \varepsilon_j^h)$ . We group individuals into five health groups  $\varepsilon^h \in \{1, 2, 3, 4, 5\}$  by self-reported health status: 1. excellent health, 2. very good health, 3. good health, 4. fair health, and 5. poor health. We then calculate average medical spending of each health group by age and education level to determine the magnitude of the health spending shocks  $m(j, \vartheta, \varepsilon^h)$ . Since MEPS only accounts for about 65–70 percent of health care spending in the national accounts (compare [Sing, Banthing, Selden, Cowan and Keehan \(2006\)](#) and [Bernard, Cowan, Selden, Cai, Catling and Heffler \(2012\)](#)) we scale up the medical spending profiles for individuals older

<sup>7</sup>This functional form is similar to the one in [French \(2005\)](#). This warm-glow type bequest motive was first introduced by [Andreoni \(1989\)](#) and used in a general equilibrium model in [De Nardi \(2004\)](#). A more sophisticated form of altruism would require an additional state variable and increase the computational complexity.

than 65 similar to [Pashchenko and Porapakarm \(2013\)](#). The resulting spending profiles are shown in Panels [1]–[3] of [Figure D.1](#). Next, we estimate an ordered logit model to determine the conditional probability of moving to a specific health group  $\varepsilon_{j+1,t+1}^h$  in year  $t + 1$  conditional on being a member of health group  $\varepsilon_{j,t}^h$  at time  $t$  and age  $j$  using a fourth order age polynomial.<sup>8</sup> Finally, we use MEPS 1996–2018 data and estimate that the fraction of 40 year old households with private health insurance,  $\varepsilon_j^{\text{chi}} = 1$  is 75 percent.

### 4.1.3 Endowments

To calibrate the labor income process, we first assume that labor productivity at age  $j$  can be decomposed as  $e_j(\vartheta, \varepsilon^h, \varepsilon^{\text{incP}}) = \bar{e}_j(\vartheta, h(\varepsilon^h)) \times \varepsilon^{\text{incP}}$ , where  $\bar{e}_j(\vartheta, h(\varepsilon^h))$  depends on age  $j$ , education level  $\vartheta$ , and health state  $\varepsilon^h$ . The education level is permanent and fixed at age 40. Using 1996–2018 MEPS data we construct cohort adjusted and bias corrected wage profiles for each education-health subgroup  $(\vartheta, h(\varepsilon^h))$  limiting the sample to heads of households with labor incomes larger than \$400. We distinguish between three permanent educational groups:  $\vartheta = 1$  less than high school,  $\vartheta = 2$  if high school and  $\vartheta = 3$  if college graduate or higher, and two health states: {healthy, sick}. We deflate hourly wage observations with the urban CPI and remove cohort effects. We then follow the procedure in [Rupert and Zanella \(2015\)](#) and [Casanova \(2013\)](#) and estimate a selection model to remove the selection bias that is typically associated with wage observations to get an average wage offer rate for each  $(\vartheta, h(\varepsilon^h))$  subgroup. We finally smooth the wage profiles with a second degree polynomial in age.<sup>9</sup> The income shock component is modeled as an auto-regressive process so that  $\ln(\varepsilon_j^{\text{incP}}) = \rho \times \ln(\varepsilon_{j-1}^{\text{incP}}) + \varepsilon$ , with persistence parameter  $\rho$  and a white-noise disturbance  $\varepsilon \sim N(0, \sigma_{\varepsilon^{\text{incP}}}^2)$ . To calibrate the stochastic component  $\varepsilon^n$ , we use  $\rho = 0.977$  and  $\sigma_{\varepsilon^{\text{incP}}}^2 = 0.0141$  based on estimates in [French \(2005\)](#) who uses PSID data and controls for cohort effects and health states. We approximate the joint distribution of the persistent and transitory shocks using a five-state first-order discrete Markov process following [Tauchen and Hussey \(1991\)](#). Initial asset holdings are based on wealth holdings of individuals between ages 40–44 in the HRS and include all assets except for housing and real estate wealth as discussed in [Section 2.1](#) and shown in the first panel of [Figure E.2](#). We drop individuals with assets exceeding 1 million USD and set negative assets equal to zero as the model does not allow borrowing.

### 4.1.4 Financial markets

Stock market returns are standard estimates from the literature. We assume that the risk premium is  $\mu^s = 0.04$  and  $\sigma_{\varepsilon^s} = 0.157$  (e.g., [Mehra and Prescott \(1985\)](#), [Cocco \(2005\)](#)). The nominal dividend yield

<sup>8</sup>Appendix [B](#) provides detailed information about the distribution of health groups by age, the associated distribution of medical spending shocks by health group and age, and the conditional transition probabilities between the health states by age.

<sup>9</sup>Appendix [B.3](#) contains more details about the procedures to remove cohort effects and wage biases.

$d$  is set at 3.2 percent following [Gomes, Michaelides and Polkovnichenko \(2009\)](#). The inflation rate is set at 2.8 percent. The risk free rate is  $r^b = 0.02$  ([McGrattan and Prescott \(2000\)](#)). This results in an average risky stock return of 6 percent. The stock market participation costs by age and skill is assumed to follow a polynomial structure in age  $j$ :  $q(j, \vartheta) = \delta_{s,\vartheta,1} + \delta_{s,\vartheta,2}j + \delta_{s,\vartheta,3}j^2$  and will be estimated from within the model.

#### 4.1.5 Taxes and transfers

Taxes and transfers are calibrated to mimic the US fiscal policy settings. Following [Gomes, Michaelides and Polkovnichenko \(2009\)](#) we set the proportional dividend tax  $\tau^d = 25$  percent and the tax on capital gains  $\tau^g = 20$  percent. The progressive income tax function has the following specification  $\text{tax}^y(y^{\text{tax}}) = \max \left[ 0, y_j^{\text{tax}} - \tau_0^{\text{inc}} \times \left( y_j^{\text{tax}} \right)^{1-\tau_1^{\text{inc}}} \right]$ , where  $\text{tax}^y(y^{\text{tax}})$  denotes net tax revenues as a function of taxable income  $y^{\text{tax}}$  with  $\tau_1^{\text{inc}}$  being the progressivity parameter and  $\tau_0^{\text{inc}}$  being a scaling factor. We impose a non-negative tax payment restriction in the benchmark model,  $\text{tax}^y \geq 0$ . This restriction excludes all government transfers embedded in the progressive tax function. Government transfers are explicitly modeled in government spending programs. We chose the tax curvature parameter  $\tau_1^{\text{inc}} = 0.053$  following [Guner, Lopez-Daneri and Ventura \(2016\)](#).<sup>10</sup> The consumption tax rate  $\tau^c$  is set to 5 percent. The Social Security system is partly financed via a payroll tax with a contribution limit. The Social Security payroll tax is  $\tau^{\text{ss}} = 10.6$  percent. The Social Security payroll tax is collected on labor income up to a maximum of USD 106,800.<sup>11</sup> The government collects a Medicare payroll tax from workers and Medicare premium payments of individuals older than 65. The Medicare payroll tax is  $\tau^{\text{mcare}} = 2.9$  percent.

In the model, social security transfers are defined as a function of average labor income per skill type  $\bar{y}^\vartheta$ . Let  $\text{tr}_{ss}^{\text{ss}}(\bar{y}^\vartheta) = \Psi^\vartheta \times \bar{y}^\vartheta$  be type specific pension payments where  $\Psi^\vartheta = \{0.50, 0.36, 0.30\}$  is a skill type dependent replacement rate that determines the size of the pension payments.<sup>12</sup>

We fix the Medicare coinsurance rate at  $\gamma^{\text{mcare}} = 0.30$  is calculated directly from MEPS data and the Medicare premium at USD 1,140 which is close to 2.1 percent of per capita GDP a value used in [Jeske and Kitao \(2009\)](#). The Medicare tax  $\tau^{\text{mcare}}$  is set to 2.9 percent. The Medicaid coinsurance rate  $\gamma^{\text{maid}} = 0.11$  is calculated directly from MEPS data. The income test for Medicaid varies greatly across states. According to [Kaiser \(2013\)](#), 16 states have Medicaid eligibility thresholds below 50 percent of the FPL, 17 states have eligibility levels between 50 and 99 percent, and 18 states have eligibility levels that exceed 100 percent of the FPL. In addition, state regulations also vary greatly with respect to the

<sup>10</sup>This tax function was implemented into a dynamic setting by [Benabou \(2002\)](#) and more recently in [Heathcote, Storesletten and Violante \(2017\)](#). These authors do not model transfers explicitly and therefore allow income taxes to become negative for low income groups.

<sup>11</sup>Compare contribution bases for Social Security contributions at: <https://www.ssa.gov/oact/cola/cbb.html>

<sup>12</sup>These replacement rates are based on wage indexed average earnings presented in Table 1 in [Biggs and Springstead \(2008\)](#) that we adjust for the fact that in the model replacement rates are multiplied with the last active wage income before retirement which results in lower replacement rates as demonstrated in [Congressional Budget Office \(2019\)](#).

asset test of Medicaid. The remaining parameters are calibrated from within the model in two steps as described in the next section.

## 4.2 Internally calibrated parameters

We calibrate the parameters governing government taxes and transfers, including a tax scaling parameter  $\tau_0^{inc}$ , a consumption floor  $c_{\min}$ , and thresholds for Medicaid asset and income tests  $\bar{a}^{\text{maid}}$  and  $\bar{y}^{\text{maid}}$ , respectively. The scaling factor  $\tau_0^{inc}$  is calibrated to match average U.S. income taxes of 40 year olds. The government makes lump-sum transfers to maintain a minimum level of consumption  $c_{\min}$  of \$4,000. Similarly to [Jeske and Kitao \(2009\)](#) this floor is calibrated to target the 20 percent share of households with net asset worth of less than \$5,000 based on estimates in [Kennickell \(2003\)](#). In the model we therefore calibrate the Medicaid income eligibility level to  $\bar{y}^{\text{maid}} = 5,500$  USD in order to target the Medicaid eligible working age population between ages 40–50. Similarly we calibrate the asset eligibility level to  $\bar{a}^{\text{maid}} = 75,000$  USD in order to match the fraction of workers between ages 51–64 insured via Medicaid. Panel 2 of [Figure D.3](#) shows the Medicaid coverage by age group in the model vs. MEPS data.

## 4.3 Estimation of the remaining internal parameters

The second set of internally determined parameters are deep preference parameters including the fixed costs of work by skill and health status  $\bar{n}_j(\vartheta, \varepsilon^h)$ , time preference parameters  $\beta(\vartheta, \varepsilon^h)$ , a preference weight on consumption vs. leisure  $\eta$ , the strength of the bequest motive  $\theta_1(\vartheta)$  as well as the stock market participation costs by skill and health status  $q(j, \vartheta)$ .<sup>13</sup> These parameters are collected in vector  $\Theta = \{\bar{n}_j(\vartheta, \varepsilon^h), \beta(\vartheta, \varepsilon^h), \eta, \theta_1(\vartheta), q(j, \vartheta)\}$  and estimated in an inner loop via the method of simulated moments (MSM). The structural model provides a mapping from the set of parameters  $\Theta$  to the model-simulated moments. The goal of the estimation procedure is to minimize the weighted distance between target moments estimated in the data and the corresponding moments simulated by the model, taking the externally determined parameter values from [Section 4.1](#) and the internally calibrated government transfer thresholds (from the outer loop) as given. The data moments for stock market participation are constructed from PSID 1984–2019. The data moments for labor hours as well as labor market participation are from MEPS 1996–2018.

The fixed cost of working  $\bar{n}_j(\vartheta, \varepsilon^h)$  is effective if the individual works (i.e.,  $n_j = (1 - \ell_j) > 0$ ) and is set to match the average work participation rate by age, permanent education type, and health status from MEPS as shown in [Figure D.5](#). It is assumed to be linear in age  $j$  and the intercept is assumed to

<sup>13</sup>We moved the determination of the utility constant  $\bar{u}$  into the outer loop. This parameter is typically set to match the value of statistical life (VSL). Unfortunately, the estimates of the VSL are imprecise and range from 1–16 million USD ([Viscusi, 1993](#)). The life cycle literature tends to target a VSL at the lower end of this range—[De Nardi, Pashchenko and Porapakarm \(2025\)](#), for instance, target a value of 2 million. However, in their model working age starts earlier at the age of 20. We end up with  $\bar{u} = 10$  which translates into a VSL of about 2.5 million for the working age population of 40–65 year olds.

depend on the health state:  $\bar{n}_j(\vartheta, \varepsilon^h) = \delta_{\ell, \vartheta, h, 1} + \delta_{\ell, \vartheta, 2}j$ , which results in nine  $\delta_\ell$  parameters that need to be estimated as shown in Table 5. Similarly, the cost of stock market participation is assumed to be a polynomial in age but independent of health:  $q(j, \vartheta) = \delta_{s, \vartheta, 1} + \delta_{s, \vartheta, 2}j + \delta_{s, \vartheta, 3}j^2$ , which results in nine  $\delta_s$  parameters that need to be estimated. The consumption intensity parameter  $\eta$  is chosen to match the average labor hours of the working age population. We target the behavior of households over the life cycle with respect to wealth accumulation and risky assets participation. While the six time preference parameters  $\beta(\vartheta, h(\varepsilon^h))$  can influence various model-generated moments, they have a particularly strong effect on wealth accumulation. Therefore, we use the wealth-to-income ratio as a targeted moment. De Nardi, Pashchenko and Porapakkarm (2025) similarly allow for health dependent time preferences. Empirical evidence also hints at discount rates decreasing with age (Kureishi, Paule-Paludkiewicz, Tsujiyama and Wakabayashi, 2021) and cognitive ability (Dohmen, Falk, Huffman and Sunde, 2010; Sunde, Dohmen, Enke, Falk, Huffman and Meyerheim, 2022). As poor health states become more prevalent in the model as the individual ages, our assumption on health dependent time preferences lines up well with this empirical literature.

Parameter  $\eta$ , the weight on consumption vs. leisure will strongly influence overall labor supply of the households. We therefore target the average hours worked in the data. In order to estimate the strength of the bequest motive  $\theta_1$  we target moments of assets holdings at age 80 and higher. Finally, to estimate the age-group and education dependent stock market participation costs, we rely on moments of stock market participation rates by age from 40–70 and three education levels (low, medium and high). We report all internally calibrated/estimated parameter values in Tables 4 and 5.

## 4.4 Model performance

Our benchmark model is capable of matching important life cycle patterns observed from the data.

**Targeted data moments.** Figure 4 shows the targeted stock market participation rates by skill and health.<sup>14</sup> The estimated participation costs vary according to age and permanent income type. Individuals with low education have the lowest average participation costs, around USD 2,000. These costs are stable across the life cycle. A similar pattern can be observed for individuals with a high school education, however, overall their participation cost is higher at USD 2,200. Finally, individuals with college degrees have the highest participation costs at USD 6,000. The estimates in the literature show a wide range of estimates of participation costs that range from a few hundred dollars per year such as Fagereng, Gottlieb and Guiso (2017) and Catherine (2022) who both require coefficients of relative risk aversion beyond a value of 4, to a few thousand dollars.<sup>15</sup> For instance, Vissing-Jorgensen (2003) estimates that

<sup>14</sup>Figures D.3–D.5 in Appendix D.3 show additional targeted moments of the calibration, including insurance type, labor force participation, work hours and asset holdings over the life cycle.

<sup>15</sup>A more recent contribution by Velásquez-Giraldo (2023) finds similarly low participation costs with a much lower risk aversion factor of 1.6 via introducing heterogeneity in expectations of stock returns.

per-period stock market participation costs range from USD 890–1,930 (in 2018 dollars). These estimates do not include first time investment costs, a fixed cost of trading stocks, nor variable (proportional) cost of brokerage commissions and should therefore be interpreted as lower bound estimates. [Daminato and Pistaferri \(2024\)](#) use a life cycle model without health shocks and labor supply and estimate participation costs of USD 1,300 for highly educated and USD 2,100 (in 2018 dollars) for lower educated workers. [Khorunzhina \(2013\)](#) estimates stock market participation costs to range between 4–6 percent of labor income, that are in line with our calibrated values. Our estimates show higher participation costs for college-educated workers (approximately \$6,000 vs. \$2,000 for high school educated), which may reflect opportunity costs of time and effort in portfolio management that scale with income, in addition to the direct monetary costs emphasized in prior studies.

**Non-targeted data moments.** Table 6 shows how well the model replicates non-targeted moments in the data.<sup>16</sup> The model replicates the long-term correlation and shows the distinctive gap in stock participation between the two health-types. Figure 5 shows the stock market participation rates by health at age 45–55. Figure E.1 shows that the model reproduces the overall shape of the labor income and the health expenditure distribution. The model tracks the life cycle profiles of medical spending as fraction of income and the overall fraction of healthy individuals. Figure E.2 shows the close fit of the financial wealth distribution by health type based on PSID data. The wealth Gini coefficient is 0.73 in the model, which is close to 0.76 calculated from PSID. Figure E.4 shows how the financial wealth distributions of sick and healthy individuals shift as individuals age from the 40–50 age group into the 60–70 age group. The model replicates the pattern discussed in section 2 that shows a rightward shift in the financial asset distribution of healthy individuals as they age, but not for sick individuals who seem to be “stuck” and have limited ability to “move” the financial wealth distribution to the right.<sup>17</sup> The model also tracks the average wealth to average income ratio by age, health type, and education level fairly well as shown in Figure E.3.

Finally, Table E.2 uses model generated data to estimate a selection model of stock market participation similar to the regressions in Section 2 and illustrate how the strong correlation of health-at-age 45–55 with stock market participation rates at age 60–70 is replicated in the model. Finally, Table E.3 present estimates of the same selection model for the simulated subsample of individuals who report being healthy at age 40, in order to abstract from differences in initial health conditions. These estimates using model generated data show similarly strong correlations of health status when young and stock participation as well as stock shares in the wealth portfolios of older individuals. In Table E.4 we estimate the selection model separately by education group and find that while stock market participation is negatively affected by poor health at younger ages across all three education groups, the null effect of poor health on the stock share of the elderly is driven by college graduates. Individuals with lower

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<sup>16</sup>Additional non-targeted moments are shown in Figures 5–E.3 and Tables E.1–E.4 in Appendix E.

<sup>17</sup>Appendix E presents the close fit of the model with respect to the wealth mobility index based on [Shorrocks \(1978\)](#).

levels of education do seem to be negatively affected by poor health with respect to their stock market participation rate and the fraction of assets held in risky assets.

## 5 Quantitative analysis

In this section we use the model to assess the impact of health dynamics on lifetime earnings and wealth inequality via the health-wealth portfolio channel.

### 5.1 The benefits of good health

We begin by quantifying the benefits of good health over the life cycle. In our two-asset framework, good health generates monetary and welfare benefits through four reinforcing channels identified before: (i) the health-longevity channel, through which longer expected life encourages additional wealth accumulation; (ii) the health-income channel, through which better health raises labor productivity and work hours; (iii) the health-medical expenditure channel, through which lower out-of-pocket costs free up resources for saving; and (iv) the health-wealth portfolio channel, through which reduced background risk and a stronger liquidity position facilitate participation in high-return risky assets. By aggregating these benefits we can measure the accumulated gains due to good health that an individual experiences over the life cycle.

**Monetary benefit.** We follow a similar approach as in [De Nardi, Pashchenko and Porapakkarm \(2025\)](#) to measure the monetary benefits of good health in our two-asset model. To do so, we simulate a counterfactual situation where they only draw “good health states” (by surprise) while all the other exogenous variables evolve identically as in the original benchmark economy. We use the following notation to differentiate benchmark outcomes from outcomes based on “good health surprises.” An individual  $i$  in the benchmark economy has income  $y_{ij}^*$  in period  $j$  while an individual in the hypothetical alternative scenario has income  $y_{ij}^{**}$ .<sup>18</sup> We then compare their lifetime income (net out-of-pocket health spending) and calculate the average monetary benefit as:

$$\overline{\text{benefit}}_i = \frac{\sum_{j=1}^J 1_{\text{alive}_j} \times \left( \left( y_{ij}^{**} - \text{oop}_{ij}^{**} \right) - \left( y_{ij}^* - \text{oop}_{ij}^* \right) \right)}{\sum_{j=1}^J 1_{\text{alive}_j}},$$

where  $\text{oop}_{ij}^*$  is out-of-pocket health expenditure of the individual in the benchmark economy and  $\text{oop}_{ij}^{**}$  is out-pocket health expenditure of the same individual who only draws good health states. The difference in available income between the benchmark and the counterfactual world with only good health draws presents a measure of the monetary benefit of good health (or the average cost of falling into poor health

<sup>18</sup>Variable  $y$  refers to gross income from earnings and transfers but excludes dividends, capital gains, and interest income.

if one were to switch the sign of the expression). We next calculate a measure of welfare which is a more comprehensive measure as health shocks additionally influence the disutility from work and life expectancy. We therefore implement a similar procedure to measure welfare gains/losses in terms of compensating equivalent consumption variation (CEV). We consider two counterfactual: (i) good health during the peak of the earnings capacity between ages 45–55; and good health (ii) from age 40 to death. We display the main results in Table 7.

We begin with the case where individuals are switched to excellent health during the peak of their earnings capacity between ages 45–55. This experiment eliminates about 9 percent of time spent in bad health and therefore decreases health expenditure while it increases labor productivity simultaneously for individuals who experienced bad health states in the benchmark economy. The average monetary benefit of staying in best health (i.e., a health status of excellent) is around USD 3,280 per year. The monetary benefit captures the direct income and expenditure effects of good health but does not account for the disutility of additional work hours or the value of longer expected life. To provide a more comprehensive welfare assessment, we also compute the compensating equivalent variation (CEV)—the permanent percentage increase in consumption that would make an individual indifferent between the benchmark economy and the counterfactual with good health surprises. The welfare gains in terms of CEV are 9.7, 8.1, and 5.5 percent for low, medium, and high skill types, respectively. Next, we turn to the case where individuals are surprised with excellent health from age 40 until death. We find the monetary benefits of good health over the entire lifetime more than double to around USD 7,900 on average. Similarly we observe larger welfare gains, between 13 and 21 percent of annual consumption across the different skill groups.<sup>19</sup>

Our two-asset framework introduces a channel that is absent from existing single-asset models: better health facilitates participation in high-return risky assets, generating additional monetary and welfare gains that accumulate through compounding over the life cycle. As a result, our estimated benefits of good health are quantitatively larger than those reported by [De Nardi, Pashchenko and Porapakkarm \(2025\)](#), whose framework restricts households to a single risk-free asset and therefore captures only the expenditure, income, and longevity channels. This confirms that the value of good health is systematically understated in models that abstract from asset portfolio choice.

**Stock market participation.** Figure 6 shows that the stock participation rate increases for both health types when bad health states between ages 45–55 are removed from the model. The group of individuals classified as sick in the benchmark economy disappears over this age range, as shown in panel 1. However, once individuals are again exposed to bad health shocks from age 56 onward, this group re-emerges and exhibits substantially higher participation rates. The absence of bad health shocks between ages 45–55 allows these individuals—who would have been classified as sick in the benchmark—to

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<sup>19</sup>We also calculate the value of statistical life (VSL) and find that there are large differences in the VSL between sick and healthy individuals over the life cycle, varying between 0.6–0.8 million. Detailed calculations are available in a Supplementary Online Appendix.

participate in the stock market at much higher rates, as they have more resources available to invest and to cover the fixed participation costs.<sup>20</sup>

Panel 2 shows that stock shares display a very similar pattern across healthy and sick types. The close correspondence between panels 1 and 2 reflects the absence of liquidity costs in the model: households that enter the stock market typically invest nearly all of their assets in risky stocks, as illustrated in panel 3. Panels 3 and 4 report stock market participation and stock shares by health status at ages 45–55. Consistent with the earlier results, the healthy group also benefits from the positive health shock and increases its stock market participation. The group classified as sick at ages 45–55 does not exist in this counterfactual, as all individuals receive favorable health realizations over this age range in the experiment.

Thus, poor health constrains participation in risky, high-return assets, particularly during prime working ages when wealth accumulation is most critical. When adverse health risks are mitigated, households—especially those in the lower and middle segments of the wealth distribution—gain greater access to high-return assets, resulting in higher levels and faster growth of asset accumulation. Next, we quantify the implications of this health-wealth portfolio channel for wealth inequality.

## 5.2 The health-wealth portfolio channel

The results in Section 5.1 establish that good health generates substantial monetary and welfare benefits, in part through increased access to high-return assets. We now turn to quantifying the independent contribution of this health–wealth portfolio channel to wealth inequality, decomposing the effects of portfolio choice, health-related earnings and expenditure risk.

We consider three counterfactual experiments: (i) No bad health shocks, where all individuals experience excellent health surprises from age 40 until death; (ii) No portfolio choice, where households can invest only in a single risk-free asset without participation costs; and (iii) a combination of excellent health and no portfolio choice. The logic of the decomposition is as follows. Comparing the benchmark to experiment (i) isolates the total effect of eliminating health risk. Comparing the benchmark to experiment (ii) isolates the total effect of eliminating portfolio choice. The residual—the portion of the wealth gap reduction in experiment (iii) that exceeds the sum of the reductions in experiments (i) and (ii)—measures the interaction between health heterogeneity and portfolio choice that neither channel can explain independently. This interaction term is the quantitative signature of the health–wealth portfolio channel. We report results in Tables 8 and 9, with column A.1 representing the benchmark model, column A.2 for the no bad health shock case, column A.3 for the no portfolio choice case and column A.4

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<sup>20</sup>A potentially surprising result is that stock market participation also increases for individuals in good health. This occurs because individuals classified as healthy can be in one of three states—(i) excellent, (ii) very good, or (iii) good health. In this experiment, all individuals are “surprised” with excellent health between ages 45–55, implying that those in very good or good health also experience a productivity increase and a reduction in out-of-pocket medical expenditures.

for the combined excellent health and no portfolio choice case.

**Labor supply, income, consumption and assets.** The first two columns A.1 and A.2 of Table 8 highlight the economic benefits of always being in good health. Eliminating bad health states induces more individuals to participate in the stock and labor markets. These benefits translate into the asset accumulation differences shown in Table 8, where eliminating bad health between ages 40 and death increases average asset holdings by 55.63 percent.

When the risky asset choice is removed from the model, only the first three health channels are in play. Individuals in the single asset economy are poorer as shown in column A.3 of Table 8. The benefits of removing bad health states in the single asset economy are still positive but slightly smaller than in the benchmark (2 assets) economy. To see this, compare the change in consumption levels across the last two columns A.3 and A.4 of Table 8 to the change in consumption levels across the first two columns A.1 and A.2. The removal of bad health states in the 2 assets economy increases aggregate consumption by almost 4 percent whereas the increase in consumption in the one asset economy is smaller at around 2 percent.

Not surprisingly, the wealth-to-income (W/I) ratios are quite similar at age 40 with and without portfolio choice, as all models are started from the same initial asset distribution based on PSID data of 40–44 year old individuals and the model tracks labor income fairly. However, the W/I ratios at 65 are much higher in the two-asset economy, 4.41 in column A.1 compared to 2.79 in column A.3. The main reason is that interest compounding is more pronounced in the two-asset model where individuals can invest in risky high return assets. This increases the W/I ratios more forcefully over time in the two-asset economy in column A.1. Removing bad health states from the two-asset economy also drives up the W/I ratios to higher levels than removing bad health states from the single asset economy (5.96 in column [A.2] compared to 3.54 in column [A.4]). These differences underscore the quantitative importance of the health-wealth portfolio channel.

**Wealth inequality.** We next decompose the effects of the health-wealth portfolio channel on wealth inequality. We measure wealth inequality in terms of the gap between the 90th and the 50th wealth percentile as well as the gap between the 50th and the 25th wealth percentile. These wealth gaps are expressed as ratios, P90/P50 and P50/P25 respectively. In addition we also calculate the wealth Gini coefficient and report all measures in Table 9. For direct comparison, we do not recalibrate the model for each counterfactual experiment.

In the two-asset economy, the measured wealth gaps are sizable. The P90/P50 wealth ratio is 13.58 and the P50/P25 ratio equals 4.49. When bad health states are removed from the model, we observe a substantial compression of the wealth distribution as reported in column A.2 of Table 9. In this counterfactual economy, the overall P90/P50 wealth gap declines by 47 percent. The channel grows stronger as households approach retirement at age 65 where the P90/P50 ratio falls by 54.5 percent—notably larger than the all-age average—reflecting the compounding of earlier differences in risky-asset participation

into substantially larger wealth gaps by retirement. This age gradient is a direct implication of the accumulation mechanism where even modest health-driven differences in portfolio allocation at younger ages translate into large wealth disparities at retirement when returns are allowed to compound over a long horizon. The P50/P25 ratio at age 65 decreases by a more modest 10.7 percent, indicating that the channel operates primarily through compression at the upper end of the wealth distribution.

In the single-asset economy, where portfolio choice is eliminated by restricting households to a single risk-free asset (column A.3 of Table 9), yields a broadly similar pattern, though the magnitude and distribution of the reductions differ in informative ways. The overall P90/P50 wealth gap declines by a larger amount—around 55 percent—while the reduction in the P50/P25 financial wealth gap is more modest, at approximately 7.6 percent. For individuals aged 65, the reduction in the P90/P50 wealth gap is substantially smaller (41.5 percent) than in the two-asset model, where the corresponding reduction is 54.5 percent. In contrast, the P50/P25 wealth gap shows virtually no reduction—and even a slight increase—in the single-asset economy. Taken together, these results indicate that allowing for portfolio choice and heterogeneity in rates of return can generate substantial differences in wealth inequality over the life cycle. Models that incorporate two assets produce markedly different wealth-distribution outcomes compared with models that restrict households to a single asset with a fixed return.

In the final experiment where both, bad health and portfolio choice, are eliminated, the wealth gaps for P90/P50 and P50/P25 are reduced further by 70 percent and 35 percent, respectively (column A.4 of Table 9). The P90/P50 wealth gap at age 65 declines by 52 percent. This result implies that the interaction between health heterogeneity and portfolio choice amplifies wealth disparity across groups and over the life cycle.

Hence, the decomposition reveals a finding that goes beyond what either channel can explain in isolation: the interaction between health heterogeneity and portfolio choice accounts for a substantial share of the total wealth gap—a portion that would be missed entirely by models that consider health risk and portfolio choice separately. This interaction arises because compounding amplifies even modest early-life differences in asset allocation into large gaps at retirement; health shocks that push sick households away from risky assets at age 45 generate wealth disparities that widen continuously until death, even if the health shock itself is temporary. This finding confirms that health heterogeneity and portfolio choice are complements in generating wealth inequality. Differences in health status shape saving decisions and risk-taking behavior, and these differences are magnified, not merely added, by the presence of heterogeneous returns across asset classes.

### **5.3 The value of health insurance**

Having established that the health–wealth portfolio channel accounts for a substantial share of observed wealth gaps, we now ask whether expanding access to health insurance can serve as a policy lever for

reducing health-related wealth inequality. The logic is direct: if poor health keeps sick households out of the risky asset market by raising background risk and compressing liquidity, then policies that mitigate health expenditure risk should—by relaxing these constraints—induce greater risky-asset participation and narrow the resulting wealth gaps. We examine this hypothesis through two counterfactual insurance reforms.

We specifically examine two counterfactual health insurance reforms that expand coverage through different institutional arrangements. The first reform (*i*) considers an expansion of public health insurance by extending Medicare coverage to all individuals, including both workers and retirees. The second reform (*ii*) focuses on an expansion of private health insurance by providing employer-sponsored health insurance (EHI) to all workers. These two policy experiments allow us to contrast the distributional and welfare implications of broadening public versus private insurance coverage. We report the effects of these insurance expansions on health, wealth, and welfare outcomes in Table 10.

**Universal Medicare.** In our benchmark model, sick workers are more likely to have lower income because health shocks are correlated with labor productivity and are associated with higher medical expenditures. At the same time, low-income workers—unless they qualify for Medicaid—are also more likely to be uninsured, as they are less likely to be matched with employers that offer employer-sponsored health insurance (EHI). The expansion of Medicare reduces these workers’ exposure to medical expenditure risk. As a result, both the capacity and the incentive to invest in risky assets increase as individuals face lower background risk, relaxing the precautionary motive that crowds out risky-asset holdings, while the reduction in out-of-pocket expenditure risk frees up resources to cover participation costs. This result is consistent with background risk theory that states that individuals facing greater non-diversifiable risks such as medical expenditure risk are less willing to take on additional risk. Consequently, uninsured or under-insured workers are less likely to participate in the risky stock market (e.g., [Pratt and Zeckhauser, 1987](#); [Kimball, 1993](#); [Gollier and Pratt, 1996](#)). In addition, removing the income and asset tests for Medicaid eligibility induces low-skill and sick workers to accumulate more assets in this environment (e.g., [Hubbard, Skinner and Zeldes 1995](#)).

These results confirm that the expansion of public health insurance via Medicare induces more households to participate in the risky asset market and hold riskier wealth portfolios with higher long-term returns. As shown in column [A.5], the expansion of Medicare leads to an increase in the stock market participation rates, wealth accumulation and a reduction in the wealth gap across all wealth gap measures and age groups. More specifically, the P90/P50 wealth gap across all age groups declines by 18.5 percent, rising to 25.5 percent for individuals at age 65. This age gradient is not coincidental but reflects the compounding of higher risky-asset participation over the full working life. Households that gain insurance coverage early in their careers gradually shift toward riskier portfolios, and these modest early-life reallocations compound into substantially larger wealth gains by retirement. The gap between the all-age and age-65 estimates therefore provides direct quantitative evidence that the portfolio channel of health

insurance operates through accumulation over time rather than through a one-period shock to resources. The larger reduction in the P90/P50 ratio relative to the P50/P25 ratio indicates that universal Medicare primarily compresses wealth differences between the top and the middle of the distribution. This pattern reflects the fact that households around the median are most likely to be uninsured or under-insured in the benchmark, and therefore most responsive to the Medicare expansion through increased stock market participation. Households near the bottom of the distribution, many of whom already qualify for Medicaid, experience smaller portfolio responses.

**EHI for all workers.** The expansion of private health insurance via EHI to all workers has significant effect on wealth inequality. In particular, the reform lowers the P90/P50 wealth ratio, indicating a compression of wealth differences between households at the top and the middle of the distribution. While this reduction is sizable, it is smaller than under the universal Medicare expansion, reflecting the less generous coverage provided by EHI contracts. The more modest inequality effects of the EHI expansion can be attributed to the higher coinsurance rates associated with private employer-sponsored insurance. Compared with Medicare, EHI provides weaker protection against medical expenditure risk, which limits the extent to which background risk is reduced. As a result, the induced increase in stock market participation and risky asset holdings among previously uninsured or underinsured households is smaller, leading to a more limited narrowing of wealth gaps at the top of the distribution. Moreover, we find that the EHI expansion generates relatively small changes in the P50/P25 wealth ratio. This pattern suggests that the primary distributional effects of the reform operate between the middle and lower-middle segments of the wealth distribution rather than at the very bottom. Households around the median are more likely to be uninsured in the benchmark model and sufficiently unconstrained to respond to improved insurance coverage by adjusting their portfolio choices. In contrast, households at the lower tail remain largely constrained by low income and limited savings, muting the impact of the EHI expansion on the P50/P25 ratio.

Overall, both the health insurance reforms generate sizable welfare improvements—ranging from 1.9 to 2.07 percent in consumption equivalent variation. These gains arise not only from reduced exposure to medical expenditure risk, but also from improved access to higher-return assets in the two-asset framework. More broadly, our results emphasize that health insurance plays an important role beyond its traditional function of insuring medical expenditures. By mitigating non-health risks and relaxing portfolio participation constraints, health insurance encourages investment in risky assets and affects long-run wealth accumulation. Reforms to Medicare and employer-sponsored health insurance can therefore have sizable impacts on health-related wealth inequality in a multi-asset environment with health, labor productivity, and investment risks. These findings highlight the importance of explicitly accounting for the institutional features of the U.S. health insurance system when studying wealth inequality and suggest that expanding insurance coverage can be an effective tool for reducing inequality over the life cycle.

Taken together, the Medicare and EHI experiments reveal a clear hierarchy in the distributional ef-

fectiveness of health insurance reforms. Universal public coverage provides more comprehensive risk protection and is therefore more effective at reducing wealth inequality than employer-sponsored private coverage, particularly at the upper end of the distribution where the portfolio response is largest. Crucially, both reforms generate inequality reductions that are entirely absent from single-asset frameworks, underscoring that the welfare benefits of health insurance expansion extend beyond consumption smoothing to include improved access to high-return assets. This finding has direct implications for evaluating the social value of health insurance and health insurance reforms. Abstracting from portfolio choice might systematically understate the social benefits of expanded health insurance coverage.

## 6 Extensions

In this section we investigate whether the health-wealth portfolio channel discussed in the previous section is robust under different counterfactual considerations, including other policy reforms and alternative preferences.

### 6.1 Risky asset returns and the strength of health-wealth portfolio channel

The gap in rates of return between safe and risky assets plays a key role in determining the strength of the health-wealth portfolio channel. To assess the importance of this mechanism, we conduct a set of counterfactual experiments in which we progressively reduce the risky asset premium  $\mu^s$ , while holding all other model parameters fixed. Following each change in the risk premium, households reoptimize their saving and portfolio choices. We report the effects on asset allocation, stock market participation, and wealth inequality in Table 11.

We find that a reduction in the risky asset premium diminishes the incentive for households to invest in stocks, resulting in lower stock market participation and reduced overall asset holdings, as reported in columns [B.1]–[B.3] of Table 11. As the risk premium declines, the expected return on risky assets becomes less attractive relative to safer investments, while the fixed costs and effort associated with participating in the stock market remain unchanged. When the premium falls below a certain threshold, individuals rationally withdraw from stock investments altogether, since the additional expected return no longer compensates for the higher risk and participation costs. This behavioral response has important implications for household heterogeneity and wealth inequality. In particular, the narrowing of the wealth gap occurs because the health-portfolio channel is weakened. Households at the top of the wealth distribution, who are typically more exposed to risky assets, experience smaller relative gains from stock investment, while those at lower wealth levels avoid the potential losses associated with risky asset holdings. As a result, both the level and dispersion of wealth across the population are compressed when the risky asset premium declines. This highlights the central role of asset returns and portfolio choices in

amplifying wealth disparities across households and over the life cycle.

## 6.2 Expansion of private health insurance

We next examine two additional policy reforms, both of which further expand the role of private health insurance in the economy. The first reform involves extending employer-provided health insurance (EHI) coverage to all workers while simultaneously eliminating Medicaid for low-income individuals. This scenario allows us to isolate the effects of shifting from public to private insurance for the working-age population and to assess how broader access to EHI affects health expenditures, labor supply, and asset accumulation. The second reform goes further by extending EHI coverage not only to all workers but also to retirees, while eliminating Medicaid for the poor and Medicare coverage for retirees. This more radical reform effectively replaces the public health insurance system with universal private coverage, allowing us to explore the combined effects of broadening private insurance and removing public health programs. The results of these experiments are summarized in Table 12.

Column [A.7] of Table 12 shows that expanding employer-sponsored health insurance (EHI) reduces health inequality. Interestingly, a more radical reform that replaces the entire Medicare and Medicaid system with universal EHI for all (workers and retirees) results in a large reduction in wealth inequality. However, this approach comes with considerable welfare costs. Column [A.8] shows that the compensating variation in consumption (CEV) falls by 4.8 percent under this reform, reflecting the loss of the generous public coverage previously provided by Medicare and Medicaid. These two counterfactual scenarios provide a framework to study how changes in the mix of public and private health coverage influences both health outcomes and wealth inequality. In particular, they shed light on the extent to which private insurance can substitute for public programs in mitigating health-related risks and enabling households to accumulate assets over the life cycle. These findings highlight a fundamental trade-off in the design of health insurance. Expanding private insurance can reduce wealth inequality by improving access to risky, high-return assets. However, when such expansions come at the expense of comprehensive public coverage—such as Medicare and Medicaid—they generate substantial welfare losses, particularly for low-income and chronically ill individuals.

The broader social value of public health insurance therefore extends beyond direct protection against medical expenditure risk. By providing effective consumption insurance and reducing downside risk, public coverage enables vulnerable households to participate in higher-return investment opportunities and sustain wealth accumulation over the life cycle. This dual role underscores the importance of carefully balancing the private and public provision of health insurance. Policies that narrow wealth inequality through expanded market access may simultaneously weaken welfare if they erode the insurance value of public programs.

## 7 Conclusion

This paper studies how health shocks shape savings, portfolio choice, and wealth inequality over the life cycle. We identify a health–wealth portfolio channel, a mechanism through which poor health increases background risk and reduces household liquidity, thereby strengthening precautionary motives. This causes sicker households to substitute high-return risky assets with lower-return safe assets. The resulting heterogeneity in realized returns compounds over the life cycle into large and persistent wealth gaps between sick and healthy households. This channel is distinct from those emphasized in the existing macro-health literature that restrict households to a single risk-free asset.

Our empirical analysis using PSID and HRS panel data documents that individuals who experience poor health during their prime earning years (ages 45–55) are substantially less likely to hold risky assets—a gap that persists within education groups, widens over the life cycle, and translates into large differences in wealth accumulation by retirement. These patterns establish the empirical foundation for the health-wealth portfolio channel. To quantify the channel, we develop a life-cycle model with health risk, endogenous labor supply, health insurance, and portfolio choice, and discipline it using method-of-moments estimation. The model replicates the observed life-cycle profiles of stock market participation and asset holdings across health and education groups. Counterfactual decompositions show that bad health shocks cause a P90/P50 wealth ratio that is 47 percent higher compared to an equilibrium without bad health shocks. Introducing portfolio choice in isolation increases the P90/P50 gap by 55 percent. Crucially, the combined experiment where we measure the effects of both bad health shocks and portfolio choice increases the P90/P50 wealth ratio by 70 percent. The main reason for the larger effect is that asset return compounding amplifies even modest early-life differences in asset allocations into large wealth gaps at retirement. This additive interaction is the quantitative signature of the health–wealth portfolio channel.

Building on these findings, our model also reveals a stronger role for health insurance in reducing wealth inequality. By mitigating medical expenditure risk, insurance expansions reduce the background risk that crowds sick households out of risky asset markets. Extending Medicare to all workers reduces the P90/P50 wealth ratio by 18–25 percent and delivers welfare gains of approximately 2 percent (CEV), with larger effects at retirement age reflecting the compounding of higher risky-asset participation over the full working life. An expansion of employer-sponsored insurance produces qualitatively similar but quantitatively more modest effects, reflecting its less comprehensive coverage and higher coinsurance rates. Importantly, both of these portfolio-channel benefits are entirely absent from single-asset frameworks, implying that standard welfare analyses of health insurance reform which focus solely on the consumption-smoothing value of coverage systematically understate the full social benefit of expanding access to health insurance.

While our analytical framework identifies and quantifies the health–wealth portfolio channel, it does

abstract from general equilibrium effects of large-scale policy reforms on wages, interest rates, and public finances. To the extent that insurance expansions raise aggregate labor supply and increase capital accumulation, equilibrium wages may rise and interest rates may fall, which would dampen the return premiums on risky assets and partly offset the gains we observe in partial equilibrium. Conversely, broader stock market participation could amplify capital formation in ways that reinforce them. Resolving the net direction of these forces requires extending the analysis to a dynamic general equilibrium setting with multiple assets. Also, our analysis does not include other dimensions of heterogeneity such as race, ethnicity, and gender that could also contribute to shaping wealth inequality over the life cycle. We leave these extensions for future research.

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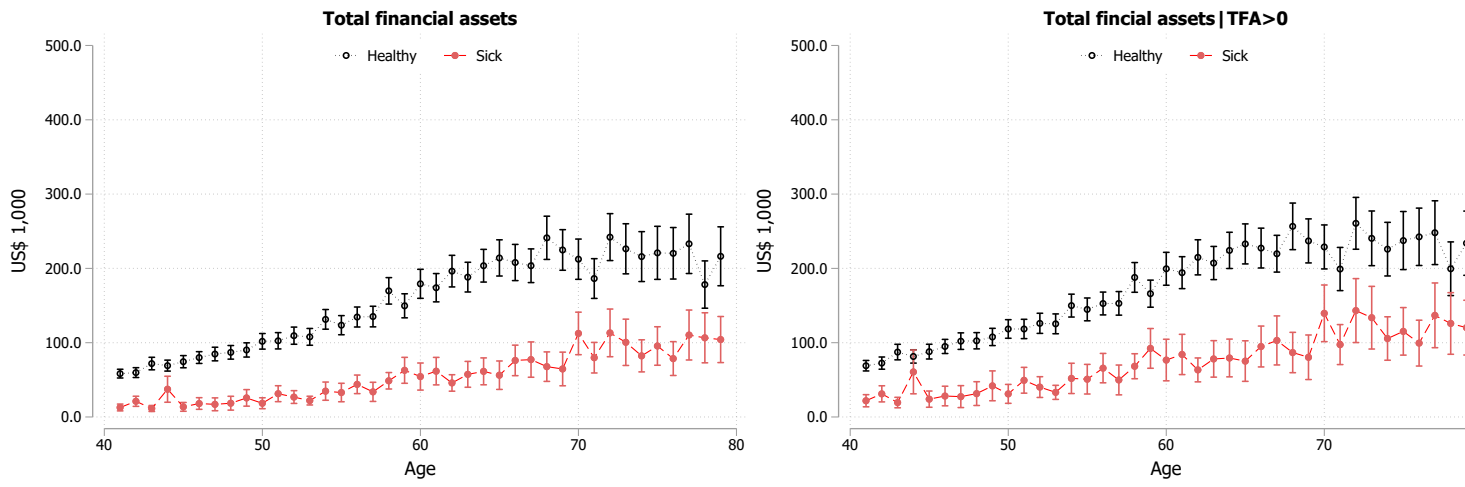
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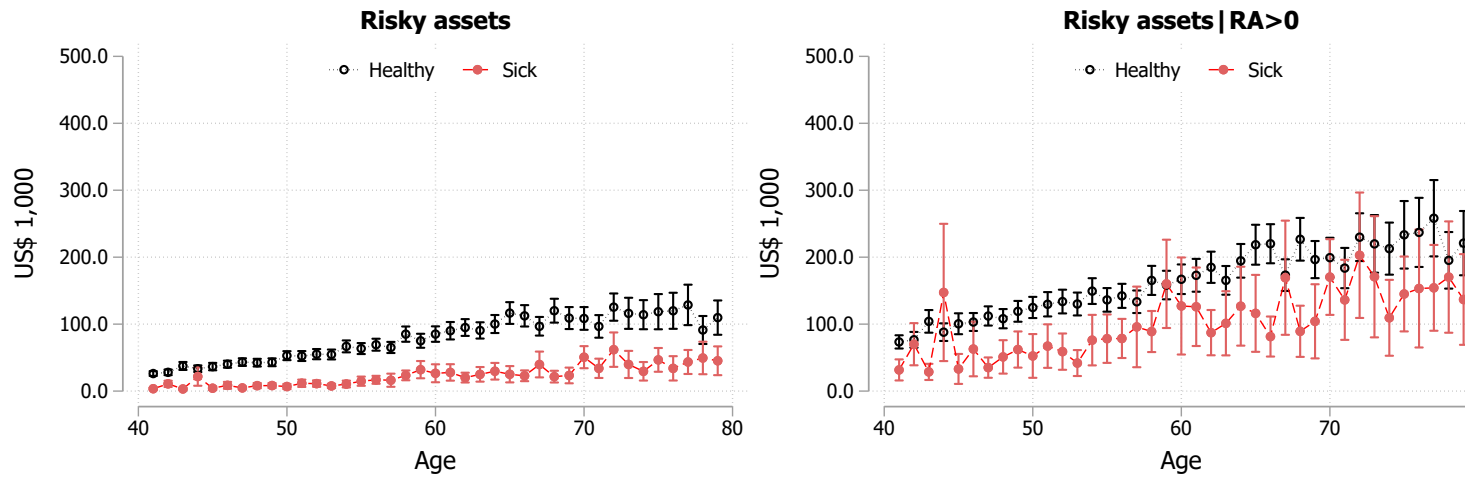
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# Figures



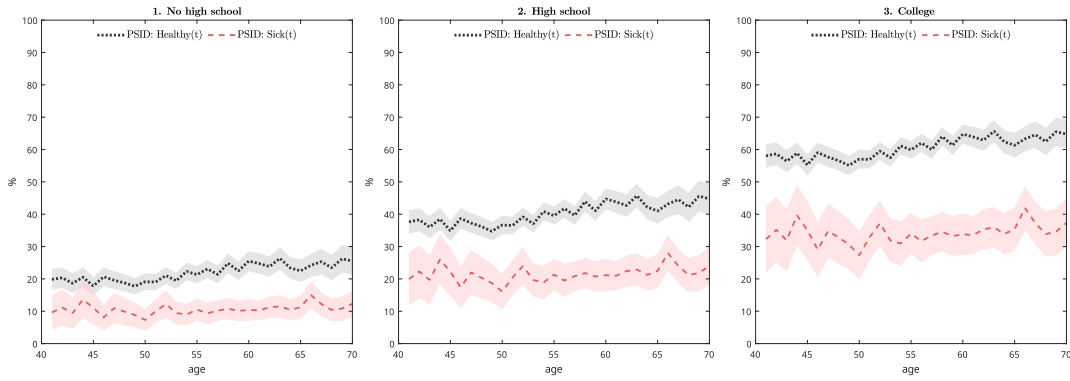
(a) Total financial assets



(b) Risky assets

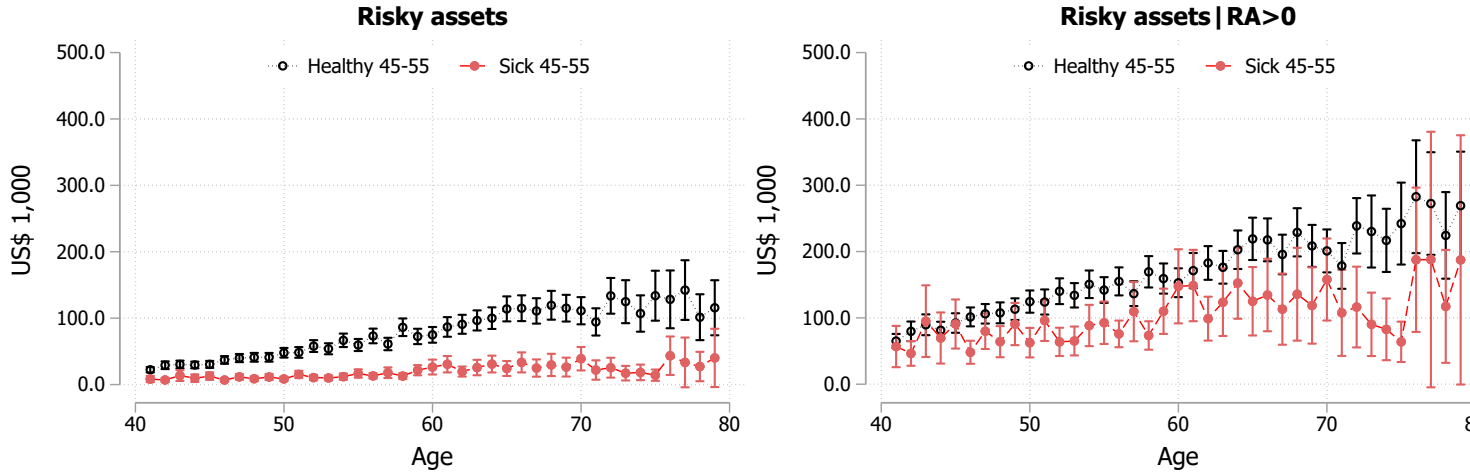
**Figure 1: Asset profiles by current health status**

*Notes:* In the top row we distinguish between individuals who do not report having bad health (i.e., health states excellent, very good, and good) and individuals who do (i.e., health states fair and poor). We refer to these two groups as Healthy vs. Sick by their current health status. In the bottom row we cut the sample to only include individuals who report being healthy between 40–44. We use weighted data. All dollar values are denominated in 2018 USD. Data source: Heads of households in PSID 1984–2019.

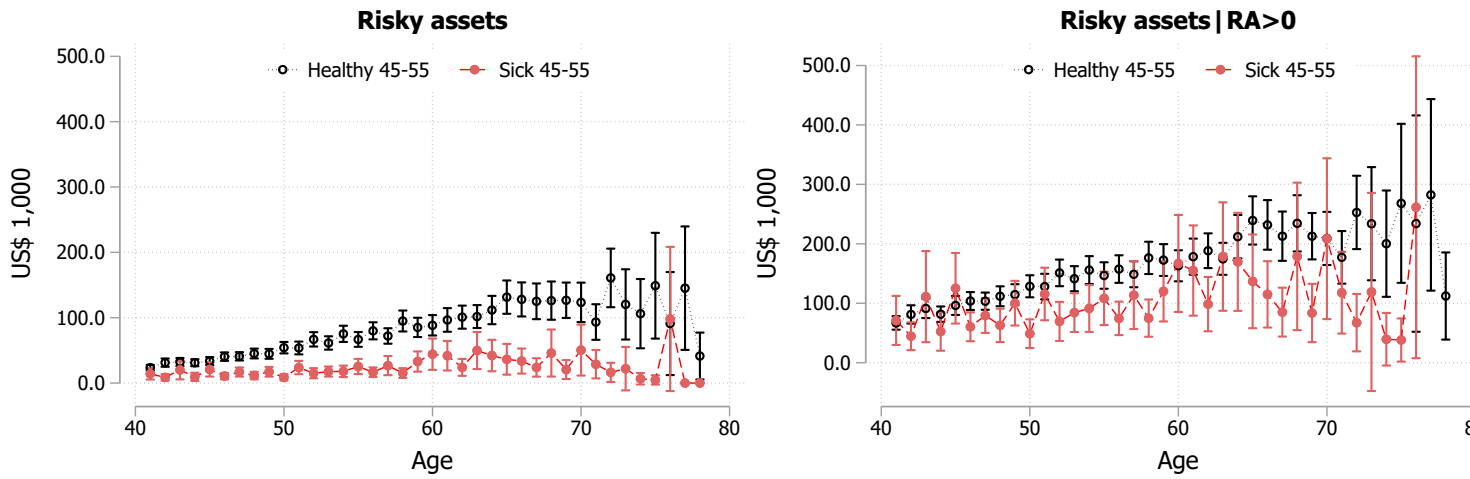


**Figure 2: Stock market participation by current health status and education level**

*Notes:* In the top row we distinguish between individuals who do not report having bad health (i.e., health states excellent, very good, and good) and individuals who do (i.e., health states fair and poor). We refer to these two groups as Healthy vs. Sick. In the bottom row we distinguish between individuals who do not report having bad health (or alternatively work limiting health issues) between ages 45–55 and individuals who do. We refer to these two groups as Healthy 45–55 vs. Sick 45–55. All participation probabilities are based on Probit models. Controls include: age dummies, health status, insurance status, gender, living w/ partner, number of children, smoking, race, education, household income, assets, debt, mortgage, stock ratio at age 35–45, region indicator, and initial health. We use **unweighted** data. Data source: Heads of households in **PSID 1984–2019**.



(a) Full sample w/ health info: Risky assets by health at age 45–55



(b) Sample of healthy at 40–44: Risky assets by health at age 45–55

**Figure 3: Risky asset profiles by health at 45-55**

*Notes:* In the top row we distinguish between individuals who do not report having bad health (i.e., health states excellent, very good, and good) and individuals who do (i.e., health states fair and poor). We refer to these two groups as Healthy vs. Sick. In the bottom row we distinguish between individuals who do not report having bad health (or alternatively work limiting health issues) between ages 45–55 and individuals who do. We refer to these two groups as Healthy 45–55 vs. Sick 45–55. We use weighted data. All dollar values are denominated in 2018 USD. Data source: Heads of households in **PSID 1984–2019**.

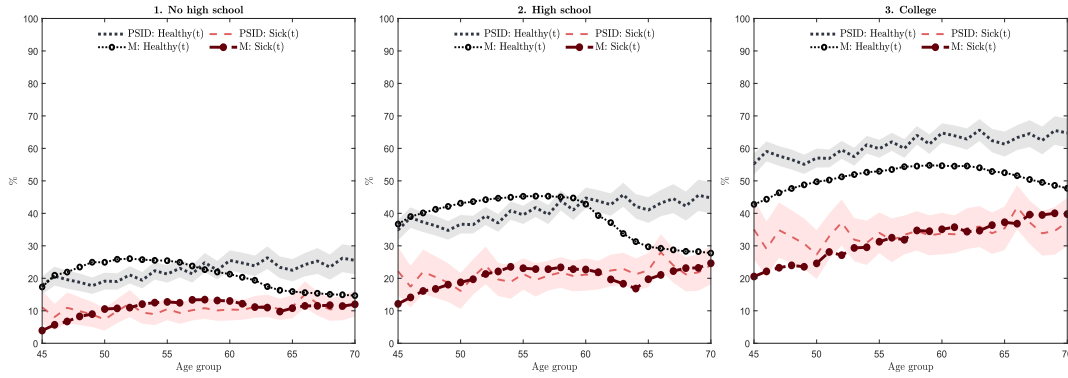


Figure 4: **Estimation target: Risky asset participation rate by current health and education**

Notes: We target stock market participation by permanent education status of individuals in good respectively bad current health. We use risky asset market access cost as parameters. These costs differ by age and education status:  $q_j(\vartheta)$ . Data source is **PSID 1984–2019**, heads of households.

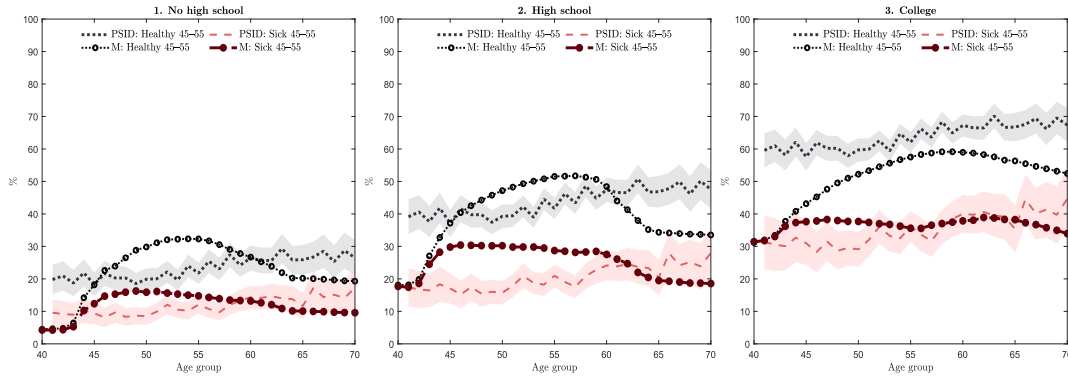


Figure 5: **Performance Check: Risky asset participation rate by health-at-45-55 and education**

Notes: This is not a target. The lines distinguish between individuals in good respectively bad health when 45–55 years old. Data source is **PSID 1984–2019**, heads of households.

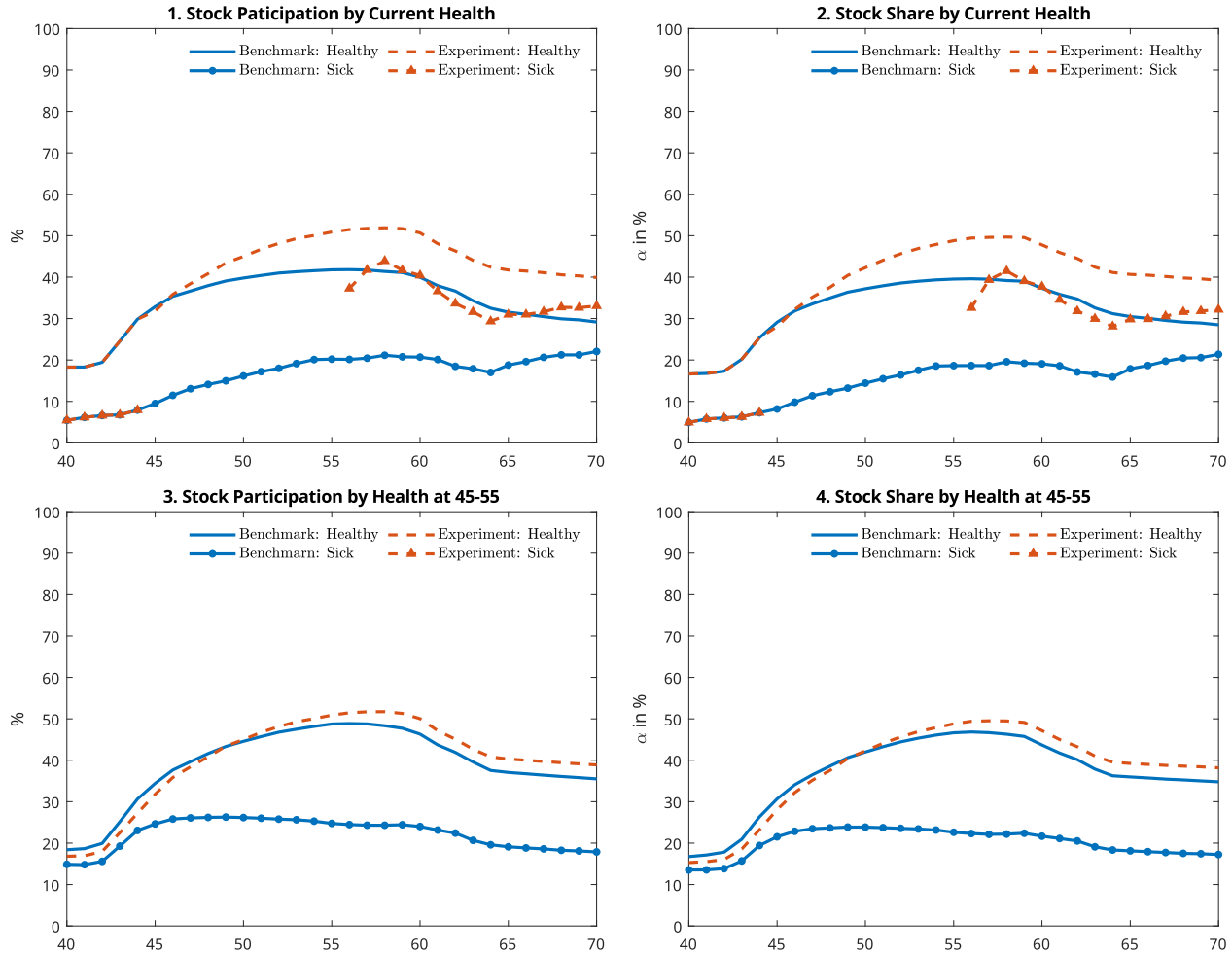


Figure 6: Experiment: Surprise excellent health shocks at age 45–55 – Stock market activities

*Notes:* In this figure we show how not allowing bad health between ages 45–55 affects stock market participation rates of health and unhealthy types. We accomplish this by "surprising" individual with the best health state possible between ages 45–55. After age 55 the health shock process is identical to the one in the benchmark model and individuals are exposed to poor health again. **Panel 1** shows that the absence of bad health shocks during the age of 45–55 allows individuals (who were classified as sick in the benchmark) to participate in the stock market at much higher rates as they have more funds available to invest and pay the participation cost (shown as red line with triangle markers). Similarly, individuals in good health also participate at higher rates as their health state is also moved to the best health state possible. **Panel 2** shows that stock shares follow a very similar pattern across the healthy and sick types. **Panels 3–4** show the stock participation and stock share by health-at-45–55. We again see that the healthy group also benefits from the good health surprise and increases its stock market participation. The sick-at-45–55 group does, of course, not exist in this context as we "surprise" everybody with good health draws when they are between 45–55 in this experiment.

# Tables

**Table 1: Risky asset share and poor health status**

	(1)	(2)	(3)	(4)	(5)
Sick at 45_55	-0.028*** (0.008)	-0.040*** (0.010)	-0.035*** (0.010)	0.008 (0.017)	0.004 (0.015)
Unemployed at 45_55	-0.004 (0.007)	0.005 (0.009)	-0.004 (0.010)	0.035** (0.015)	0.035*** (0.013)
Uninsured at 45_55	-0.030*** (0.009)	-0.047*** (0.010)	-0.031*** (0.009)	-0.018 (0.028)	0.000 (0.026)
Observations	5625	5625	5625	2335	2335
R <sup>2</sup>	0.323	0.302			0.107
Conditional P(Y>0)	No	No	No	Yes	Yes
Random Effects	No	No	Yes	Yes	No
Weighted	No	Yes	No	No	Yes

*Notes:* The dependent variable is the detrended ratio of stocks in the financial portfolio at ages 60–70 including individuals with zero stock holdings. The independent variables of interest are indicator variables for whether an individual has reported being in bad health at ages 45–55 or whether an individual has reported to ever having a work limiting health problem at ages 45–55. Column (7) and (8) are estimated on the subsample of individuals with positive stock holdings. The regressions also include controls for age, education, race, living w/ partner, gender, insurance status, household income, assets, debt, size of outstanding mortgage and size of other home loans, stock ratio at age 35–45, and region indicators. The sample comprises **heads of households** in the **PSID 1984–2019** ages 60–70 who report their health status when they were between age 45–55.

**Table 2: Healthy sample: Risky asset share and poor health status**

	(1)	(2)	(3)	(4)	(5)
Sick at 45_55	-0.044*** (0.009)	-0.067*** (0.012)	-0.047*** (0.013)	0.001 (0.019)	0.000 (0.018)
Unemployed at 45_55	0.009 (0.008)	0.019* (0.010)	0.007 (0.012)	0.043*** (0.016)	0.039*** (0.013)
Uninsured at 45_55	-0.040*** (0.012)	-0.062*** (0.012)	-0.041*** (0.012)	-0.018 (0.033)	-0.013 (0.034)
Observations	4521	4521	4521	2152	2152
R <sup>2</sup>	0.297	0.284			0.109
Conditional P(Y>0)	No	No	No	Yes	Yes
Random Effects	No	No	Yes	Yes	No
Weighted	No	Yes	No	No	Yes

Standard errors in parentheses

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

*Notes:* The dependent variable is the detrended ratio of stocks in the financial portfolio at ages 60–70 including individuals with zero stock holdings. The independent variables of interest are indicator variables for whether an individual has reported being in bad health at ages 45–55 or whether an individual has reported to ever having a work limiting health problem at ages 45–55. Column (7) and (8) are estimated on the subsample of individuals with positive stock holdings. The regressions also include controls for age, education, race, living w/ partner, gender, insurance status, household income, assets, debt, size of outstanding mortgage and size of other home loans, stock ratio at age 35–45, and region indicators. The "healthy" sample comprises **heads of households** in the **PSID 1984–2019** ages 60–70 who report their health status when they were between age 45–55 and who report being healthy when they were between ages 40–44.

Table 3: External parameters

Parameter description	Parameter values	Source
Periods	$J = 55$	
Work periods	$J_w = 25$	Age 40–64
Years modeled	years = 55	Age 40–94
Relative risk aversion	$\sigma = 3$	Standard values between 2.5 – 3.5
Survival probabilities	$\pi_j (h(\varepsilon^h))$ ( D.1)	İmrohoroğlu and Kitao (2012)
Health shocks	$\varepsilon_j^h$ ( B)	MEPS 1996–2018
Health transition prob.	$\Pi_j^h$ ( B)	MEPS 1996–2018
Persistent labor shock autocor.	$\rho = 0.977$	French (2005)
Risk premium	$\mu = 0.04$	Mehra and Prescott (1985)
Risk free rate	$r^b = 0.02$	McGrattan and Prescott (2000)
RA log return std. dev.	$\sigma_{\varepsilon^s} = 0.157$	Mehra and Prescott (1985)
Variance of transitory labor shock	$\sigma_{\varepsilon^{\text{incP}}}^2 = 0.0141$	French (2005)
Bias adjusted wage profile	$\bar{e}_j(\vartheta, h(\varepsilon^h))$ ( B)	MEPS 1996–2018
Private employer HI	$\gamma^{\text{ehi}} = 0.31$	MEPS 1996–2018
Medicaid coinsurance	$\gamma^{\text{maid}} = 0.11$	MEPS 1996–2018
Medicare coinsurance	$\gamma^{\text{mcare}} = 0.30$	MEPS 1996–2018
Consumption tax	$\tau^c = 5\%$	IRS
Bequest parameter	$\theta_2 = \$500,000$	De Nardi (2004); French (2005)
Payroll tax Social Security	$\tau^{\text{SS}} = 10.6\%$	IRS
Payroll tax Medicare	$\tau^{\text{mcare}} = 2.9\%$	SSA (2007)
Tax progressivity	$\tau_1^{\text{inc}} = 0.053$	Guner, Lopez-Daneri and Ventura (2016)
Dividend tax	$\tau^d = 25\%$	Gomes, Michaelides and Polkovnichenko (2009)
Capital gains tax	$\tau^g = 20\%$	Gomes, Michaelides and Polkovnichenko (2009)
Dividend yield	$d = 3.2\%$	Gomes, Michaelides and Polkovnichenko (2009)
Inflation	$\pi^i = 2.8\%$	Gomes, Michaelides and Polkovnichenko (2009)

Notes: These parameters are based on our own estimates from MEPS and CMS data as well as other studies.

Table 4: Internal calibrated parameters

Parameters	Values	Calibration target	Source
Utility constant	$\bar{u} = 10$	VSL of workers: \$1–16 million	\$1–16 million in Viscusi (1993)
Prog. tax scaling	$\tau_0^{\text{inc}} = 1.016$	Avg. tax rate at 40	16% in NBER-TaxSim
Medicaid asset test	$\bar{a}^{\text{maid}} = \$75,000$	Age 40–64 on Medicaid	MEPS 1996–2018
Medicaid income test	$\bar{y}^{\text{maid}} = \$5,500$	Age 20–39 on Medicaid	MEPS 1996–2018
Consumption floor	$c_{\text{min}} = \$3,200$	Frac. net-assets < \$5,000	Jeske and Kitao (2009)

Notes: We choose internal parameters so that model generated data matches data from MEPS, CMS, and NIPA. The average tax rate of 40 year olds is based on the TaxSim software at: <https://taxsim.nber.org/byage/>

Table 5: Estimated structural parameters

Parameters	Value	S.E.
Consumption weight: $\eta$	0.2778	0.0016
<b>Time discount factor</b>		
No high school		
$\beta(\vartheta = 1, \text{healthy})$	0.9788	0.0009
$\beta(\vartheta = 1, \text{sick})$	0.9563	0.0072
High school		
$\beta(\vartheta = 2, \text{healthy})$	0.9783	0.0011
$\beta(\vartheta = 2, \text{sick})$	0.8822	0.0061
College		
$\beta(\vartheta = 3, \text{healthy})$	0.9859	0.0014
$\beta(\vartheta = 3, \text{sick})$	0.7541	0.0091
<b>Bequest motive</b>		
$\theta_1(\vartheta = 1)$	334.0142	69.5270
$\theta_1(\vartheta = 2)$	241.8307	0.5716
$\theta_1(\vartheta = 3)$	111.6670	6.1756
<b>Stock market participation cost:</b>		
$q(j, \vartheta) = \delta_{s,\vartheta,1} + \delta_{s,\vartheta,2}j + \delta_{s,\vartheta,3}j^2$		
No high school		
$\delta_{s,\vartheta=1,1}$	0.0076	0.0058
$\delta_{s,\vartheta=1,2}$	0.0001	0.0343
$\delta_{s,\vartheta=1,3}$	-0.0000	0.0344
High school		
$\delta_{s,\vartheta=2,1}$	0.0094	0.0038
$\delta_{s,\vartheta=2,2}$	0.0001	0.0120
$\delta_{s,\vartheta=2,3}$	-0.0000	0.0130
College		
$\delta_{s,\vartheta=3,1}$	0.0216	0.0029
$\delta_{s,\vartheta=3,2}$	0.0001	0.0042
$\delta_{s,\vartheta=3,3}$	-0.0000	0.0041
<b>Labor force participation cost:</b>		
$\bar{n}_j(\vartheta, h(\varepsilon^h)) = \delta_{\ell,\vartheta,h,1} + \delta_{\ell,\vartheta,2}j$		
No high school		
$\delta_{\ell,\vartheta=1,\text{healthy},1}$	0.1540	0.0024
$\delta_{\ell,\vartheta=1,\text{sick},1}$	0.1627	0.0000
$\delta_{\ell,\vartheta=1,2}$	-0.0011	0.0001
High school		
$\delta_{\ell,\vartheta=2,\text{healthy},1}$	0.1414	0.0039
$\delta_{\ell,\vartheta=2,\text{sick},1}$	0.3298	0.0000
$\delta_{\ell,\vartheta=2,2}$	-0.0005	0.0003
College		
$\delta_{\ell,\vartheta=3,\text{healthy},1}$	0.0788	0.0046
$\delta_{\ell,\vartheta=3,\text{sick},1}$	0.0764	0.0000
$\delta_{\ell,\vartheta=3,2}$	-0.0014	0.0003

Notes: The estimates are obtained using a minimum distance approach. We minimize the distance between moments of actual and simulated data. Data moments include measures of wealth-to-income ratios, labor hours, stock market participation rates by age-group, education level, and health status at 45–55, and labor market participation rates by age, education level, and health status. Figure 4 shows the estimation target of stock participation rates by age, education and health state together with the model generated moments. Figure D.2 shows the associated participation cost by age and education.

Table 6: Benchmark model performance

Moments	Model	Data	Sources
Medical exp/income	see Figure E.1	see Figure E.1	MEPS 1996–2018
Gini medical spending	0.56	0.60	MEPS 1996–2018
Gini gross income	0.40	0.46	MEPS 1996–2018
Gini labor income	0.55	0.54	MEPS 1996–2018
Gini financial assets	0.73	0.76	PSID 1984–2019
Frisch labor supply elasticities	1.19–1.51	1.1–1.7	Fiorito and Zanella (2012)
Avg. interest rate: $r$	5.9%	5.2 – 5.9%	Gomme, Ravikumar and Rupert (2011)
Wealth: P90/P50 at 65	14.47	16.84	PSID 1984–2019
<u>Worker population shares:</u> *			
Sick: No high school	5.1%	5.1%	MEPS 1996–2018
Sick: High school	6.1%	6.1%	MEPS 1996–2018
Sick: College	1.4%	1.4%	MEPS 1996–2018
Healthy: No high school	16.2%	16.2%	MEPS 1996–2018
Healthy: High school	47.9%	47.9%	MEPS 1996–2018
Healthy: College	23.4%	23.4%	MEPS 1996–2018

Notes: These are not estimation targets.

(\*) Worker population shares are not estimation targets but the outcome of the initial share of individuals by education and health at age 20 and the subsequent evolution of health states over the lifecycle. Our model with exogenous health states tracks the overall fraction of individual types by education and health very well. We compare the shares to survey weighted data from MEPS 1996–2018. Sick types are individuals who report having fair or poor health. Healthy types are individuals who report excellent, very good, and good health. We show the shares of health-education types of working age individuals between age 20–65.

Table 7: The benefits of good health

	All	By skill level		
		Low	Medium	High
<b>In good health between 45–55</b>				
• % of time in bad health eliminated	8.89%	12.56%	8.10%	5.64%
• Medical cost ↓ + income ↑	\$3,278	\$3,815	\$3,070	\$3,032
• Welfare (CEV)	–	+9.72%	+8.11%	+5.55%
<b>In good health between 40–death</b>				
• % of time in bad health eliminated	16.27%	23.19%	15.17%	10.125%
• Medical cost ↓ + income ↑	\$7,913	\$9,256	\$7,534	\$6,971
• Welfare (CEV)	–	+21.45%	+20.01%	+13.68%

Notes: Good health conditions are defined as health states of excellent for this counterfactual experiment. Skill types include: Low (No high school), Medium (High school) and High (College).

Table 8: **Importance of the health-wealth portfolio channel**

	Two-asset economy		One-asset economy	
	A.1 Bench.	A.2 Good health (40–death)	A.3 One-asset	A.4=A.2+A.3
<b>Stock participation</b>				
• Age 40: sick 45–55	15%	n/a	n/a	n/a
• Age 40: healthy 45–55	18%	18%	n/a	n/a
• Age 65: sick 45–55	19%	n/a	n/a	n/a
• Age 65: healthy 45–55	37%	47%	n/a	n/a
<b>Assets</b>	100	155.63	70.17	103.89
<b>Labor participation</b>	49.74%	67.78%	50.20%	66.71%
<b>Hours (workers)</b>	100	100.99	99.03	102.25
<b>Consumption</b>	100	103.91	99.08	101.78
<b>Wealth-to-income (W/I)</b>				
• W/I at 40: all	1.15	1.19	1.20	1.14
• W/I at 65: all	3.70	5.96	2.30	3.54

Notes: Both safe and risky assets are present in the two asset economy [A.1]. The bad health states are removed in [A.2]. Portfolio choice is eliminated in [A.3]. The health-wealth portfolio channel is completely eliminated in [A.4].

Table 9: **Health shocks and wealth inequality**

	Two-asset economy		One-asset economy	
	A.1 Bench.	A.2 Excellent health (40–Death)	A.3 Single asset	A.4 = A.2+A.3
<b>Wealth gap</b>				
<u>All age groups</u>				
• P90/P50	13.58	7.14 (↓47.4%)	6.07 (↓55.3%)	4.11 (↓69.73%) (↓ <b>32.29%</b> )
• P50/P25	4.49	5.09 (↑13.36%)	4.05 (↓9.8%)	2.91 (↓35.19%) (↓ <b>28.14%</b> )
<u>Age 65</u>				
• P90/P50	14.02	6.38 (↓54.5%)	8.13 (↓41.5%)	4.78 (↓65.90%) (↓ <b>41.21%</b> )
• P50/P25	6.65	5.94 (↓10.7%)	6.651 (↑0.0%)	3.17 (↓52.33%) (↓ <b>52.33%</b> )
<b>Wealth Gini</b>	0.73	0.73	0.65	0.70

Notes: Both safe and risky assets are included in the two-asset economy in column A.1. Bad health shocks (i.e., the health channel) are removed in column A.2, the wealth portfolio channel is eliminated in column A.3, and the health–wealth portfolio channel is fully removed in column A.4. Percentage changes shown in the non-bold numbers are relative to column A.1, whereas the percentage changes in bold in column A.4 are relative to column A.3.

Table 10: **Public and private health insurance expansion**

	<b>A.1 Benchmark</b>	<b>A.5 Medicare for all + No EHI / Medicaid</b>	<b>A.6 EHI for all workers + Medicaid &amp; Medicare</b>
<b>Assets</b>	100	104.3	103.8
<b>Stock participation</b>			
• At 65: sick 45–55	19%	24%	23%
• At 65: healthy 45–55	37%	41%	41%
<b>Wealth gap</b>			
<u>All age groups</u>			
• P90/P50	13.58	11.09 (↓ 18.33%)	11.10 (↓ 18.26%)
• P50/P25	4.49	4.28 (↓ 4.6%)	4.90 (↑ 9.13%)
<u>Age 65</u>			
• P90/P50	14.02	10.44 (↓ 25.5%)	11.20 (↓ 20.11%)
• P50/P25	6.65	4.94 (↓ 25.7%)	6.08 (↓ 8.57%)
<b>Welfare (CEV)</b>	0	+2.07	+1.92

Notes: The health-wealth portfolio channel is in play in the two asset economy model. Two experiments: [A.5] Medicare for all - expansion of Medicare for all workers and retirees; and [A.6] EHI for all workers - expansion of EHI for all workers while maintaining Medicare and Medicaid.

Table 11: **Alternative risk premiums**

	<b>A.1 Benchmark.</b>	<b>B.1 <math>\mu^s = 0.03</math></b>	<b>B.2 <math>\mu^s = 0.02</math></b>	<b>B.3 <math>\mu^s = 0.01</math></b>
<b>Assets</b>	100	67.95	52.59	43.53
<b>Stock participation</b>				
• At 65: sick 45-55	19%	7%	1%	~0%
• At 65: healthy 45-55	37%	19%	4%	~0%
<b>Wealth gap</b>				
• At 65: P90/P50	14.02	11.12 (↓ 20.68%)	8.65 (↓ 38.30%)	7.99 (↓ 43.01%)
• At 65: P50/P25	6.65	6.18 (↓ 0.71%)	5.17 (↓ 21.66%)	5.10 (↓ 23.30%)
<b>Welfare (CEV)</b>	0.0	-1.60	-2.40	-2.71

Notes: The risk premium is 4 percent in the benchmark model, i.e.,  $\mu = 0.04$ .

Table 12: **Health insurance reforms**

	<b>A.1 Benchmark</b>	<b>A.7 EHI for All Workers + No Medicaid</b>	<b>A.8 EHI for All + No Medicaid/care</b>
<b>Assets</b>	100	106.83	144.67
<b>Stock participation</b>			
• At 65: sick 45-55	19%	22%	49%
• At 65: healthy 45-55	37%	40%	65%
<b>Wealth gap</b>			
• At 65: P90/P50	14.02	10.44 (↓ 25.55%)	5.24 (↓ 62.41%)
• At 65: P50/P25	6.65	5.56 (↓ 16.39%)	3.53 (↓ 46.91%)
<b>Welfare (CEV)</b>	0.0	+1.90	-4.83

Notes: We consider two other health insurance reforms: [A.6] EHI for all workers + No Medicaid - expansion of EHI for all workers, while removing Medicaid; and [A8] Extending EHI to all workers and retirees, while removing both Medicaid and Medicare.

# Appendices

## A Panel Study of Income Dynamics (PSID)

The Panel Study of Income Dynamics (PSID) is available in waves from 1968–2021. From 1968–1997 the survey was conducted every year and from 1999 onward every other year. Wealth data was first available through survey supplements for the years 1984, 1989, 1994, 1999, 2001, 2003, 2005, and 2007. Since wave 2009 the wealth questionnaire is part of the main survey and wealth data is available biennially. We primarily use data from the years 1984–2019. We use the PSID\_SHELF version (Pfeffer, Daumler and Friedman, 2023).<sup>21</sup> We then use the main PSID (PSID, 2024) for health status information, health expenditure and health insurance information as well as labor hours and wages as those variables are not yet part of PSID\_SHELF.

### A.1 Sample selection

Sample selection proceeds as follows. After cleaning the data (i.e., removing individuals who do not report their age or have other critical information missing) we drop individuals younger than 40 and older than 80 and are thus left with an unbalanced panel with 107,993 head of household/year observations. These individual/year observations increase by wave, starting with 2,922 in 1984 to 5,263 in 2019 as can be seen from Table A.1a. The top panel of Figure A.1 shows the age distribution of this sample. The average (unweighted) age in this PSID sample is 57.1 in 1984 and it stays relatively stable throughout the remaining waves. We next drop outliers with respect to income and wealth. We drop individual observations if their reported total asset holdings (excluding housing) is larger than 2 million USD. We next only keep individuals who report their health status at least once when they are between ages 45–55 so that we can assign them into treated (i.e., report to have poor health or work limiting health problems when aged 45–55) and untreated groups. Since not all individuals report their health status and since some individuals first entered the survey when they were older than 55, we lose about 10,000 observations and are left with a sample of 95,244 head of household observations as shown in Table A.1b. Out of the 95,244 head of household observations, 29,356 report that they were in poor health at least once when aged 45–55 (compare second column in Table A.2). This is the sample used to make the risky and safe asset profile graphs in Figure C.1.

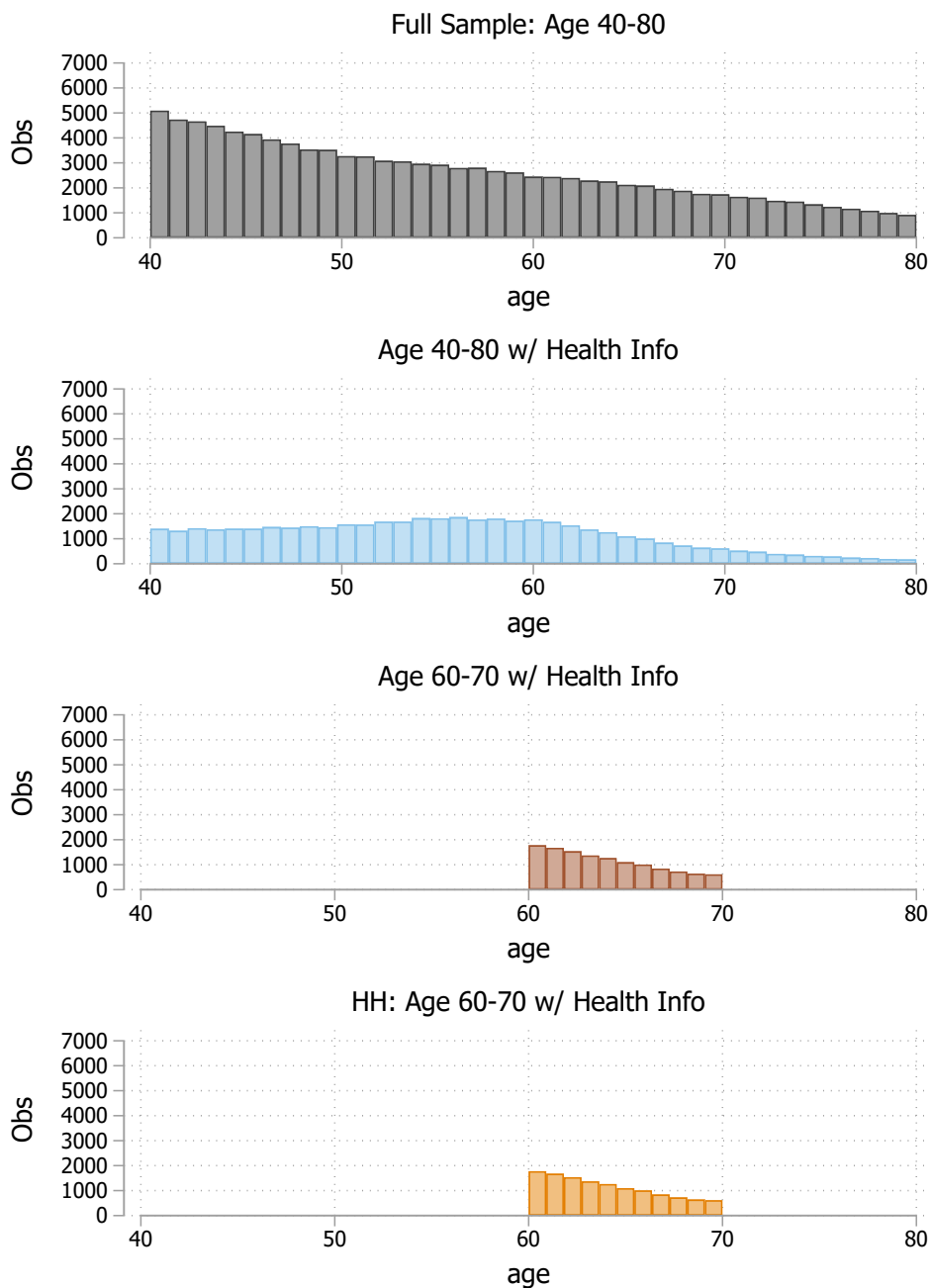
The second panel of Figure A.1 shows the age distribution of this sample. Figure A.3 shows the stock participation profile, the wealth portfolio share of stocks conditional on owning stocks, the safe asset participation profile, and the wealth portfolio share of safe assets for the sample of individuals who report their health state when they were 45–55 years old compared to the full sample of 40–80 year olds.

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<sup>21</sup>PSID\_SHELF is available at: <https://www.openicpsr.org/openicpsr/project/194322/version/V1/view>

We can see that the sample with individuals that reports the relevant health information has very similar life cycle profiles of risky and safe assets.

Out of the 95,244 individuals aged 40–80 with health information, 62,103 are still alive at ages 60–70. Finally, the sample of 60–70 year olds that report health status information when they were 45–55 year old (and are still alive in at least one wave when they are 60–70 year old) contains 20,521 individual/time observations. This sample was used in the regressions shown in Tables 1–C.4. The age distribution of this sample is shown in the third panel of Figure A.1. Finally, Figure A.2 shows the age distribution of this sample for individuals reporting to being “sick” when they were 45–55 years old and individuals who reported being “healthy”. Depending on which control variables are added the sample further decreases in sample size.



**Figure A.1: Age distribution of full and restricted sample**

*Notes:* Sample selection. The top panel shows the full sample with heads of households aged 40–80. The middle panel shows heads of households aged 40–80 who report their health when they are between 45–55 and who are still in the sample when they are between 60–70 years old. The third panel are heads of households between ages 60–70 who reported their health status when they were between 45–50. The bottom panel are heads of households and their spouse between ages 60–70 who reported their health status when they were between 45–50. Since we limit the data to heads of households, the last two histograms are identical. All information is from PSID waves 1984–2019, unweighted.

**Figure A.2: Age distribution of 60–70 year old individuals by health status between ages 45–55**

*Notes:* Heads of households in PSID 1984–2019, unweighted.

**Figure A.3: Asset profiles in full sample vs. sample with health status info at age 45–55**

*Notes:* We distinguish between the full sample of 40–80 year olds and individuals between 40–80 year olds who report their health status at least once while they are 45–55 years old. We use **unweighted** data. Data source: Heads of households in HRS 1992–2018.

Table A.1: PSID Sample Selection

	(a) 40–80 full sample			(b) 40–80 w/ health info at 45–55			(c) H. info at 45–55 & alive at 60–70			(d) 60–70 w/ health info at 45–55					
	Nobs.	Freq.	Age	Nobs.	Freq.	Age	Nobs.	Freq.	Age	Nobs.	Freq.	Age			
<b>Wave</b>			<b>Wave</b>			<b>Wave</b>			<b>Wave</b>						
1984	2,922	2.7%	57.1	1984	1,346	1.7%	47.5	1984	890	1.9%	48.5	1987	1	0.0%	60.0
1985	2,980	2.8%	57.0	1985	1,462	1.8%	47.9	1985	960	2.0%	49.1	1988	8	0.1%	60.6
1986	2,984	2.8%	57.0	1986	1,542	1.9%	48.3	1986	1,019	2.2%	49.5	1989	79	0.6%	60.1
1987	3,062	2.8%	56.7	1987	1,702	2.1%	48.4	1987	1,128	2.4%	49.7	1990	160	1.3%	60.6
1988	3,143	2.9%	56.3	1988	1,846	2.3%	48.6	1988	1,237	2.6%	49.8	1991	231	1.8%	61.1
1989	3,167	2.9%	56.1	1989	1,948	2.4%	48.7	1989	1,325	2.8%	50.0	1992	310	2.5%	61.7
1990	4,580	4.2%	56.0	1990	2,686	3.4%	48.6	1990	1,446	3.1%	50.3	1993	392	3.1%	62.1
1991	4,635	4.3%	55.9	1991	2,786	3.5%	49.0	1991	1,525	3.2%	50.7	1994	442	3.5%	62.7
1992	4,914	4.6%	55.5	1992	2,995	3.7%	49.4	1992	1,651	3.5%	50.9	1995	493	3.9%	63.0
1993	5,062	4.7%	55.1	1993	3,157	3.9%	49.8	1993	1,798	3.8%	51.1	1996	542	4.3%	63.6
1994	5,561	5.1%	54.6	1994	3,565	4.4%	49.8	1994	2,025	4.3%	51.0	1997	413	3.3%	64.2
1995	5,475	5.1%	54.4	1995	3,566	4.5%	50.2	1995	2,118	4.5%	51.3	1999	508	4.0%	64.9
1996	4,513	4.2%	53.7	1996	3,239	4.0%	50.4	1996	2,223	4.7%	51.6	2001	508	4.0%	64.9
1997	3,533	3.3%	53.5	1997	2,847	3.6%	49.7	1997	2,247	4.8%	50.9	2003	535	4.3%	64.6
1999	3,799	3.5%	53.4	1999	3,182	4.0%	50.3	1999	2,467	5.2%	51.7	2005	594	4.7%	64.2
2001	4,202	3.9%	53.3	2001	3,606	4.5%	50.9	2001	2,531	5.4%	53.4	2007	658	5.2%	64.1
2003	4,497	4.2%	53.3	2003	3,959	4.9%	51.6	2003	2,559	5.4%	55.3	2009	807	6.4%	63.8
2005	4,553	4.2%	53.7	2005	4,154	5.2%	52.5	2005	2,548	5.4%	57.1	2011	952	7.6%	63.9
2007	4,667	4.3%	54.1	2007	4,323	5.4%	53.3	2007	2,516	5.3%	58.8	2013	1,095	8.7%	64.1
2009	4,753	4.4%	54.5	2009	4,490	5.6%	54.3	2009	2,512	5.3%	60.6	2015	1,215	9.7%	64.2
2011	4,824	4.5%	54.9	2011	4,545	5.7%	54.7	2011	2,399	5.1%	61.8	2017	1,295	10.3%	64.5
2013	4,890	4.5%	55.3	2013	4,589	5.7%	55.2	2013	2,284	4.8%	63.1	2019	1,323	10.5%	64.7
2015	4,871	4.5%	55.7	2015	4,410	5.5%	56.1	2015	2,101	4.4%	64.3	Total	12,561	100.0%	63.9
2017	5,143	4.8%	55.8	2017	4,214	5.3%	57.5	2017	1,960	4.1%	65.9				
2019	5,263	4.9%	55.9	2019	3,972	5.0%	58.9	2019	1,810	3.8%	67.3				
Total	107,993	100.0%	55.1	Total	80,131	100.0%	52.1	Total	47,279	100.0%	55.4				

Notes: Panel (a) shows unweighted counts and average age of the sample of 40–80 year old heads of households in each wave. Panel (b) shows 40–80 year old heads of households who report their health status when they are between ages 45–55. Panel (c) shows 40–80 year old heads of households who report their health status when between ages 45–55 and who are still in the sample in at least one waves when they are between 60–70 years old., Panel (d) shows 60–70 year old heads of households who report their health status when between 45–55. This is the sample used in the regression analysis. Source: PSID 1984–2019.

## A.2 Summary statistics

Unweighted summary statistics of the dependent and control variables of the different samples are presented in Table A.2. Our core sample of 40–80 year old individuals who report health information in at least one wave when they were 45–55 year old comprises 92,244 individual/year observations. About 30 percent of these report that they were in poor health in at least one wave when they were 45–55 year old. Summary statistics of this group are shown in column (2) of Table A.2.

The group reporting bad health when 45–55 has a smaller fraction investing in financial assets (only 17 percent invest in risky assets compared to 35 percent in the full sample and 61 percent invest in the safe assets compared to 71 percent in the full sample), has lower levels of financial assets (USD 16,000 vs. USD 49,000 in risky assets and USD 18,000 vs. USD 45,000 in safe assets), and has lower shares of investments in both assets (8 percent vs. 16 percent in risky assets and 55 vs. 61 percent in safe assets). Note that these shares do not sum to one as they include individuals who report to have zero holdings in either asset. The “sick” group has slightly higher debt (USD 10,170 vs. USD 13,350) but lower mortgages. In addition, this group is also slightly younger (age 52.4 vs. 54.7), has more females (38 percent vs. 30 percent), is less likely to be married (48 percent vs. 58 percent), has a higher fraction of minorities, is less educated and has less income, is in worse current health, has a higher fraction of smokers, has similar out-of-pocket medical expenditures but is less likely to have health insurance, and if they have health insurance it is more likely to be public health insurance.

Table A.4 shows a tabulation of individuals between ages 45–55 by whether they have ever reported being in bad health—defined as a health status of either “fair” or “poor”. If they have, we call them the “Sick”. First, we observe a strong correlation between an individual reporting being in bad health and having work limiting health problems. Furthermore, respondents in bad health are more likely to be unemployed. Therefore, not surprisingly, individuals in bad health are also more likely to be uninsured than individuals who report better health states. Sick individuals are less likely to have a college degree.<sup>22</sup> Our core sample of 40–80 year old individuals who report health information in at least one wave when they

### Figure A.4: Stocks profiles by health state between ages 45–55

*Notes:* We distinguish between individuals who do not report having bad health (or alternatively work limiting health issues) between ages 45–55 and individuals who do. Panel 2.A is based on a linear probability model whereas Panels 3.A and 4.A are based on Probit models. We refer to these two groups as Healthy vs. Unhealthy. We use **weighted** data. Data source: Heads of households in **PSID 1984–2019**.

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<sup>22</sup>All dollar values are denominated in 2018 USD using the OECD-CPI for the U.S. from OECD (2022), “Inflation (CPI)” (indicator) at: <https://doi.org/10.1787/eee82e6e-en> (accessed on 09 November 2022).

Table A.2: PSID Summary Statistics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	w/H.Info Age:40-80	Sick 45-55 A:40-80	H:40-44 Sick 45-55 A:40-80	Alive60-70 A:40-80	All A:60-70	w/H.Info A:60-70	Sick 45-55 A:60-70	HlimWrk A:60-70	UnEmp A:60-70	Sick+UE A:60-70	Sick+UI A:60-70
Sick at 45_55	0.37	1.00	1.00	0.36	0.36	0.36	1.00	0.62	0.55	1.00	1.00
Health Lim.Wrk at 45_55	0.37	0.67	0.54	0.40	0.42	0.42	0.71	1.00	0.64	0.85	0.72
Health limits work	0.21	0.41	0.25	0.23	0.36	0.32	0.55	0.57	0.52	0.66	0.53
Health limits work spouse	0.09	0.11	0.09	0.10	0.14	0.13	0.13	0.15	0.12	0.11	0.11
Unemployed at 45_55	0.38	0.60	0.49	0.38	0.39	0.40	0.59	0.61	1.00	1.00	0.66
Uninsured at 45_55	0.19	0.29	0.26	0.18	0.24	0.19	0.29	0.34	0.38	0.33	1.00
P(Stocks excl. 401k)	0.33	0.17	0.21	0.40	0.37	0.41	0.21	0.27	0.24	0.14	0.10
P(Safe Assets excl. 401k)	0.76	0.61	0.67	0.80	0.79	0.82	0.69	0.72	0.68	0.62	0.56
Risky Assets excl. 410k (\$1,000)	44.89	15.56	20.64	59.94	65.22	74.12	27.69	39.46	43.62	19.25	2.65
Safe Assets excl.401k (\$1,000)	45.60	18.51	24.34	58.03	67.71	75.34	29.94	43.19	39.74	17.98	7.00
Risky Asset Share excl.401k	0.16	0.08	0.10	0.19	0.18	0.20	0.10	0.13	0.12	0.07	0.04
Safe Asset Share excl.401k	0.61	0.53	0.57	0.61	0.61	0.63	0.59	0.59	0.57	0.55	0.52
Bonds+CDs+Cash+Check (\$1,000)	24.24	11.58	14.26	30.34	34.40	34.39	16.14	23.09	20.26	9.67	4.79
Stocks (\$1,000)	27.25	9.85	12.29	36.81	37.75	40.23	16.36	22.90	27.55	12.43	0.84
Bonds+CDs (\$1,000)	4.31	2.35	3.99	8.48	4.88	5.39	4.04	4.68	2.96	2.50	0.75
IRAs (\$1,000)	45.01	14.89	20.33	59.62	75.86	79.75	26.97	46.74	45.35	16.41	4.46
Debt excl. home (\$1,000)	14.36	10.14	11.58	12.13	11.77	13.81	9.36	10.06	7.11	7.08	8.90
Total value of primary residence (\$1,000)	102.21	56.10	65.79	120.87	127.24	137.73	76.02	92.29	92.63	56.28	40.83
Mortgage (\$1,000)	66.24	38.11	50.15	59.71	44.84	51.73	30.10	32.50	31.18	22.05	21.30
age	52.10	52.32	50.45	55.41	64.63	63.91	63.81	64.44	64.42	63.76	63.43
Female	0.28	0.38	0.32	0.28	0.33	0.31	0.43	0.47	0.49	0.51	0.49
Married/Partnered	0.61	0.49	0.54	0.62	0.57	0.58	0.43	0.42	0.39	0.34	0.34
numChildrenInHH	0.70	0.69	0.72	0.54	0.18	0.15	0.23	0.20	0.20	0.24	0.35
Black	0.33	0.46	0.43	0.31	0.30	0.31	0.46	0.41	0.41	0.52	0.56
Hispanic	0.08	0.11	0.07	0.03	0.10	0.04	0.06	0.03	0.04	0.05	0.11
No high school degree	0.19	0.34	0.20	0.19	0.34	0.20	0.36	0.43	0.42	0.42	0.46
High school degree	0.57	0.56	0.65	0.56	0.47	0.55	0.53	0.46	0.46	0.51	0.48
College	0.23	0.10	0.15	0.26	0.19	0.25	0.11	0.11	0.12	0.07	0.05
Labor income (\$1,000)	47.27	26.45	36.96	46.02	22.13	27.99	14.17	12.88	9.80	6.01	10.89
HH labor income (\$1,000)	64.54	36.80	51.47	62.42	31.63	40.40	20.95	19.12	16.09	10.66	14.47
HH income (\$1,000)	85.61	54.80	68.39	87.10	64.75	74.39	46.81	47.51	43.05	33.77	33.30
Employed	0.72	0.57	0.71	0.68	0.38	0.46	0.31	0.28	0.24	0.18	0.32
Health Excellent	0.17	0.05	0.08	0.17	0.11	0.12	0.03	0.04	0.07	0.03	0.03
Health Very Good	0.30	0.13	0.21	0.30	0.24	0.27	0.10	0.16	0.18	0.09	0.08
Health Good	0.32	0.32	0.43	0.31	0.31	0.32	0.28	0.28	0.27	0.23	0.27
Health Fair	0.15	0.36	0.22	0.15	0.23	0.20	0.38	0.31	0.29	0.39	0.41
Health Poor	0.06	0.15	0.06	0.06	0.12	0.09	0.21	0.20	0.19	0.27	0.21
First rep. health Excellent	0.28	0.13	0.23	0.28	0.19	0.25	0.09	0.11	0.13	0.08	0.07
First rep. health Very Good	0.33	0.21	0.33	0.33	0.27	0.32	0.18	0.18	0.22	0.16	0.17
First rep. health Good	0.26	0.33	0.39	0.26	0.27	0.27	0.31	0.29	0.27	0.28	0.28
First rep. health Fair	0.10	0.25	0.05	0.10	0.17	0.12	0.32	0.27	0.23	0.33	0.40
First rep. health Poor	0.03	0.08	0.01	0.03	0.10	0.04	0.10	0.15	0.15	0.15	0.08
Healthy	0.78	0.49	0.72	0.78	0.65	0.71	0.41	0.48	0.52	0.35	0.38
Smoking	0.20	0.29	0.27	0.18	0.15	0.15	0.20	0.20	0.20	0.24	0.22
OOPExpenditure	280.49	321.74	230.69	397.50	258.99	244.14	331.60	369.69	353.44	416.51	434.74
Insured	0.92	0.88	0.88	0.94	0.95	0.95	0.94	0.95	0.93	0.93	0.86
Uninsured	0.08	0.12	0.12	0.06	0.05	0.05	0.06	0.05	0.07	0.07	0.14
Public health insurance	0.32	0.50	0.37	0.33	0.45	0.43	0.60	0.57	0.60	0.73	0.77
Private health insurance	0.68	0.50	0.63	0.67	0.55	0.57	0.40	0.43	0.40	0.27	0.23
Observations	80131	29707	10462	47279	23412	12561	4561	8518	7994	2710	1139

Notes: Core samples unweighted summary statistics of heads of households in the PSID 1984–2019. The first column shows the sample of 40–80 year olds who report their health status in at least one wave when they were between 45–55 years old. Column (2) shows individuals who reported a poor health status in at least one year when they were between 45–55 years old. Column (3) show individuals who are between 40–80 years old and alive in at least one year when they are between 60–70 years old. Column (4) are individuals who are between 60–70 years old and column (5) shows a smaller sample of only those 60–70 year olds who reported a health status when they were younger at ages 45–55. Columns (6)–(10) reports subsamples of the 60–70 year olds with information from their 45–55 age period and includes only individuals who reported at ages 45–55 to be either sick, having a work limiting health problem, being unemployed, being sick and unemployed, and being sick and uninsured, respectively.

Table A.4: Summary statistics by health state between ages 45–55

	Sick at 45_55					
	Healthy		Sick		Total	
	No.	%	No.	%	No.	%
<b>Health Lim.Wrk at 45_55</b>						
No-Wrk-Limit	18,470	81.3%	4,911	33.3%	23,381	62.4%
Wrk-Limit	4,261	18.7%	9,825	66.7%	14,086	37.6%
Total	22,731	100.0%	14,736	100.0%	37,467	100.0%
<b>HH:Health Lim.Wrk at 45_55</b>						
No-Wrk-Limit	15,593	68.6%	4,029	27.3%	19,622	52.4%
Wrk-Limit	7,140	31.4%	10,707	72.7%	17,847	47.6%
Total	22,733	100.0%	14,736	100.0%	37,469	100.0%
<b>Unemployed at 45_55</b>						
Not-Unempl	16,898	74.3%	5,841	39.6%	22,739	60.7%
Unemployed	5,835	25.7%	8,895	60.4%	14,730	39.3%
Total	22,733	100.0%	14,736	100.0%	37,469	100.0%
<b>Uninsured at 45_55</b>						
Insured	15,480	85.5%	7,380	70.2%	22,860	79.9%
Uninsured	2,622	14.5%	3,138	29.8%	5,760	20.1%
Total	18,102	100.0%	10,518	100.0%	28,620	100.0%
<b>Female</b>						
0	17,857	78.6%	9,393	63.7%	27,250	72.7%
1	4,876	21.4%	5,343	36.3%	10,219	27.3%
Total	22,733	100.0%	14,736	100.0%	37,469	100.0%
<b>College</b>						
0	15,798	69.5%	13,218	89.7%	29,016	77.4%
1	6,935	30.5%	1,518	10.3%	8,453	22.6%
Total	22,733	100.0%	14,736	100.0%	37,469	100.0%

Notes: Tabulation is based on PSID 1984–2019 data of heads of households between ages 45–55.

## B Medical Expenditure Panel Survey (MEPS)

### B.1 Sample selection

We primarily use data from the Medical Expenditure Panel Survey (MEPS) from the years 1996–2018 for our estimation and calibration. MEPS provides a nationally representative survey about health care use, health expenditures, health insurance coverage as well as demographic data on income, health status, and other socioeconomic characteristics. The original household component of MEPS was initiated in 1996. Each year about 15,000 households are selected and interviewed five times over two full calendar years.

MEPS groups individuals into families similar to the CPS (Current Population Survey) as well as Health Insurance Eligibility Units (HIEU) which are subsets of households that typically include individuals covered under the same health insurance—usually a couple and their children. We do abstract from family size effects and concentrate on adult head of households aged 40–80. A variable in a MEPS survey of year  $t$  is typically represented three times as either VARNAME13, VARNAME24, and VARNAME35, where 13 indicates that this variable is either a response of a first round interview of an individual who entered the survey in year  $t$  or the third round interview of an individual who entered the survey in year  $t - 1$ . Similarly 24 indicates that this response is the second interview response of the individual who entered in year  $t$  or the fourth round response of the individual who entered the previous year  $t - 1$ . Finally, 35 indicates that this variable is the response from the third interview of an individual who entered in year  $t$  or the final fifth round interview response from an individual who entered in the prior year  $t - 1$  and then subsequently exits the survey. We drop outlier observations from individuals whose gross household income exceeds 1 million USD, whose labor income exceeds 400,000 USD, and whose medical spending exceeds 100,000 USD.

## B.2 Summary statistics

Summary statistics of the unweighted sample are presented in Table B.1<sup>23</sup>

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<sup>23</sup>All dollar values are denominated in 2018 USD using the OECD-CPI for the U.S. from OECD (2022), "Inflation (CPI)" (indicator) at: <https://doi.org/10.1787/eee82e6e-en> (accessed on 09 November 2022).

Table B.1: MEPS Summary Statistics

	(1) All Age:20–91	(2) SubSample: Age:40–80	(3) Working Age: Age:40–65	(4) LaborInc>\$400: Age:40–65
Year	2007.59	2007.71	2007.66	2007.49
Age of head of household	48.69	56.38	51.51	50.66
Five-year age groups	6.35	7.89	6.92	6.75
Female	0.54	0.52	0.52	0.48
Married/Partnered	0.46	0.51	0.53	0.55
Black	0.15	0.16	0.16	0.15
Years of education	11.80	11.75	11.91	12.25
Avge hourly wage over 3 waves	21.41	23.63	23.90	23.95
Labor income (in \$1,000)	30.38	31.20	37.92	49.20
Labor income of HH (in \$1,000)	50.75	53.21	63.72	76.00
Pre-government HH income (in \$1,000)	62.67	68.59	73.69	83.80
Pre-government HIEU income (in \$1,000)	45414.81	43872.08	42724.18	45114.34
Total health expenditures (in \$1,000)	5.07	6.08	5.11	3.97
healthExpenditureHIEU	5585.57	5396.41	5256.50	5531.60
Total health expenditures HIEU (in \$1,000)	9.30	10.86	9.80	8.60
Out-of-pocket health exp	0.80	0.95	0.84	0.78
OOPEXpenditureHIEU	975.48	942.52	918.22	966.72
Total OOP expenditure HIEU (\$1,000)	1.43	1.71	1.62	1.59
No high school degree	0.24	0.24	0.22	0.18
High school degree	0.52	0.51	0.52	0.53
College or higher degree	0.23	0.24	0.25	0.29
Insured	0.85	0.88	0.84	0.84
Public health insurance	0.23	0.24	0.16	0.07
Private health insurance	0.62	0.63	0.68	0.77
d_H_excellent	0.17	0.14	0.15	0.18
d_H_very_good	0.38	0.35	0.36	0.40
d_H_good	0.30	0.32	0.31	0.31
d_H_fair	0.12	0.15	0.14	0.09
d_H_poor	0.03	0.04	0.04	0.01
Observations	290677	175988	134517	103755

Notes: Unweighted summary statistics of heads of households based on MEPS 1996–2018.

### B.3 Cohort effects

Panel data variables over the life cycle of an individual are determined by age, time and cohort effects. Since our model only explicitly accounts for age effects, we should ideally remove time and cohort effects from the data in order to make life cycle observations from the data consistent with life cycle statistics generated by the model. Since age, time and cohort effects are perfectly collinear it is difficult to estimate all three simultaneously (e.g., Jung and Tran (2014)). The literature (e.g., Kaplan (2012)) suggests to conduct separate analyses once controlling for the cohort effect and in a repeat exercise controlling for the time effect in order to assess modeling implications. In this work we explicitly control for cohort effects of wages, income, wealth and health expenditures by regressing the log of the output variable on a set of age and cohort dummies. We focus on controlling of cohort effects because Jung and Tran (2014) show that they seem to be large in health expenditure data and time effects can be somewhat mitigated by deflating with the CPI index. We then use predictions of these regressions to generate cohort-adjusted

variables with the birth cohort 1945–1954 as reference group.

## B.4 Unbiased wage profiles

We follow [Rupert and Zanella \(2015\)](#) and [Casanova \(2013\)](#) and estimate a selection model to remove biases in self reported wages. [Rupert and Zanella \(2015\)](#) use PSID and CPS data and then employ a Tobit 2-step procedure based on [Wooldridge \(1995\)](#) to estimate selection corrected wage profiles. They find that once wage profiles are bias corrected they tend to be very flat which contradicts the often used hump-shaped wage profiles. Similarly, [Casanova \(2013\)](#) uses HRS data and finds evidence of flat wage profiles but no selection bias. In our selection model we include fourth order polynomials in age, a health status variable, whether someone lives with a partner, family size, schooling, gender, and an indicator for part-time work. We use indicator variables for whether an individual is older than 62 and a second indicator variable for whether an individual is older 65 in the selection equation as is customary in this literature. These two indicator variables are exclusion restrictions and not included in the outcome equation of the selection model. Figure B.2 shows the wage profiles for healthy and sick types and the three educational groups. We only use observations from individuals whose wage income exceeds 400 USD.<sup>24</sup>

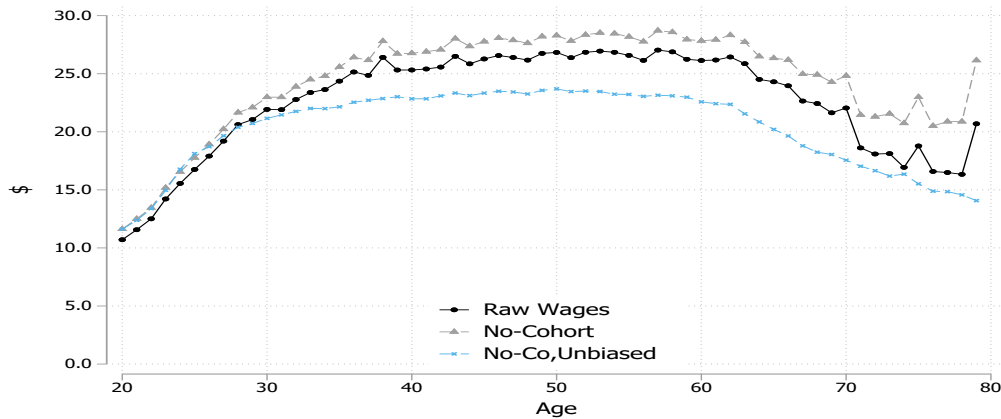


Figure B.1: Raw wages vs. unbiased and cohort adjusted wage profiles

*Notes:* Data source is MEPS 1996–2018, heads of HIEU, population weighted. We report raw hourly wages, cohort adjusted wages, and cohort adjust unbiased wages. Unbiased wages are based on a selection model. The latter is used as wage efficiency input. We use a dummy variable approach to estimate unbiased wages profiles for two health (healthy vs. sick) and two education (no college vs. college) types.

<sup>24</sup>[Blundell, Reed and Stoker \(2003\)](#), [Arellano and Bonhomme \(2017\)](#), [Chiappori, Dias and Meghir \(2018\)](#), and more recently [De Nardi, Fella and Paz-Pardo \(2024\)](#) use selection type models with exclusion restrictions to estimate wages. Instruments that have been used in the literature in the participation equation include potential welfare income (when not working), home ownership status, college dummies, marital status, a decade of birth dummy, interactions of the latter two, dummies for the years that have passed since the birth of the first child, interactions of those with marital status, dummy for husband employment (when estimating the labor participation equation of of women), and dummy for the presence of grandparents in the household. Interestingly, [De Nardi, Fella and Paz-Pardo \(2024\)](#) report fairly robust potential wage profiles across the different specifications.

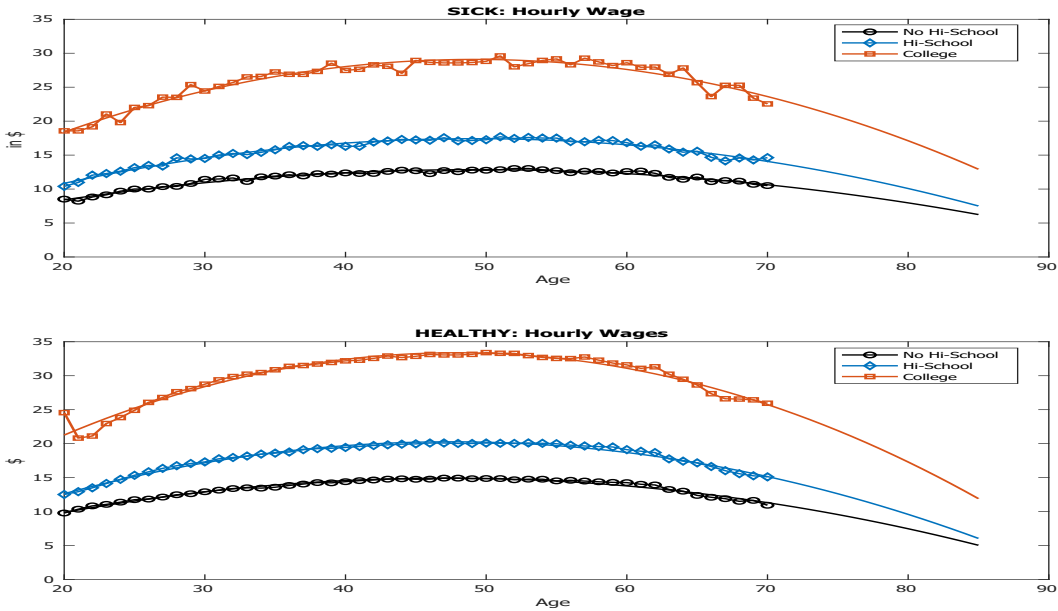


Figure B.2: Selection bias adjusted wage profiles of heads of HIEUs

Notes: Data source is MEPS 1996–2018, heads of HIEU, population weighted. This is used as wage efficiency input by health and education type into the model.

## B.5 Health care expenditure data

MEPS provides high quality health expenditure and health care utilization data. The MEPS Household Component (HC) collects data in each round on use and expenditures for office- and hospital-based care, home health care, dental services, vision aids, and prescribed medicines. In addition, the MEPS Medical Provider Component (MPC) is a follow-back survey that collects data from a sample of medical providers and pharmacies that were used by sample persons in a given year. Expenditure data collected in the MPC are generally regarded as more accurate than information collected in the HC and are used to improve the overall quality of MEPS expenditure data. Expenditures in MEPS refer to what is paid for health care services. Expenditures are defined as the sum of direct payments for care provided during the year, including out-of-pocket payments and payments by private insurance, Medicaid, Medicare, and other sources. Payments for over-the-counter drugs are not included in MEPS and neither are payments for long-term care. Similarly payments not related to specific medical events, such as Medicaid Disproportionate Share and Medicare Direct Medical Education subsidies, are also not included. MEPS records actual payments made and not original charges which tend to be much higher. However, it has become customary to apply discounts. In addition charges associated with uncollected liabilities, bad debt and charitable care do not constitute actual health care expenses and are therefore not counted. We drop 443 observations (out of 239,170) with health expenditure larger than USD 100,000 so that our estimates are not driven by outliers.

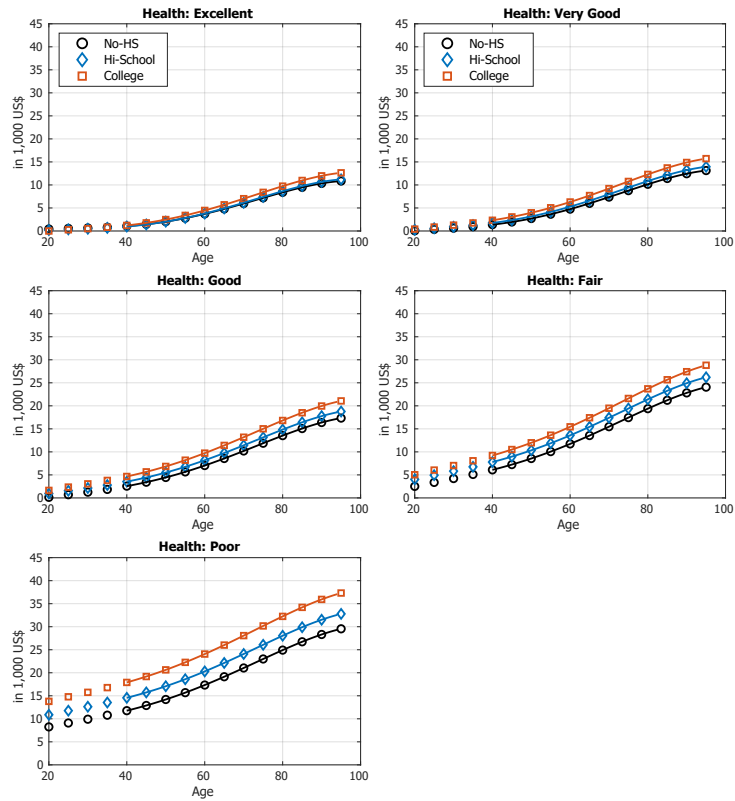


Figure B.3: Average health spending by health state

Notes: Data source is MEPS 1996–2018, heads of HIEU, population weighted. Cohort adjusted average health spending by self-reported health state and age in 2009 USD.

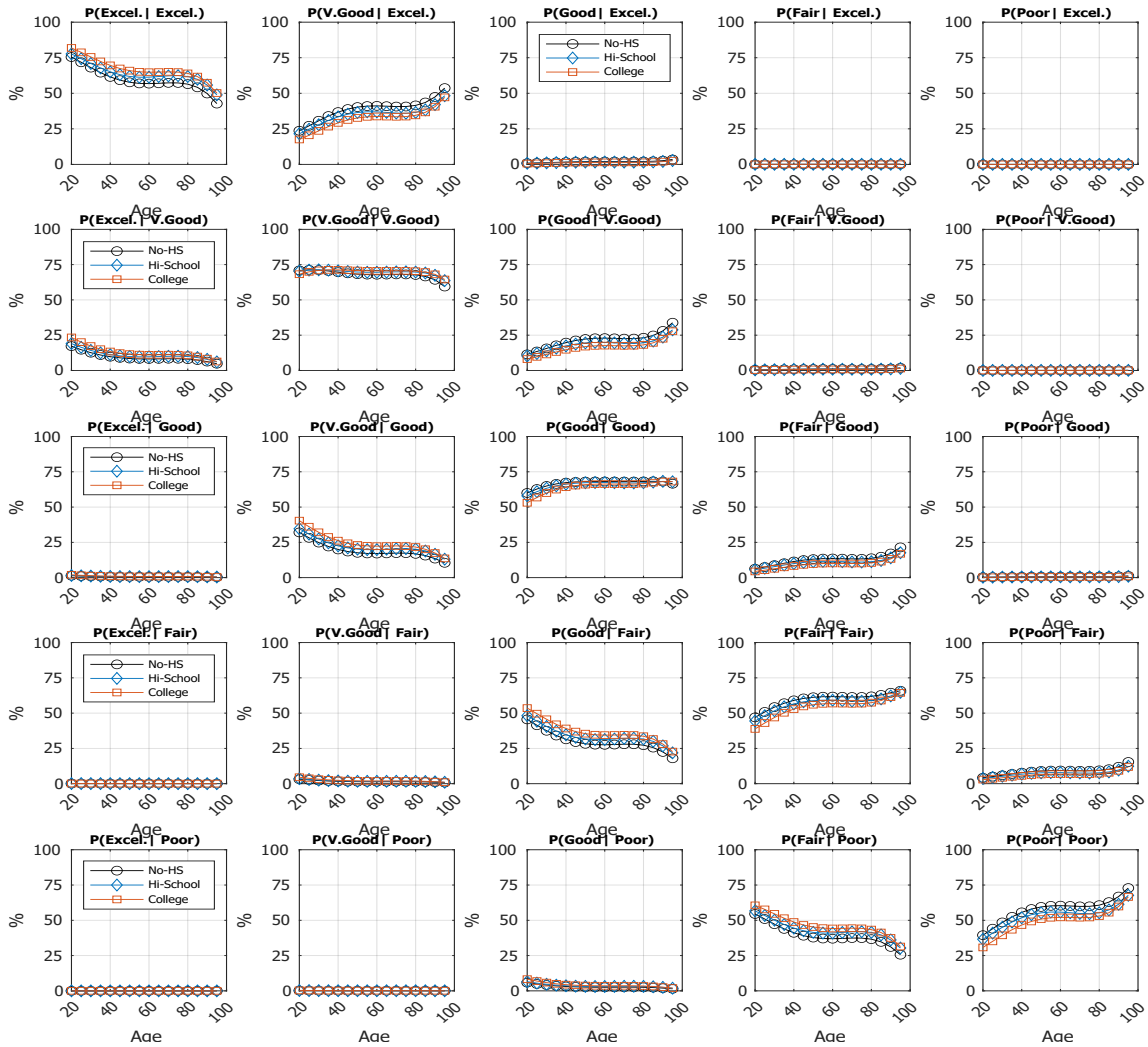


Figure B.4: Conditional health status transition probabilities

Notes: Data source is MEPS 1996–2018, heads of HIEU, population weighted. The profiles are based on predictions of an ordered logit model with controls for cohort effects.

## B.6 Private employer health insurance (ehi) status

MEPS asks detailed questions about the type and length of health insurance coverage. If health insurance is offered through the current main job (OFFER31X, OFFER42X, OFFER 53X) an individual can opt into buying employer sponsored (group) health insurance. The offer variable is automatically set to one (and skipped in the survey) if the individual reports having health insurance via their employer. We set the indicator variable GROUP-OFFER equal to one if the individual reports having received a health insurance offer from their employer in either one of the three interview rounds. In addition, a second variable asks whether an individual has had public (PUBJAx–PUBDEx) or private health insurance (PRIJAx–PRIDEx) for each month. In addition, if it is private health insurance, the survey asks whether

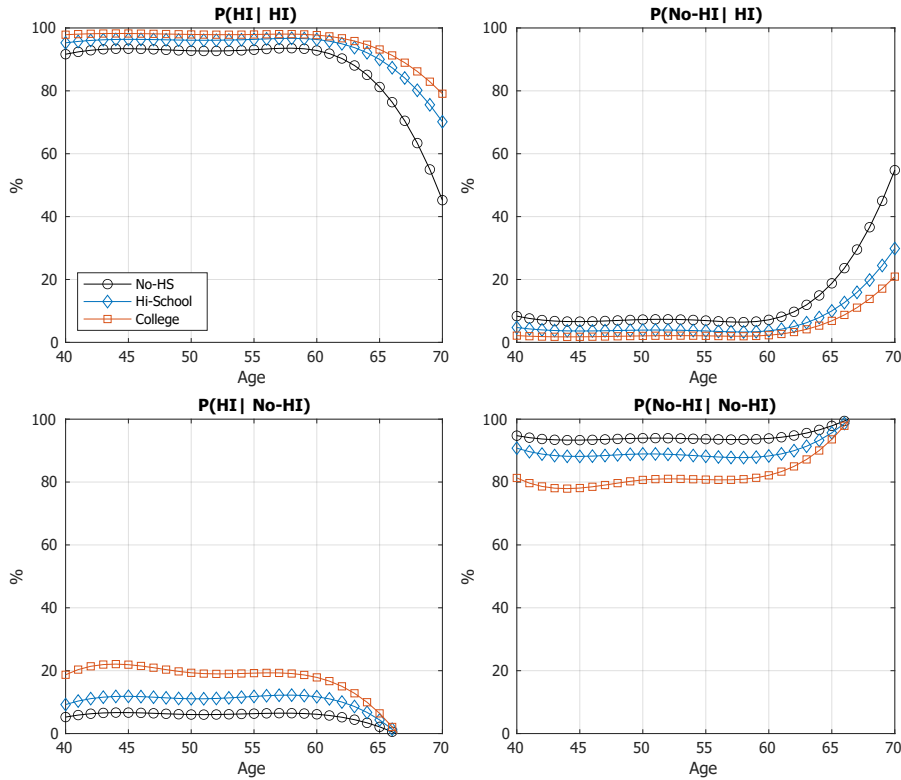


Figure B.5: **Conditional employer health insurance status transition probabilities**

Notes: Data source is MEPS 1996–2018, heads of households, population weighted. Using spline interpolation to get annual frequencies.

the insurance is from an employer or union (PEGJA<sub>x</sub>–PEGDE<sub>x</sub>). We define an individual as having employer provided group insurance (GHI) in a given year if she is covered for at least 8 months with employer provided insurance, she is otherwise classified as having individual private health insurance (IHI). We estimate an ordered logit model and use it to predict the GHI offer probability for each age-education group where we distinguish between individuals with less than high school, high school, or college level education. The predicted probabilities of receiving a GHI offer from an employer are shown in Figure B.5.

## B.7 Coinsurance rates

We define the coinsurance rate as the fraction of out-of-pocket health expenditures over total health expenditures. The coinsurance rates in our model therefore include copayments and other direct out-of-pocket payments. We use MEPS data from 1999–2000 and calculate the average coinsurance rate of heads of HIEU (population weighted) by age for all four insurance types represented in the model. Consequently we set the coinsurance rates for the different types of insurance plans to  $\gamma^{\text{hi}} = 0.31$ ,  $\gamma^{\text{maid}} = 0.11$ , and  $\gamma^{\text{mcare}} = 0.30$  respectively.

## C Empirical results

### C.1 Additional risky asset share regression results

Table C.1: Risky asset share and poor health status

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sick at 45_55	-0.028*** (0.008)		-0.040*** (0.010)		-0.035*** (0.010)		0.008 (0.017)	
Health Lim.Wrk at 45_55		-0.002 (0.007)		-0.009 (0.009)		-0.007 (0.010)		0.000 (0.013)
Unemployed at 45_55	-0.004 (0.007)	-0.008 (0.007)	0.005 (0.009)	-0.000 (0.009)	-0.004 (0.010)	-0.009 (0.010)	0.035** (0.015)	0.037** (0.015)
Uninsured at 45_55	-0.030*** (0.009)	-0.031*** (0.009)	-0.047*** (0.010)	-0.049*** (0.009)	-0.031*** (0.009)	-0.032*** (0.009)	-0.018 (0.028)	-0.018 (0.028)
Healthy	0.046*** (0.008)	0.056*** (0.007)	0.045*** (0.010)	0.059*** (0.009)	0.033*** (0.007)	0.040*** (0.007)	0.040*** (0.014)	0.038*** (0.014)
Insured	0.029* (0.015)	0.029* (0.015)	0.027 (0.017)	0.028 (0.017)	0.015 (0.011)	0.015 (0.011)	0.010 (0.033)	0.009 (0.033)
Smoking	-0.065*** (0.009)	-0.067*** (0.009)	-0.073*** (0.010)	-0.077*** (0.010)	-0.052*** (0.009)	-0.054*** (0.009)	-0.029* (0.017)	-0.029* (0.017)
Female	0.008 (0.010)	0.006 (0.010)	0.010 (0.012)	0.009 (0.012)	0.002 (0.012)	0.000 (0.012)	-0.014 (0.022)	-0.014 (0.022)
Married/Partnered	0.045*** (0.009)	0.045*** (0.009)	0.057*** (0.012)	0.056*** (0.012)	0.040*** (0.012)	0.040*** (0.012)	0.001 (0.020)	0.000 (0.020)
Black	-0.071*** (0.008)	-0.073*** (0.008)	-0.084*** (0.010)	-0.086*** (0.010)	-0.073*** (0.011)	-0.075*** (0.010)	-0.008 (0.018)	-0.007 (0.018)
High school degree	0.024** (0.011)	0.028*** (0.011)	0.025** (0.010)	0.032*** (0.010)	0.023** (0.010)	0.029*** (0.010)	0.037 (0.031)	0.035 (0.031)
College	0.099*** (0.012)	0.104*** (0.012)	0.095*** (0.013)	0.103*** (0.013)	0.104*** (0.014)	0.112*** (0.013)	0.057* (0.032)	0.055* (0.032)
tanh(preGovIncHH)	-0.047 (0.032)	-0.047 (0.032)	-0.047** (0.021)	-0.042* (0.022)	-0.039* (0.020)	-0.039* (0.020)	-0.020 (0.041)	-0.021 (0.041)
tanh(assets)	0.044*** (0.006)	0.044*** (0.006)	0.063*** (0.006)	0.064*** (0.006)	0.032*** (0.005)	0.033*** (0.005)	-0.001 (0.025)	-0.002 (0.025)
Initial (median) Stock-Ratio 35-45	0.212*** (0.012)	0.215*** (0.012)	0.214*** (0.017)	0.220*** (0.017)	0.220*** (0.021)	0.224*** (0.021)	0.097*** (0.021)	0.099*** (0.021)
Initial Health (0-16) Excellent	-0.055*** (0.018)	-0.055*** (0.018)	-0.061** (0.027)	-0.066** (0.026)	-0.059** (0.024)	-0.059** (0.024)	-0.026 (0.035)	-0.027 (0.035)
Initial Health (0-16) Very Good	0.148*** (0.046)	0.146*** (0.046)	0.200*** (0.027)	0.200*** (0.026)	0.137*** (0.038)	0.135*** (0.038)	0.060 (0.037)	0.058 (0.037)
Debt excl. home (\$1,000)	0.000*** (0.000)	0.000*** (0.000)	0.000* (0.000)	0.000* (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Observations	5625	5671	5625	5671	5625	5671	2335	2346
R <sup>2</sup>	0.323	0.323	0.302	0.301				
Conditional P(Y>0)	No	No	No	No	No	No	Yes	Yes
Random Effects	No	No	No	No	Yes	Yes	Yes	Yes
Weighted	No	No	Yes	Yes	No	No	No	No

Standard errors in parentheses

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

*Notes:* The dependent variable is the detrended ratio of stocks in the financial portfolio at ages 60–70 including individuals with zero stock holdings. The independent variables of interest are indicator variables for whether an individual has reported being in bad health at ages 45–55 or whether an individual has reported to ever having a work limiting health problem at ages 45–55. Column (7) and (8) are estimated on the subsample of individuals with positive stock holdings. The regressions also include controls for age, an indicator for Hispanic, size of outstanding mortgage and size of other home loans. Data source: Heads of households in the **PSID 1984–2019**.

Table C.2: Risky asset share and poor health status (HRS sample)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Sick at 45_55	-0.025*** (0.007)		-0.030*** (0.009)		-0.038*** (0.010)		0.003 (0.015)		-0.002 (0.012)	
Health Lim.Wrk at 45_55		-0.020*** (0.007)		-0.023** (0.009)		-0.026** (0.010)		0.000 (0.014)		-0.003 (0.011)
Unemployed at 45_55	-0.026*** (0.007)	-0.024*** (0.007)	-0.027*** (0.009)	-0.026*** (0.009)	-0.029*** (0.010)	-0.028*** (0.011)	0.005 (0.014)	0.005 (0.015)	-0.003 (0.012)	-0.003 (0.012)
Uninsured at 45_55	-0.024*** (0.007)	-0.023*** (0.007)	-0.013 (0.009)	-0.013 (0.009)	-0.029*** (0.009)	-0.028*** (0.010)	0.006 (0.014)	0.006 (0.014)	0.020* (0.012)	0.020* (0.012)
Healthy	0.037*** (0.007)	0.043*** (0.007)	0.046*** (0.009)	0.053*** (0.008)	0.021*** (0.007)	0.025*** (0.007)	0.007 (0.012)	0.007 (0.011)	0.007 (0.012)	0.008 (0.012)
Insured	0.035*** (0.009)	0.036*** (0.009)	0.036*** (0.012)	0.036*** (0.012)	0.013 (0.008)	0.013 (0.008)	0.002 (0.014)	0.002 (0.014)	0.010 (0.017)	0.010 (0.017)
Smoker	-0.021*** (0.007)	-0.021*** (0.007)	-0.021** (0.010)	-0.021** (0.010)	-0.011 (0.009)	-0.011 (0.009)	0.002 (0.013)	0.002 (0.013)	0.020 (0.014)	0.020 (0.014)
Female	0.000 (0.009)	0.000 (0.009)	0.010 (0.012)	0.010 (0.012)	-0.008 (0.012)	-0.008 (0.012)	-0.017 (0.018)	-0.018 (0.018)	0.021 (0.019)	0.021 (0.019)
Married/Partnered	0.045*** (0.009)	0.044*** (0.009)	0.059*** (0.011)	0.059*** (0.011)	0.037*** (0.010)	0.037*** (0.010)	-0.031** (0.016)	-0.031** (0.016)	-0.002 (0.017)	-0.002 (0.017)
Black	-0.074*** (0.008)	-0.075*** (0.008)	-0.057*** (0.008)	-0.058*** (0.008)	-0.075*** (0.012)	-0.076*** (0.012)	-0.019 (0.019)	-0.019 (0.019)	-0.029** (0.014)	-0.030** (0.014)
High school degree	0.043*** (0.008)	0.045*** (0.008)	0.051*** (0.008)	0.053*** (0.008)	0.042*** (0.011)	0.047*** (0.011)	0.006 (0.019)	0.005 (0.019)	0.033** (0.014)	0.033** (0.014)
College or higher	0.095*** (0.010)	0.098*** (0.010)	0.110*** (0.011)	0.113*** (0.011)	0.096*** (0.014)	0.102*** (0.014)	0.016 (0.021)	0.016 (0.021)	0.036** (0.015)	0.036** (0.015)
tanh(preGovIncHH)	0.012 (0.021)	0.012 (0.021)	0.055** (0.025)	0.053** (0.025)	0.014 (0.019)	0.013 (0.019)	-0.048 (0.038)	-0.048 (0.038)	-0.032 (0.034)	-0.032 (0.034)
tanh(assets)	0.046*** (0.006)	0.046*** (0.006)	0.054*** (0.006)	0.054*** (0.006)	0.025*** (0.006)	0.026*** (0.006)	-0.004 (0.015)	-0.004 (0.015)	0.008 (0.013)	0.008 (0.013)
Initial (mean) Stock-Ratio 40-51	0.258*** (0.013)	0.260*** (0.013)	0.259*** (0.018)	0.259*** (0.018)	0.264*** (0.019)	0.267*** (0.019)	0.188*** (0.023)	0.188*** (0.023)	0.198*** (0.021)	0.198*** (0.021)
Debt (\$1,000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Observations	6144	6143	6111	6110	6144	6143	3072	3072	3065	3065
R <sup>2</sup>	0.290	0.289	0.284	0.283					0.080	0.080
Conditional P(Y>0)	No	No	No	No	No	No	Yes	Yes	Yes	Yes
Random Effects	No	No	No	No	Yes	Yes	Yes	Yes	No	No
Weighted	No	No	Yes	Yes	No	No	No	No	Yes	Yes

Standard errors in parentheses

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

*Notes:* The dependent variable is the detrended ratio of stocks in the financial portfolio at ages 60–70 including individuals with zero stock holdings. The independent variables of interest are indicator variables for whether an individual has reported being in bad health at ages 45–55 or whether an individual has reported to ever having a work limiting health problem at ages 45–55. Column (7) and (8) are estimated on the subsample of individuals with positive stock holdings. The regressions also include controls for age, an indicator for Hispanic, size of outstanding mortgage and size of other home loans. Data source: Heads of households in the **HRS 1992–2018**.

## C.2 Two-part and selection models

In this section we estimate a two-part model and a selection model that consist of a participation equation (whether an individual invests or not) and conditional on investing and outcome equation (the level of the asset share). Our estimates from these two models show the relative importance of the extensive and intensive margins. In the participation equation (the extensive margin), bad health has a negative effect on participating in risky investments into stocks. However, once an individual has decided to

invest into stocks, bad health has virtually no effect on the share of stock holdings in the overall financial portfolio (the intensive margin). We conclude that the effects of poor health on the wealth portfolio operate primarily through the extensive margin.

Table C.3: Two-Part model: Risky and safe asset share

	Stock Share	P(Stocks)	Safe A. Share	P(Safe A.)	Stock Share	P(Stocks)	Safe A. Share	P(Safe A.)
Sick at 45_55	0.000 (0.015)	-0.095*** (0.018)	0.040*** (0.011)	-0.039*** (0.013)				
Health Lim.Wrk at 45_55					-0.003 (0.010)	0.001 (0.012)	0.002 (0.008)	-0.016* (0.010)
Unemployed at 45_55	0.035*** (0.013)	-0.035** (0.016)	-0.006 (0.010)	-0.039*** (0.011)	0.033*** (0.011)	-0.056*** (0.012)	0.006 (0.008)	-0.055*** (0.010)
Uninsured at 45_55	-0.003 (0.027)	-0.122*** (0.019)	0.052*** (0.012)	-0.097*** (0.021)	-0.019 (0.023)	-0.077*** (0.017)	0.038*** (0.012)	-0.054*** (0.013)
Initial (median) Stock-Ratio 35-45	0.113*** (0.018)	0.338*** (0.028)	-0.211*** (0.017)	0.066*** (0.015)	0.099*** (0.016)	0.350*** (0.022)	-0.211*** (0.013)	0.053*** (0.017)
Observations	2335	5625	4746	5625	2346	5671	4783	5671

Standard errors in parentheses

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Notes: The dependent variables are: (i) an indicator variable for whether an individual has investments in risky assets (participation equation); (ii) the detrended risky asset share conditional on having investments in risky assets (outcome equation); (iii) an indicator variable for whether an individual has investments in safe assets (participation equation) and (iv) the safe asset share conditional on having such investments (outcome equation). All four variables refer to the financial wealth portfolio at ages 60–70. The independent variables of interest are indicator variables for whether an individual has reported being in bad health at ages 45–55 or whether an individual has reported to ever having a work limiting health problem at ages 45–55. Additional control variables not shown in the table include: age, health status, insurance status, smoking status, gender, marriage status, number of children, race, education indicator for college or higher, debt, mortgage, overall asset level, cohort controls, time trend controls, region controls, as well as initial health at age 0–16. The participation equations are based on a linear probability model and are indicated as P(). They additionally include controls for high school status and time year indicators. Data source: Heads of households in the PSID 1984–2019. Estimates based on family unit sampling weights.

**Table C.4: Selection model: Risky and safe asset share**

	Stock Share	P(Stocks)	Safe A. Share	P(Safe A.)	Stock Share	P(Stocks)	Safe A. Share	P(Safe A.)
Sick at 45_55	0.003 (0.015)	-0.271*** (0.051)	0.036*** (0.009)	-0.198*** (0.058)				
Health Lim.Wrk at 45_55					-0.001 (0.010)	-0.007 (0.046)	0.004 (0.008)	-0.052 (0.055)
Unemployed at 45_55	0.034*** (0.012)	-0.175*** (0.047)	0.003 (0.008)	-0.232*** (0.053)	0.035*** (0.012)	-0.220*** (0.047)	0.007 (0.008)	-0.251*** (0.055)
Uninsured at 45_55	-0.027 (0.026)	-0.382*** (0.076)	0.044*** (0.012)	-0.170*** (0.064)	-0.025 (0.027)	-0.393*** (0.076)	0.045*** (0.012)	-0.178*** (0.064)
Initial (median) Stock-Ratio 35-45	0.107*** (0.028)	1.085*** (0.080)	-0.212*** (0.014)	0.745*** (0.138)	0.106*** (0.028)	1.108*** (0.080)	-0.216*** (0.014)	0.759*** (0.137)
Observations	5625		5625		5671		5671	

Standard errors in parentheses

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

*Notes:* The dependent variables are: (i) an indicator variable for whether an individual has investments in risky assets (participation equation); (ii) the detrended risky asset share conditional on having investments in risky assets (outcome equation); (iii) an indicator variable for whether an individual has investments in safe assets (participation equation) and (iv) the safe asset share conditional on having such investments (outcome equation). All four variables refer to the financial wealth portfolio at age 60–70. The independent variables of interest are indicator variables for whether an individual has reported being in bad health at ages 45–55 or whether an individual has reported to ever having a work limiting health problem at ages 45–55. Additional control variables not shown in the table include: age, health status, insurance status, smoking status, gender, marriage status, number of children, race, education indicator for college or higher, debt, mortgage, overall asset level, cohort controls, time trend controls, region controls. The participation equations, indicated as P(), are based on a Probit model and additionally include controls for high school status and time year indicators.

Data source: Heads of households in the **PSID 1984–2019**. Estimates based on unweighted data.

**Table C.5: Two-Part model: Risky and safe asset share (sample of healthy-at-40 individuals)**

	Stock Share	P(Stocks)	Safe A. Share	P(Safe A.)
Sick at 45_55	0.009 (0.017)	-0.119*** (0.020)	0.046*** (0.013)	-0.039*** (0.015)
Unemployed at 45_55	0.049*** (0.013)	-0.013 (0.017)	-0.024** (0.011)	-0.037*** (0.012)
Uninsured at 45_55	-0.033 (0.031)	-0.142*** (0.023)	0.067*** (0.014)	-0.118*** (0.023)
Initial (median) Stock-Ratio 35-45	0.113*** (0.019)	0.307*** (0.028)	-0.204*** (0.018)	0.051*** (0.013)
Observations	2190	4784	4154	4784

Standard errors in parentheses

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

*Notes:* The dependent variables are: (i) an indicator variable for whether an individual has investments in risky assets (participation equation); (ii) the detrended risky asset share conditional on having investments in risky assets (outcome equation); (iii) an indicator variable for whether an individual has investments in safe assets (participation equation) and (iv) the safe asset share conditional on having such investments (outcome equation). All four variables refer to the financial wealth portfolio at ages 60–70. The independent variables of interest are indicator variables for whether an individual has reported being in bad health at ages 45–55 or whether an individual has reported to ever having a work limiting health problem at ages 45–55. Additional control variables not shown in the table include: age, health status, insurance status, smoking status, gender, marriage status, number of children, race, education indicator for college or higher, debt, mortgage, overall asset level, cohort controls, time trend controls, region controls, as well as initial health at age 0–16. The participation equations are based on a linear probability model and are indicated as P(). They additionally include controls for high school status and time year indicators.

Data source: Heads of households in the **PSID 1984–2019**. Estimates based on family unit sampling weights.

Table C.6: **Two-Part model: Risky and safe asset share (w/o IRAs)**

	Stock Share	P(Stocks)	Safe A. Share	P(Safe A.)	Stock Share	P(Stocks)	Safe A. Share	P(Safe A.)
Sick at 45_55	0.019 (0.036)	-0.043*** (0.014)	0.022* (0.012)	-0.037*** (0.014)				
Health Lim. Wrk at 45_55					0.011 (0.023)	-0.013 (0.011)	0.016* (0.009)	-0.021** (0.010)
Unemployed at 45_55	0.017 (0.026)	0.057*** (0.014)	-0.040*** (0.011)	-0.037*** (0.012)	0.016 (0.024)	0.031*** (0.011)	-0.029*** (0.010)	-0.049*** (0.010)
Uninsured at 45_55	0.018 (0.050)	-0.006 (0.014)	-0.002 (0.012)	-0.090*** (0.021)	-0.045 (0.055)	-0.004 (0.015)	0.001 (0.014)	-0.050*** (0.014)
stockNew3_ratio_Age35_45								
Observations	1025	5625	4682	5625	1031	5671	4718	5671

Standard errors in parentheses

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

*Notes:* The dependent variables are: (i) an indicator variable for whether an individual has investments in risky assets (participation equation); (ii) the detrended risky asset share conditional on having investments in risky assets (outcome equation); (iii) an indicator variable for whether an individual has investments in safe assets (participation equation) and (iv) the safe asset share conditional on having such investments (outcome equation). All four variables refer to the financial wealth portfolio at ages 60–70. The independent variables of interest are indicator variables for whether an individual has reported being in bad health at ages 45–55 or whether an individual has reported to ever having a work limiting health problem at ages 45–55. Additional control variables not shown in the table include: age, health status, insurance status, smoking status, gender, marriage status, number of children, race, education indicator for college or higher, debt, mortgage, overall asset level, cohort controls, time trend controls, region controls, as well as initial health at age 0–16. The participation equations are based on a linear probability model and are indicated as P(). They additionally include controls for high school status and time year indicators. Data source: Heads of households in the **PSID 1984–2019**. Estimates based on family unit sampling weights.

### C.3 Participation and outcome profiles

Figure C.1 shows participation (extensive margin) and portfolio share conditional on owning stocks (intensive margin) over the life cycle conditional on health status at age 45–55 based on data from PSID. In the top two panels 1.A and 1.B of Figure C.1 based on raw data. We also use three different methods to control for cohort and time effects: (i) a simple regression model with dummy variables for observation year and birth cohort in panels 2.A and 2.B; (ii) a two-part model in panels 3.A and 3.B; and (iii) a selection model in panels 4.A and 4.B. We again observe a much higher participation rate in risky asset investments of healthy individuals over the entire age range. It ranges between 40–58 percent for healthy individuals and 15–25 percent for sick individuals. Both profiles show a slight hump shape. However, if we condition on an individual reporting having stock investments and then calculate the average wealth share of risky stock investments in an individuals wealth portfolio, we observe first flat profiles for both healthy and sick types and second only very small differences in the wealth shares of risky assets between the two health types. The risky asset share is around 40 percent. We conclude that the share of financial wealth invested in stocks (and mutual funds), the risky share, varies little with age which is consistent with the finding in Bertaut and Starr-McCluer (2002).

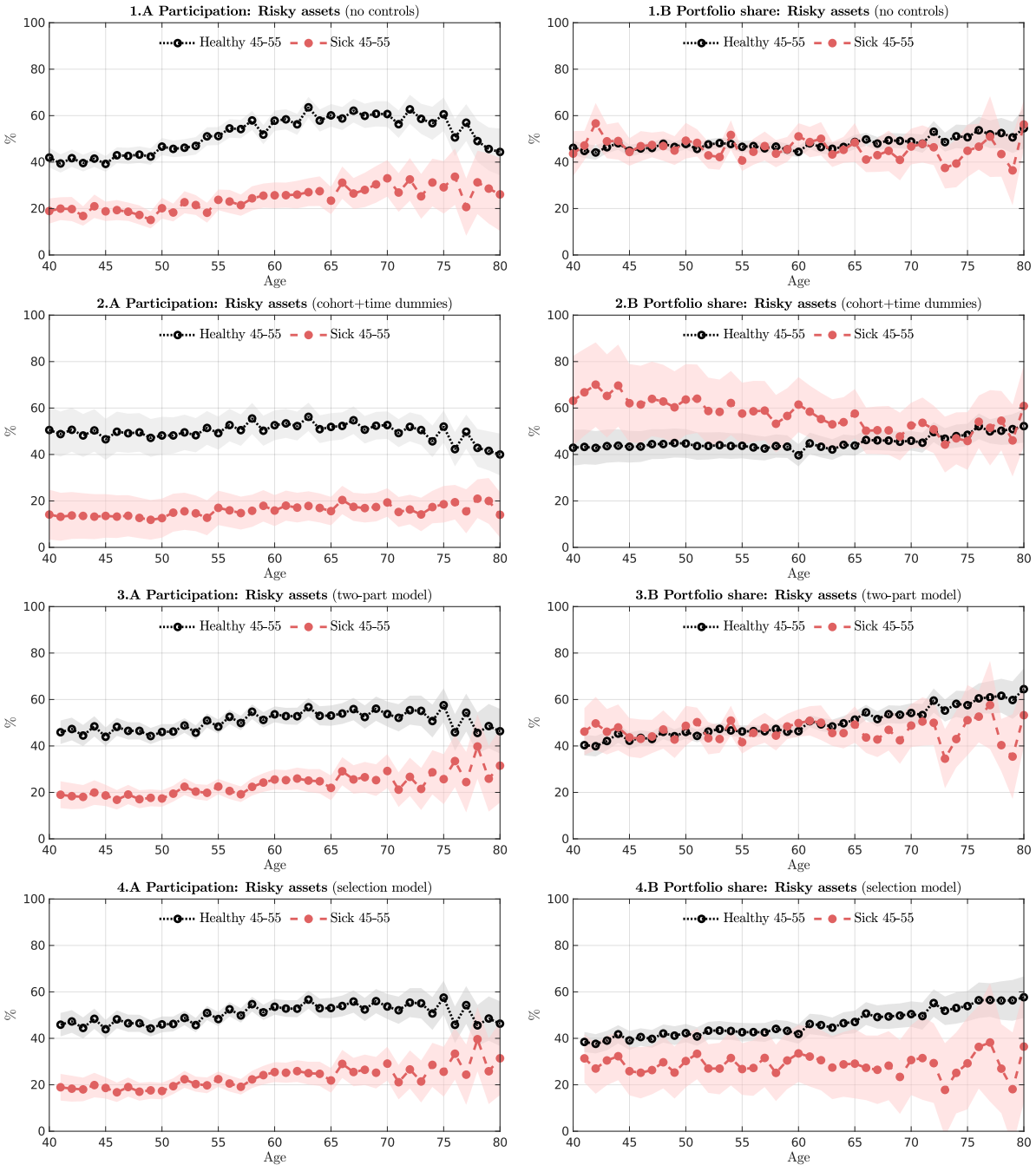


Figure C.1: Stocks profiles by health state between ages 45–55

*Notes:* We distinguish between individuals who do not report having bad health (or alternatively work limiting health issues) between ages 45–55 and individuals who do. We refer to these two groups as Healthy vs. Unhealthy. **Panel 2.A** is based on a linear probability model whereas **Panel 3.A** and **Panel 4.A** are based on Probit models. We use **unweighted** data. Controls include: health statue, insurance status, gender, living w/ partner, number of children, smoking, race, education, household income, assets, debt, mortgage, stock ratio at age 35–45, region indicator, initial health. Data sources: Heads of households in PSID 1984–2019.

# D Model estimation

## D.1 Input data

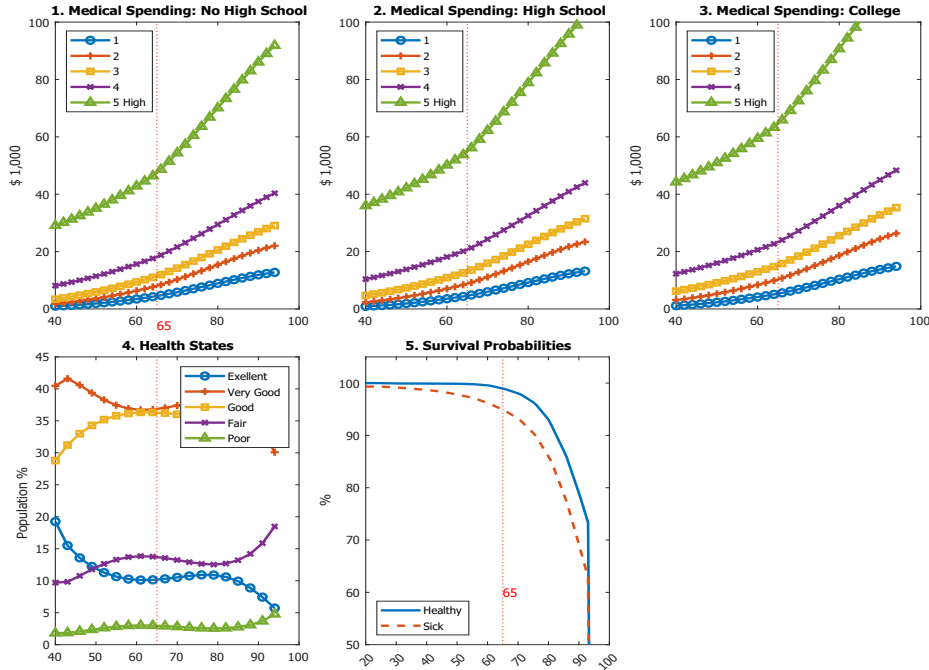


Figure D.1: Exogenous data input

*Notes:* Healthy is defined as an individual reporting either Excellent, Very Good, or Good health. Sick is defined as Fair or Poor health. Data source is MEPS 1999–2018. The observational unit is the head of a Health Insurance Eligibility Unit (HIEU) which is a subset of a household. We apply population weights. The survival probabilities in panel [6] are from [İmrohoroğlu and Kitao \(2012\)](#) who base their estimates on data from the Health and Retirement Study and life table estimates in [Bell and Miller \(2005\)](#).

## D.2 Parameter values

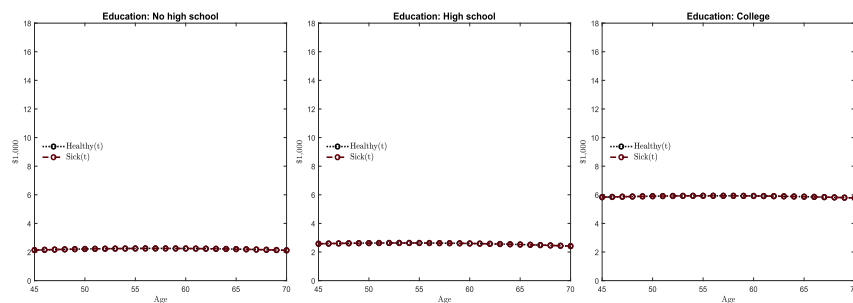


Figure D.2: The estimated costs of risky asset market participation

*Notes:* We target stock market participation rates by current health status as shown in Figure 4. The cost of stock participation is a function of age and permanent income group. It is independent of the health state.

### D.3 Estimation targets for inner loop parameters

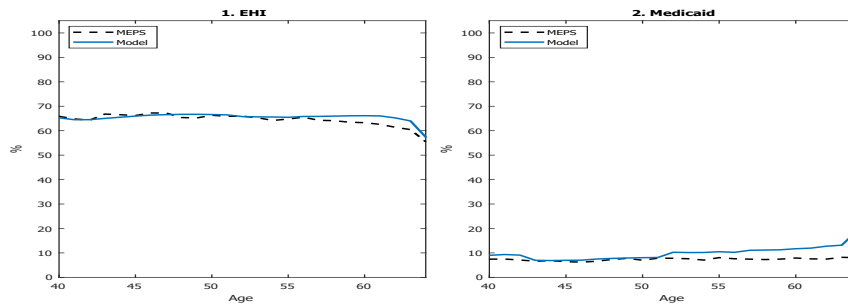


Figure D.3: **Estimation target: Insurance type** (only Medicaid is an estimation target)

Notes: We target Medicaid take-up of 40–50 year olds and 55–65 year olds in panel 2. Data source is **MEPS 1996–2018**, heads of households.

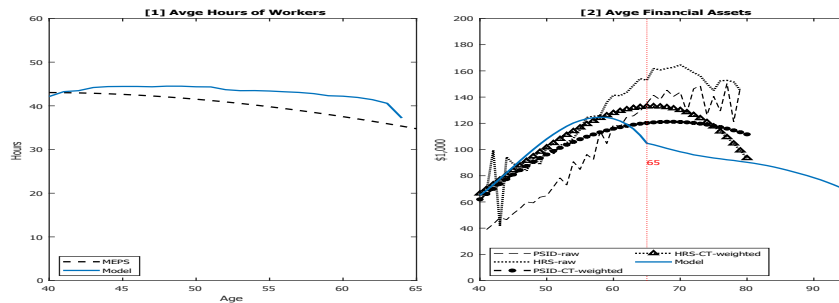


Figure D.4: **Estimation target: Labor supply and overall assets**

Notes: Data source for Panel [1] is **MEPS 1996–2018**, heads of households. Data sources for Panel [2] are heads of households in **HRS 1992–2018** and heads of households in **PSID 1984–2019**.

Figure D.5: **Estimation target: Labor force participation by education and health**

Notes: Cohort adjusted labor participation profiles by permanent income group and health state. Data source is **MEPS 1996–2018**, heads of households, population weighted.

# E Model performance

## E.1 Medical spending

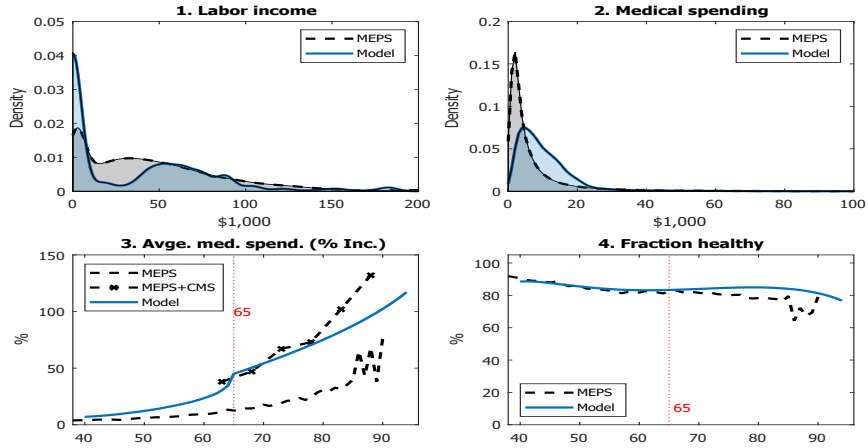


Figure E.1: Model performance: medical spending and health states

Notes: These are not calibration targets. Data sources is MEPS 1996–2018, heads of HIEU, population weighted.

## E.2 Asset distribution and life cycle profiles

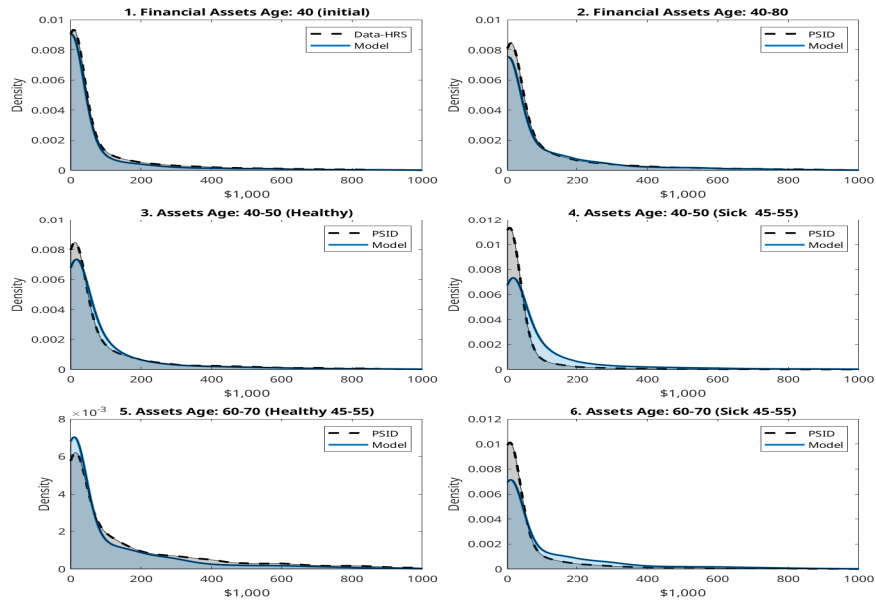


Figure E.2: Model performance: financial asset distribution by age group and health type

Notes: These are not calibration targets. Data source: head of households in PSID 1984–2019.

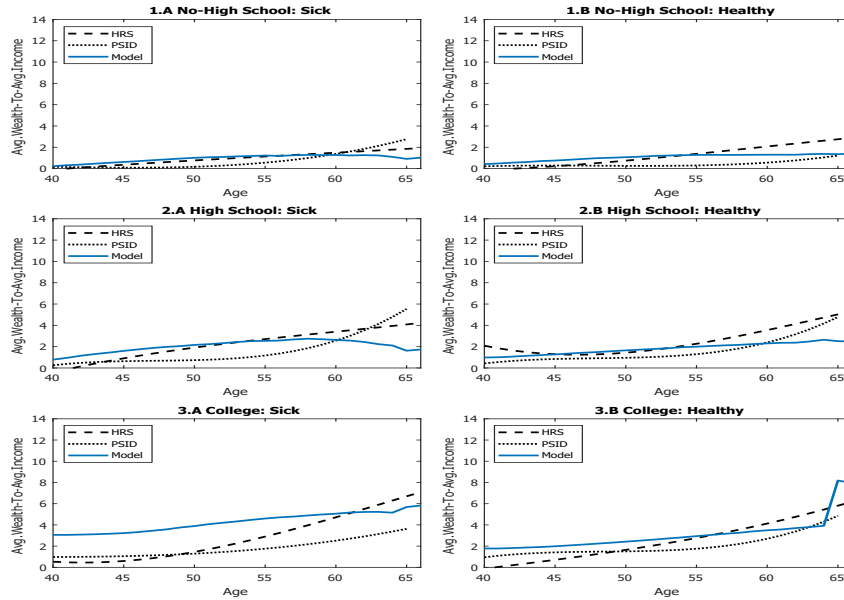


Figure E.3: **Model performance: wealth to income ratio by age group and health type**

Notes: These are not calibration targets. For asset data we use information from heads of households in **HRS 1992–2016** and **PSID 1984–2019**. Income is labor income plus government transfers.

Figure E.4a reports the distribution of assets by health and age. We find that individuals that were healthy (i.e. no bad health between 45–55) are able to shift their asset distribution when moving from ages 40–50 to ages 60–70. Conversely, individuals that were sick (i.e., had bad health between 45–55) are not able to climb up the wealth ladder and shift their asset distribution up. As seen in panel 4 of Figure E.4a, the distribution of assets of the sick is virtually unchanged after 20 years. Thus, wealth mobility is low and decreases with age for the sick.

(a)(b)  
PSIDdel

Figure E.4: **Model performance: financial asset distribution of 40–50 vs 60–70 year olds by health type at ages 45–55**

Notes: These are not calibration targets. We distinguish between individuals who do not report having bad health (or alternatively work limiting health issues) between ages 45–55 and individuals who do. We refer to these two groups as Healthy vs. Unhealthy. The graph shows asset distributions based on **unweighted “raw” data** per age and health group. Assets are corrected for cohort and time effects. Data source: Heads of households in **PSID 1984–2019**.

### E.3 Wealth mobility transitions

Table E.1: **Wealth mobility Shorrocks index: data vs. model**

	Shorrocks	Std Err		Shorrocks	Std Err
PSID			HRS		
All	0.679	0.011	All	0.660	0.015
Healthy	0.688	0.026	Healthy	0.680	0.026
Sick	0.739	0.013	Sick	0.682	0.007
Benchmark Model			Benchmark Model		
All	0.678	0.008	All	0.678	0.010
Healthy	0.662	0.012	Healthy	0.662	0.028
Sick	0.709	0.015	Sick	0.709	0.006
One Asset Model			One Asset Model		
All	0.669	0.035	All	0.716	0.005
Healthy	0.649	0.038	Healthy	0.702	0.012
Sick	0.694	0.028	Sick	0.727	0.046

*Notes:* The wealth mobility index according to [Shorrocks \(1978\)](#) provides a measure for the off diagonal entries of the wealth transition matrix  $M$  from wealth quintile  $k$  in period  $t$  to wealth quintile  $k$  in period  $t + 10$ , where  $k$  indicates the five wealth quintiles. It is calculated as  $1/(K - 1) \times (K - \text{trace}(M))$  where  $K = 5$ . With perfect immobility, the Shorrocks index is 0 and with perfect mobility it approximates 1 with small enough wealth quantile bins. Compare [Savegnago \(2016\)](#) for more details and code of a Stata implementation.

## E.4 Regression: Data vs. Model Sim data

Table E.2: Selection model: Risky and safe asset share simulated model data

	Model		PSID		Model		PSID	
	Stock Share	P(Stocks)	Stock Share	P(Stocks)	Safe A. Share	P(Safe A.)	Safe A. Share	P(Safe A.)
Sick at 45_55	0.006*** (0.001)	-0.246*** (0.003)	0.003 (0.015)	-0.271*** (0.051)	0.030*** (0.000)	0.253*** (0.003)	0.036*** (0.009)	-0.198*** (0.058)
Unemployed at 45_55	0.017*** (0.002)	-0.480*** (0.003)	0.034*** (0.012)	-0.175*** (0.047)	0.063*** (0.001)	0.474*** (0.003)	0.003 (0.008)	-0.232*** (0.053)
Uninsured at 45_55	-0.001 (0.001)	-0.074*** (0.003)	-0.027 (0.026)	-0.382*** (0.076)	0.012*** (0.000)	0.078*** (0.003)	0.044*** (0.012)	-0.170*** (0.064)
Age	0.007*** (0.000)	-0.046*** (0.000)	0.003*** (0.001)	0.012 (0.014)	0.015*** (0.000)	0.043*** (0.000)	0.002** (0.001)	0.023 (0.017)
Healthy	0.001 (0.003)	0.713*** (0.004)	0.058*** (0.017)	0.283*** (0.055)	-0.054*** (0.001)	-0.768*** (0.005)	-0.055*** (0.009)	0.154*** (0.058)
Insured	-0.015*** (0.002)	0.364*** (0.005)	0.037 (0.039)	0.377*** (0.133)	-0.050*** (0.001)	-0.355*** (0.005)	-0.046** (0.021)	0.308*** (0.100)
High school degree		0.111*** (0.004)		0.421*** (0.091)		-0.171*** (0.004)		0.469*** (0.069)
College or higher	0.003* (0.002)	0.589*** (0.005)	0.009 (0.015)	0.910*** (0.096)	-0.060*** (0.001)	-0.692*** (0.005)	-0.078*** (0.008)	0.723*** (0.092)
tanh(preGovIncHH)	0.040*** (0.002)	-0.759*** (0.005)	0.011 (0.058)	-0.158 (0.296)	0.091*** (0.001)	0.655*** (0.004)	0.047 (0.049)	0.628*** (0.213)
tanh(assets)	0.590*** (0.008)	2.659*** (0.018)	0.017 (0.028)	0.620*** (0.060)	-0.153*** (0.001)	-2.210*** (0.016)	-0.067*** (0.008)	0.305*** (0.043)
Observations	945861		5625		945861		5625	

Standard errors in parentheses

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

*Notes:* The dependent variables are the ratio of risky investments, an indicator variable for having any investments in risky stocks, the ratio of investments in safe assets, and an indicator variable for having any investments in safe assets as part of the financial wealth portfolio at ages 60–70. The independent variables of interest are indicator variables for whether an individual has reported being in bad health at ages 45–55. The columns marked **PSID** are based on data of head of households from the **PSID 1984–2019**. All remaining columns are based on simulated data from our lifecycle model with 150,000 individuals that are observed from ages 40–94. Additional control variables used in the regressions based on PSID data (which are omitted from the table) include: a college indicator, gender, race indicators, living w/ partner status, number of children, smoking status, household income, assets, debt, mortgage, other home loans, cohort controls, time trends, and states. The participation equation includes an indicator for high school degree.

**Table E.3: Selection model: Risky and safe asset share w/ simulated model data of individuals who are healthy at age 40**

	All		Healthy-at-40		All		Healthy-at-40	
	Stock Share	P(Stocks)	Stock Share	P(Stocks)	Safe A. Share	P(Safe A.)	Safe A. Share	P(Safe A.)
Sick at 45_55	0.006*** (0.001)	-0.246*** (0.003)	0.005*** (0.001)	-0.233*** (0.003)	0.030*** (0.000)	0.253*** (0.003)	0.030*** (0.001)	0.239*** (0.003)
Unemployed at 45_55	0.017*** (0.002)	-0.480*** (0.003)	0.014*** (0.002)	-0.469*** (0.003)	0.063*** (0.001)	0.474*** (0.003)	0.064*** (0.001)	0.463*** (0.003)
Uninsured at 45_55	-0.001 (0.001)	-0.074*** (0.003)	-0.001 (0.001)	-0.078*** (0.003)	0.012*** (0.000)	0.078*** (0.003)	0.013*** (0.001)	0.081*** (0.003)
Age	0.007*** (0.000)	-0.046*** (0.000)	0.006*** (0.000)	-0.045*** (0.000)	0.015*** (0.000)	0.043*** (0.000)	0.015*** (0.000)	0.043*** (0.000)
Healthy	0.001 (0.003)	0.713*** (0.004)	0.005* (0.003)	0.706*** (0.005)	-0.054*** (0.001)	-0.768*** (0.005)	-0.057*** (0.001)	-0.762*** (0.005)
Insured	-0.015*** (0.002)	0.364*** (0.005)	-0.013*** (0.002)	0.374*** (0.005)	-0.050*** (0.001)	-0.355*** (0.005)	-0.053*** (0.001)	-0.363*** (0.005)
High school degree		0.111*** (0.004)		0.109*** (0.004)		-0.171*** (0.004)		-0.169*** (0.004)
College or higher	0.003* (0.002)	0.589*** (0.005)	0.005*** (0.002)	0.570*** (0.005)	-0.060*** (0.001)	-0.692*** (0.005)	-0.061*** (0.001)	-0.674*** (0.005)
tanh(preGovIncHH)	0.040*** (0.002)	-0.759*** (0.005)	0.036*** (0.002)	-0.773*** (0.005)	0.091*** (0.001)	0.655*** (0.004)	0.099*** (0.001)	0.670*** (0.005)
tanh(assets)	0.590*** (0.008)	2.659*** (0.018)	0.614*** (0.008)	2.628*** (0.018)	-0.153*** (0.001)	-2.210*** (0.016)	-0.162*** (0.002)	-2.191*** (0.017)
Observations	945861		845142		945861		845142	

Standard errors in parentheses

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

*Notes:* The dependent variables are the ratio of risky investments, an indicator variable for having any investments in risky stocks, the ratio of investments in safe assets, and an indicator variable for having any investments in safe assets as part of the financial wealth portfolio at ages 60–70. The independent variables of interest are indicator variables for whether an individual has reported being in bad health at ages 45–55.

Table E.4: Selection model: Risky and safe asset share w/ simulated model data of individuals who are healthy at age 40 (by education)

	No-HS		HS		College	
	Stock Sh.	P(Stocks)	Stock Sh.	P(Stocks)	Stock Sh.	P(Stocks)
Sick at 45_55	-0.023*** (0.004)	-0.143*** (0.007)	-0.011*** (0.002)	-0.263*** (0.004)	-0.001 (0.001)	-0.162*** (0.006)
Unemployed at 45_55	-0.106*** (0.017)	-0.912*** (0.008)	-0.010*** (0.003)	-0.381*** (0.004)	0.000 (0.002)	-0.346*** (0.006)
Uninsured at 45_55	-0.017*** (0.003)	-0.078*** (0.008)	-0.001 (0.001)	-0.072*** (0.004)	-0.002*** (0.001)	-0.034*** (0.007)
Age	0.001 (0.001)	-0.068*** (0.001)	0.005*** (0.000)	-0.037*** (0.000)	0.001*** (0.000)	-0.003*** (0.001)
Healthy	0.088*** (0.012)	0.609*** (0.010)	0.049*** (0.006)	0.677*** (0.006)	0.044*** (0.005)	0.918*** (0.009)
Insured	0.010* (0.005)	0.247*** (0.010)	0.004 (0.004)	0.414*** (0.007)	-0.009*** (0.003)	0.548*** (0.012)
tanh(preGovIncHH)	-0.007 (0.010)	-0.562*** (0.011)	-0.010 (0.007)	-0.849*** (0.007)	0.002 (0.004)	-0.835*** (0.010)
tanh(assets)	0.759*** (0.065)	4.431*** (0.055)	0.615*** (0.012)	2.260*** (0.028)	0.888*** (0.010)	0.123** (0.055)
Observations	214841		429942		200359	

Standard errors in parentheses

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Notes: The dependent variables are the ratio of risky investments, an indicator variable for having any investments in risky stocks, the ratio of investments in safe assets, and an indicator variable for having any investments in safe assets as part of the financial wealth portfolio at ages 60–70. The independent variables of interest are indicator variables for whether an individual has reported being in bad health at ages 45–55.

## F Welfare calculation

We compare each individual in a specific regime with its hypothetical self under the benchmark parameterization. For each policy regime we calculate the percent change in annual consumption that makes the persons realized lifetime welfare under the new regime equal to her realized lifetime utility in the benchmark. Formally, the realized lifetime utility of an individual in the benchmark is

$$V^B = \sum_{j=1}^J \left( \prod_{i=1}^j \beta(\vartheta, \varepsilon_i^h) \right) \left( 1_{\text{alive}_j} \times u(c_j^*, \ell_j^*) + 1_{\text{death}_j} \times u^{\text{beq}}(a_j^*) \right),$$

where  $\varepsilon_i^h$  is the health shock of an individual at age  $i$ ,  $\{c_j^*, \ell_j^*, a_j^*\}$  are optimal decisions,  $1_{\text{alive}_j}$  is an indicator function equal to one if the person is alive and  $1_{\text{death}_j}$  is an indicator function equal to one if a person has died in period  $j$ . The realized welfare loss or gain, expressed as percent of realized lifetime

consumption can then be written as

$$\sum_{j=1}^J \left( \prod_{i=1}^j \beta(\vartheta, \varepsilon_i^h) \right) \left( 1_{\text{alive}_j} \times u((1-\phi)c_j^{**}, \ell_j^{**}) + 1_{\text{death}_j} \times u^{\text{beq}}(a_j^{**}) \right) = V^B,$$

where  $\{c_j^{**}, \ell_j^{**}, a_j^{**}\}$  are optimal decisions in the new policy regime and  $\phi$  is the compensating consumption needed to make the individual indifferent between the new regime outcome and the benchmark. Once we have established the compensating consumption for each individuals  $\phi_i$  we can calculate the average across all  $N$  simulated individuals as  $\bar{\phi} = \frac{1}{N} \sum_{i=1}^N \phi_i$ . Similarly, we can calculate average compensating consumption conditional on individuals belonging to certain subgroups such as individuals with no high school degrees as

$$\bar{\phi}(1_{\vartheta=1}) = \frac{1}{N_{\text{noHS}}} \sum_{i=1}^{N_{\text{noHS}}} \phi_i(1_{\vartheta=1}),$$

where  $N_{\text{noHS}}$  would be the number of individuals (our of the  $N$  total) that “drew” a no-high-school permanent education state.

## G Additional Experiments

### G.1 No bad health realization at age 45--55

In this section we report additional results for the experiment in which bad health realizations at age 45-55 are removed. In Figure G.1 we find that the overall financial asset level increases for all age group starting with age 45 (panel 1) while wealth inequality—measured here as the ratio of the 90th percentile over the 50th percentile of financial wealth—decreases across all age groups (panel 6). In terms of labor market effects we observe in Figure G.2a an increase in labor participation of workers between age 45–55 (panel 1) and an increase in hours worked (panel 2) with subsequent increases in labor income (panels 3 and 4). These are primarily the results of increased productivity due to better health. Panel 5 shows that the expected reduction in out-of-pocket medical spending and panel 6. the overall increase in consumption across all age groups. Overall these effects lead to welfare gains that we have already highlighted above in Table 7. Finally, from Figure G.2b we see that the good health surprise draws lead to increases in private employer provided health insurance as more people join the labor market (panels 1.A, 2.A) and decreases in the fraction of individuals on Medicaid (panels 1.B and 2.B).

In a follow up experiment we use the model to calculate the treatment effect on the treated (ATET). In the above experiment the treated were defined as households who reported being in poor health in at least one year between the age of 45–55. We now focus the analysis on just this group and remove everybody else from the simulated sample. We then take these individuals and surprise them with excellent health

between the age of 45–55 and let them adjust (according to their policy functions) to this new information. This results in counterfactual outcomes of the treatment group, had they NOT been treated. Figure G.3a shows the age profiles of stock participation, stock levels, safe asset levels, total assets, labor income and consumption. The gap in the curves is a measure of the average treatment effect of the treated or ATET and is shown in Figure G.3b. From the respective panel 1 in Figures G.3a and G.3b we see that had this group of individuals not suffered from poor health in their 40s and early 50s, then their participation rate in risky assets at age 65 would have been 17 percentage points higher (an increase from 30 percent to 47 percent). From panel 4 we see that this amounts to an asset gap of 40,000 USD by age 65. This asset gap at retirement then translates into a persistent gap in consumption levels post retirement.

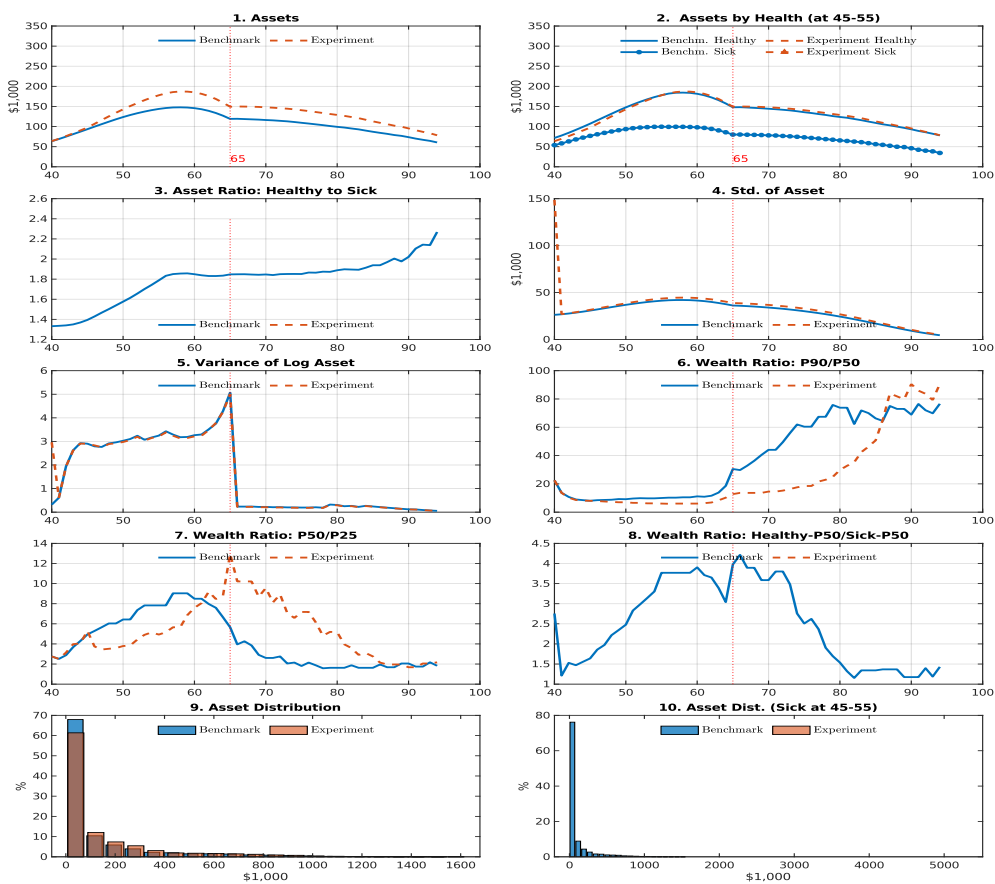


Figure G.1: Experiment: Surprise excellent health shocks at age 45–55 – Asset profiles

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Figure G.2: **Experiment: Surprise excellent health shocks at age 45–55**

*Notes:* Benchmark vs. experiment.

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Figure G.3: **Simulation of individuals in poor health at 45–55 and their counterfactual outcome with excellent health at 45–55**

*Notes:* In this experiment we compare a subsample of individuals that reports being sick in at least one year between age 45–55 in the Benchmark simulation. We call this the **treatment group**. We show averages of key outcome variables by age in “blue” in Panel (a). We then construct a counterfactual for this group and surprise the same individuals with excellent health between the age of 45–55—this is the outcome of the treated group had they NOT been treated (with poor health). The gap in the profile curves from Panel (a) are shown in Panel (b). These are the **average treatment effects** (of being sick at least once during age 45–55) **of the treated (ATET)** by age.

## G.2 Relative importance of four health channels

In this section we quantify the relative importance of each of the four channels through which health affects households and their capacity to accumulate wealth. We begin with the benchmark model in which all four channels of health effects are in play. We then consider four counterfactual experiments: [A.1-1] Turning off the health-longevity channel by assigning everyone the survival rates of healthy agents; [A.1-2] Turning off the health-labor productivity/income channel by assigning everyone the labor productivity of healthy agents; [A.1-3] Turning off the health-medical expenditure channel by assigning everyone the medical expenditures associated with an excellent health state; and [A.1-4] Turning off the health-wealth portfolio channel by assuming a uniform rate of return of 4% for both assets. We report the simulation results in Table G.1. The results of this decomposition exercise confirm that the health-wealth portfolio channel is the most important channel through which health heterogeneity affects variations in the wealth gaps between P90 and P50.

Table G.1: **The decomposition of four channels**

	<b>Two-asset economy</b>				
	<b>A.1</b>	<b>A.1-1</b>	<b>A.1-2</b>	<b>A.1-3</b>	<b>A.1-4</b>
	Bench.	H $\neq$ Longev.	H $\neq$ LaborProd.	H $\neq$ Med.Exp.	H $\neq$ Portfolio
<b>Stock participation</b>					
• Age 65: sick 45–55	19%	17%	22%	22%	0%
• Age 65: healthy 45–55	37%	36%	37%	38%	0%
<b>Assets</b>	100	94.48	100.89	104.12	78.68
<b>Wealth- gap</b>					
• All age: P90/P50	13.58	15.59	13.58	10.78	5.47
• At 65: P90/P50	14.02	15.59	14.02	12.28	7.97
<b>Welfare (CEV)</b>	0.00	8.60	0.00	6.33	0.24

*Notes:* [A.1]. The benchmark mode where all four channels are in play. [A.1-1] Turning off the health-longevity channel by assigning everyone the survival rates of healthy agents; [A.1-2] Turning off the health-labor productivity/income channel by assigning everyone the labor productivity of healthy agents; [A.1-3] Turning off the health-medical expenditure/income channel by assigning everyone the medical expenditures associated with an excellent health state; and [A.1-4] Turning off the health-wealth portfolio channel by assuming a uniform rate of return of 4 percent for both assets

## G.3 Low vs. high realizations of stock returns

We investigate to what extent stock returns affect the strength of the health-wealth portfolio channel. We use the policy functions from the benchmark economy where agents expect a risky asset premium of 4 percent but “surprise” individuals with low risky asset returns throughout their life from age 40–94. In order to do this we set the net stock returns equal to the lowest realization of stock returns in the benchmark model throughout the lifetime of all individuals. These low surprise returns measure to what extent a poor performing stock market would affect the buildup of the wealth gap at the age of retirement. We show the results of this experiment in column [C.1] in Table G.2. We then consider the other extreme

where individuals are surprised with the highest risky asset return level throughout their lifetime. The results for this highly performant stock market are shown in column [C.2] in Table G.2. These two experiments present the lower and upper bound of the risky asset’s potential contribution to the wealth gap at retirement through the health-wealth portfolio channel.

If the stock market performs consistently poorly throughout the lifetime of the agents (and households do not re-optimize their investment strategy) we find that the stock market participation drops and large welfare losses of 2.8 percent of CEV are realized as shown in column [C.1]. This experiment is different from the single asset economy in column [A.3] where households optimized their investment strategy under a single, risk free asset regime. Column [C.1] shows that even with consistent low stock market returns, households still participate in the stock market as they form expectations based on a 4 percent risky asset premium. The drop in participation is therefore a reflection of lower income levels from stock returns and not updated expectations about the stock market. Finally, since all households experience the same low risky asset returns, the wealth gap decreases slightly. If, on the other hand, the stock market performs very well and household reap the high returns from their stock investments throughout their lifetime, stock market participation increases and welfare gains of 5.7 percent of CEV are realized compared to the benchmark economy where stock return realizations are volatile.

Table G.2: C - Low and high shocks to risky asset returns

	A.1 Benchmark	C.1 Low $\tilde{r}_{net}^s$	C.2 High $\tilde{r}_{net}^s$	One asset A.3 No stocks
<b>Assets</b>	100	45.73	159.88	70.17
<b>Stock participation</b>				
• At 65: sick 45-55	19%	14%	22%	n/a
• At 65: healthy 45-55	37%	29%	40%	n/a
<b>Wealth gap</b>				
• At 65: P90/P50	14.02	7.99	3.83	8.13
• At 65: P50/P25	6.65	5.17	5.00	6.65
<b>Welfare (CEV)</b>	0.0	-2.77	+5.74	-0.47

Notes: The risk premium is 4 percent in the benchmark model, i.e.,  $\mu = 0.04$ .

## G.4 Health-in-utility (HIU) preferences

We next model health status as a consumption good which introduces a utility-health channel into the model. In this setting, there are now two channels through which the exogenous health states affect household welfare: (i) via the household budget constraint (as in our benchmark model) and (ii) via a preference shifter that depends on health status  $h$ , which is a function of the exogenous health states  $\varepsilon^h$ . We follow the approach in De Nardi, French and Jones (2010) and assume that each period the individual’s utility depends on consumption, leisure and health status,  $h$ , according to  $u(c_j, \ell_j; \bar{n}_j) =$

$\theta(h) \frac{\left( c_j^\eta \times \left[ \ell_j - \bar{n}_j \cdot 1_{[0 \leq n_j]} \right]^{1-\eta} \right)^{1-\sigma}}{1-\sigma}$ , where  $\theta(h) = \theta(h(\varepsilon^h))$  is a preference shifter and health state  $h(\varepsilon^h)$  is restricted to either either healthy ( $h = 1$ ) or sick ( $h = 0$ ) based on health status  $\varepsilon^h$ . Following [De Nardi, French and Jones \(2010\)](#), we specify the preference shifter as  $\theta(h) = 1 + \theta_h \times h$  and set parameter  $\theta_h = -0.21$ . Given our parameterization this results in  $u_c > 0$ ,  $u_h > 0$  and  $u_{c,h} < 0$ . In other words, if an individual moves from healthy ( $h = 1$ ) to sick ( $h = 0$ ), her consumption spending  $c$  is going to increase. We keep all other components of the benchmark model unchanged when we re-estimate the benchmark model using the method of simulated moments as discussed above. We summarize the main results in [Table G.4](#). Overall, we find the main conclusions established in [section 5](#) carry over to the model with health in the utility function.

Table G.3: Estimated structural parameters of model 2 with health in the utility function

Parameters	Value	S.E.
Consumption weight: $\eta$	0.2782	0.0015
<b>Time discount factor</b>		
No high school		
$\beta(\vartheta = 1, \text{healthy})$	0.9785	0.0010
$\beta(\vartheta = 1, \text{sick})$	0.9590	0.0068
High school		
$\beta(\vartheta = 2, \text{healthy})$	0.9787	0.0013
$\beta(\vartheta = 2, \text{sick})$	0.8824	0.0054
College		
$\beta(\vartheta = 3, \text{healthy})$	0.9858	0.0025
$\beta(\vartheta = 3, \text{sick})$	0.7563	0.0091
<b>Bequest motive</b>		
$\theta_1(\vartheta = 1)$	335.5095	3.1461
$\theta_1(\vartheta = 2)$	242.5343	0.3586
$\theta_1(\vartheta = 3)$	112.2752	63.2418
<b>Stock market participation cost:</b>		
$q(j, \vartheta) = \delta_{s,\vartheta,1} + \delta_{s,\vartheta,2}j + \delta_{s,\vartheta,3}j^2$		
No high school		
$\delta_{s,\vartheta=1,1}$	0.0079	0.0061
$\delta_{s,\vartheta=1,2}$	0.0001	0.0347
$\delta_{s,\vartheta=1,3}$	-0.0000	0.0347
High school		
$\delta_{s,\vartheta=2,1}$	0.0095	0.0041
$\delta_{s,\vartheta=2,2}$	0.0001	0.0115
$\delta_{s,\vartheta=2,3}$	-0.0000	0.0123
College		
$\delta_{s,\vartheta=3,1}$	0.0209	0.0026
$\delta_{s,\vartheta=3,2}$	0.0001	0.0060
$\delta_{s,\vartheta=3,3}$	-0.0000	0.0056
<b>Labor force participation cost:</b>		
$\bar{n}_j(\vartheta, h(\varepsilon^h)) = \delta_{\ell,\vartheta,h,1} + \delta_{\ell,\vartheta,2}j$		
No high school		
$\delta_{\ell,\vartheta=1,\text{healthy},1}$	0.1542	0.0023
$\delta_{\ell,\vartheta=1,\text{sick},1}$	0.1632	0.0000
$\delta_{\ell,\vartheta=1,2}$	-0.0011	0.0001
High school		
$\delta_{\ell,\vartheta=2,\text{healthy},1}$	0.1415	0.0039
$\delta_{\ell,\vartheta=2,\text{sick},1}$	0.3303	0.0000
$\delta_{\ell,\vartheta=2,2}$	-0.0004	0.0003
College		
$\delta_{\ell,\vartheta=3,\text{healthy},1}$	0.0742	0.0040
$\delta_{\ell,\vartheta=3,\text{sick},1}$	0.0768	0.0000
$\delta_{\ell,\vartheta=3,2}$	-0.0013	0.0003

Notes: The estimates are obtained using a minimum distance approach. We minimize the distance between moments of actual and simulated data. Data moments include measures of wealth-to-income ratios, labor hours, stock market participation rates by age-group, education level, and health status at 45–55, and labor market participation rates by age, education level, and health status. Figure 4 shows the estimation target of stock participation rates by age, education and health state together with the model generated moments. Figure D.2 shows the associated participation cost by age and education.

Table G.4: **Wealth inequality with HIU preferences**

	<b>A.1 Bench.</b>		<b>A.2 Good health (40–Death)</b>		<b>A.3 No portfolio</b>		<b>A.4 = A.2+A.3</b>	
	Regular	HIU	Regular	HIU	Regular	HIU	Regular	HIU
<b>Assets</b>	100	100.00	122.19	121.05	61.26	62.51	71.18	71.63
<b>Stock participation</b>								
• At 65: sick 45-55	34%	31%		NA	0.0%	0.0%	0.0%	0.0%
• At 65: healthy 45-55	47%	44%	55%	53%	0.0%	0.0%	0.0%	0.0%
<b>Wealth gap</b>								
• P90/P50 at 65	15.96	16.39	7.72	8.72	9.34	9.31	5.98	6.19
• P50/P25 at 65	7.08	7.8	6.62	5.98	7.59	6.58	3.73	3.81
<b>Welfare (CEV)</b>	0.0	0.0	+17.08	+18.28	NA	NA	+17.25	+19.97

*Notes:* Both safe and risky assets are present in the two asset economy [A.1]. The bad health shocks are removed in [A.2]. The wealth portfolio channel is eliminated in [A.3]. The health-wealth portfolio channel is completely eliminated in [A.4]