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HOUSEHOLD FINANCE:
EDUCATION, PERMANENT INCOME AND PORTFOLIO CHOICE

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ABSTRACT

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Russell Cooper† and Guozhong Zhu‡

September 12, 2013

Abstract

This paper studies household financial choices: why are these decisions dependent on the education level of the household? A life cycle model is constructed to understand a rich set of facts about decisions of households with different levels of education attainment regarding stock market participation, stock share in wealth, stock adjustment rate and wealth-income ratio. The model, including preferences and both participation and portfolio adjustment costs, is estimated to match the asset allocation decisions of different education groups. Using the estimated parameters we argue that education matters for financial decisions mainly through its effect on mean income. We also study the sensitivity of household financial decisions to: (i) government programs that support consumption floors and (ii) changes in reimbursement for medical expenditures.

1 Motivation

It is common for studies of household financial decisions to condition on education. Asset market participation decisions, adjustment rates, savings rates and portfolio choice are frequently linked to education attainment. The evidence supports the view that education is empirically relevant for household financial decisions.

But what is the underlying impact of education on financial decisions? Are different household decisions a consequence of education specific income processes and/or parameters of tastes and adjustment costs that vary across households? Addressing these questions is the point of this paper. Our approach differs from previous studies relating education to household financial decisions in a couple of respects.

First, while documenting the significance of education for financial choices, we go beyond existing work to study a number of reasons why education matters. The first set of explanations focuses on differences in

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exogenous processes for income, pre-retirement, and medical expenses, post-retirement, as well as mortality rates. The mean and/or variability of each of these processes is dependent on education. A second set of explanations allows differences in preferences and/or adjustment costs across education groups. As in Gomes and Michaelides (2005), we allow limited heterogeneity in preferences to match asset allocation patterns.[1]

Second, the various dimensions of household financial choices are commonly studied separately, here we study them jointly.[2] It is critical to study participation, stock share, adjustment rates and savings rates together because these decisions are intertwined in the household's optimization problem. For example, a household considering asset market participation will recognize the subsequent costs of portfolio adjustment. The factors, such as attitudes towards risk, that determine the share of assets in a household portfolio will also influence the participation decision of the household. With fixed portfolio adjustment cost, higher wealth levels may lead to a higher stock share as wealthy households bear a lower cost (per unit) of adjustment. All of these factors interact with the participation decision, creating identification problems when participation is not modeled explicitly.

Third, we estimate a rich set of utility functions rather than focusing on the leading case of constant relative risk aversion (CRRA). It turns out that this is an important ingredient for understanding portfolio choice. Both recursive utility (Epstein-Zin-Weil) and constant absolute risk aversion (CARA) specifications fit the data better than the CRRA representation.

Fourth, our analysis incorporates both working and retirement years. The evidence includes patterns of participation, saving, portfolio share and adjustment over the entire life cycle, not just working years. The study incorporates heterogeneous mortality rates and risky medical expenses, drawing upon DeNardi, French, and Jones (2010), as relevant factors determining household's financial choices. This is important to include in the analysis as post-retirement mortality and medical expenses depend on education.

Our approach is to specify and estimate a life cycle model of household financial choices. The life cycle framework, rather than the infinitely lived agent model, is needed to examine the affects of post-retirement income and stochastic medical expenses on pre-retirement financial decisions.

The estimation is an integral part of the analysis. Without estimating a model we would not be able to decompose the channels of influence between education and household financial decisions. Further, we would be unable to determine the affects of education on the parameters of household preferences and adjustment costs without estimating the parameters. The estimation uses a simulated method of moments approach,

[1]There also exists a literature that studies educational differences and household finance from the behavioral perspective, e.g., Roussanov (2010).

[2]For example, Hubbard, Skinner, and Zeldes (1995) study why more educated households save more. Alan (2006) studies participation patterns only using a model with a single asset. Vissing-Jorgensen (2002) and Gomes and Michaelides (2005) study both participation and stock share. Achury, Hubar, and Koulovatianos (2012) and Wachter and Yogo (2010) study the relation between education/wealth and stock share in wealth. Cocco, Gomes, and Maenhout (2005) studies portfolio shares over the life cycle, highlighting how the components of labor income influence this choice. Other studies focus on portfolio adjustment rates, such as Bonaparte, Cooper, and Zhu (2012) and Calvet, Campbell, and Sodini (2009), without focusing on participation rates.

where the moments reflect the key household financial decisions by education group. These moments are selected to identify key parameters.

More specifically, the analysis puts households into four education (attainment) groups. From the Survey of Consumer Finance (SCF), average stock market participation rates and financial wealth to income ratios increase sharply with education attainment. Stock shares also increase with education status, but not as sharply. From the Panel Study of Income Dynamics (PSID), stock (portfolio) adjustment rates are higher for more educated households.

Within a homogeneous preference framework, these differences can potentially be explained by observable heterogeneity across education groups. Based on the PSID, more educated households have higher levels of deterministic income before retirement, and less income risk. According to data from the Health and Retirement Study (HRS), after retirement, the more educated have higher out-of-pocket medical expenses relative to their income, and are subject to lower mortality risk.

Parameter estimates come from using the structural model to match the averages of stock market participation rate, stock share in wealth, stock adjustment rate and wealth-income ratio of the four education groups. These moments are very informative about costs and risk preferences. By matching these observations, we estimate adjustment costs and preferences. The recent literature provides insights that costs associated with stock market participation, eg. Vissing-Jorgensen (2002), Alan (2006), Gomes and Michaelides (2005), and costs of financial transactions, eg. Bonaparte, Cooper, and Zhu (2012), are important. We consider two types of portfolio adjustment costs: an entry cost and a transaction cost, both are fixed rather than proportional.

In the absence of costs, predictions based on common representations of risk preferences tend to contradict the data. For example, standard household portfolio models typically predict that every household should participate in the stock market, and that the share of stock in total financial wealth should be high, e.g. Heaton and Lucas (1997) and Merton (1971). As another example, CARA preferences predict that a household's optimal investment in risky asset is roughly a fixed amount independent of total wealth, which implies that the more educated should have lower share of stock in financial wealth.

Our estimation results indicate that recursive utility brings the simulated and data moments closer together than do the CARA and CRRA representations. In answer to the central question of our paper, the main factor that links household financial decisions to education is the dependence of the mean level of income on education.[3] Other factors, such as income volatility and differences in medical expenses as well as mortality do not play a large role in explaining the variation of household financial decisions across education groups. Beside these income differences, there is some evidence that higher education groups discount the future less than low education groups, controlling for differences in mortality.

Having an estimated model allows us to conduct policy experiments. We study changes in government

[3] Wachter and Yogo (2010) relate the rise of stock share with education attainment to luxury goods assumption, underlying which is higher income of the more educated. Similarly, Achury, Hubar, and Koulovatianos (2012) link income level to stock share through subsistence consumption.

programs that create a consumption floor as well as variations in out-of-pocket medical expenses. Cutting the consumption floor leads to a substantial increases in the wealth to income ratio of low education households. The effect of this policy on other groups is not substantial. A reduction in out-of-pocket medical expenses and a reduction in the variance of those expenses lead to a fall in the wealth to income ratio for post-retirement households. This points to a precautionary savings motive after retirement that is influenced by the stochastic process of medical expenses.

2 Data Facts

We present two types of data facts. The first are the processes characterizing exogenous income during working years, out-of-pocket medical expenditures during retirement and mortality risk faced by households. These processes determine the extent to which households accumulate precautionary savings balances and how they structure their portfolios.

The second set of facts concern household financial choices: asset market participation, stock share in portfolios, the frequency of adjustment and wealth-income ratios. These dimensions of household financial choice reflect both the income processes that households face as well as the costs of participation and adjustment. These facts become the moments to match in the estimation of household preference parameters and adjustment costs. As with the income processes, we study household financial decisions both pre- and post-retirement.

Consistent with the motivation of the paper, the income, mortality rates and medical expenditure processes as well as the moments summarizing household choices are presented by education group. A key point of the paper is to go beyond these education dependent facts to understand why education matters.

2.1 Income Heterogeneity

Households are broken into four groups by (highest) education attainment of the household head. For each group, income, defined as the sum of labor income and transfers, is decomposed into deterministic and stochastic components. The sample period is 1989-2007. The Appendix provides detailed information on sample selection criteria and the decomposition method.

Figure 1 presents the profiles of deterministic income of the four education groups.[4] Differences in the mean of the paths illustrate gains to education. The hump-shape of lifetime income is considerably more pronounced for higher education households.

These differences in mean income by education group will play a prominent role in our analysis. They will account for a large amount of the differences in household financial decisions by education group.

Let $\tilde{y}_{i,t}$ denote the stochastic component of income for household i in period t. We decompose it into

[4] A very similar figure appears in Cocco, Gomes, and Maenhout (2005) though for a different sample period.

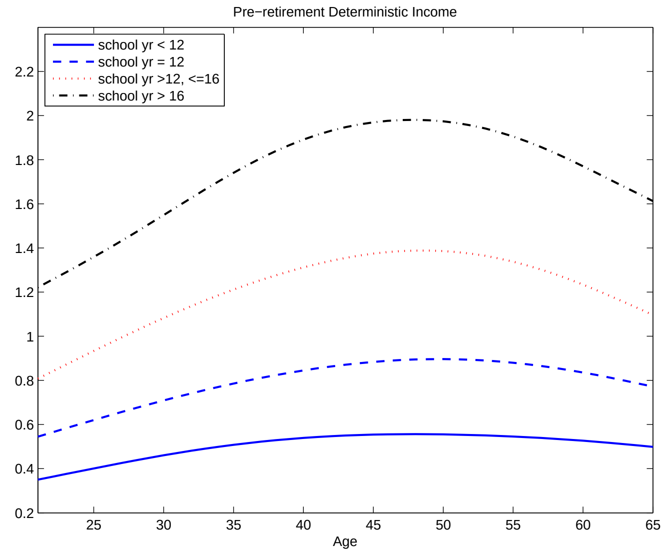

Figure 1: Pre-retirement Deterministic Income

This figure shows the average profiles of pre-retirement income by education attainment. Income profiles are normalized so that the average income across age and education groups is one.

transitory and persistent shocks.

$$\tilde{y}_{i,t} = z_{i,t} + \epsilon_{i,t}$$
$$z_{i,t} = \rho z_{i,t-1} + \eta_{i,t} \quad (1)$$

where $\epsilon_{i,t}$ and $\eta_{i,t}$ are independent zero-mean random shocks, with variance σ^2_ϵ and σ^2_η respectively. The shock $\eta_{i,t}$ is persistent, with persistence parameter of ρ. The Appendix provides additional details on this decomposition and the estimation of this stochastic income processes.

The stochastic properties of income for different groups are presented in Table 1. The rows denote the education attainment of the household head. Households with a more educated head are exposed to smaller transitory income shocks. The persistence and size of persistent income shocks are about the same across education groups, except that the most educated group appears to have less persistent but larger shocks.[5]

There are also differences across education groups post-retirement. The deterministic component of post-retirement income is a proportion of the pre-retirement permanent income, defined as the product of deterministic income and accumulated persistent shocks ($z_{i,t}$). To estimate this income replacement ratio

[5] Some other papers in the literature also find the less educated are exposed to larger transitory income shocks. Examples include Guvenen (2009) (Table 1) and Hubbard, Skinner, and Zeldes (1994) (Appendix A.4). The t-statistics reported in Hubbard, Skinner, and Zeldes (1994) imply that these parameters are imprecisely estimated. One the other hand, Carroll and Samwick (1997) (Table 1) offer very precise estimates, but find a non-monotone relation between education attainment and size of income shocks.

Table 1: Stochastic Processes for Income

	Income		
years of school.	σ^2_ϵ	σ^2_η	ρ
<12	0.107	0.017	0.963
	(0.017)	(0.004)	(0.007)
12	0.071	0.016	0.952
	(0.007)	(0.002)	(0.004)
>12, $\leq$ 16	0.067	0.018	0.960
	(0.007)	(0.004)	(0.006)
>16	0.020	0.037	0.935
	(0.008)	(0.007)	(0.009)

This table reports the variances and persistence of income shocks estimated from PSID for four education groups. Standard errors are presented in parentheses.

for each education group, we take a sample of households from PSID who have valid information on income both before and after retirement. Pre-retirement permanent income is approximated by the within education group average of reported income. Table 2 shows that the income replacement ratio decreases with education attainment.

Table 2: Income Replacement Ratio

Years of School.	<12	=12	>12, ≤16	>16	all
Replacement Ratio	0.744	0.625	0.537	0.513	0.605
	(0.06)	(0.03)	(0.03)	(0.02)	(0.02)
Number of Obs.	480	679	637	324	2201

This table reports the income replacement ratios estimated from PSID for four education groups. Standard errors are presented in parentheses.

Though post-retirement income is assumed to be non-stochastic, retired households are subject to medical expenditure shocks. Since medical expense is stochastic, the disposable income after retirement is as well. stochastic.[6]

The estimation of out-of-pocket medical expenses is based on data from French and Jones (2004). That paper shows that the logarithm of stochastic component of out-of-pocket medical expenses can be well represented by an $AR(1)$ process plus a pure transitory shock. We assume the stochastic process of medical expenses to be the same across education groups, and take the estimates directly from French and Jones

[6] We take out-of-pocket medical expense as exogenous. DeNardi, French, and Jones (2010) compare the results on wealth accumulation from models with exogenous and endogenous medical expense and find little difference.

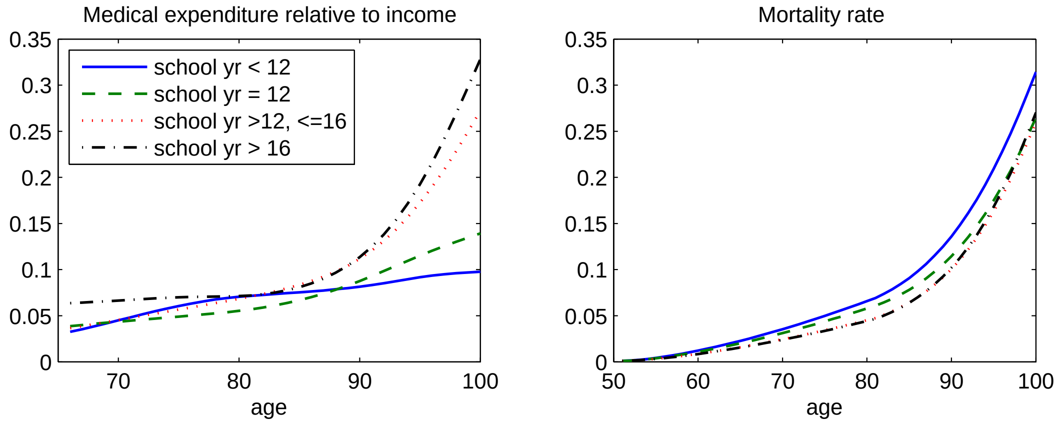

Figure 2: Post-Retirement Medical Expenditure and Mortality

The left panel shows the average profiles of post-retirement out-of-pocket medical expenditure relative to post-retirement income by education group. The right panel is the estimated mortality rate conditional on survival.

(2004). We estimate the ratio of out-of-pocket medical expenses to post-retirement income for each education group. Details about data sources, definitions and the stochastic process for medical expenses are given in the Appendix.

The left panel of Figure 2 shows average out-of-pocket medical expense relative to post-retirement income by education group. Education group level post-retirement income is constructed from individual post-retirement income, which is measured as the retiree's average income over all periods during which he or she is observed in the data from Heath and Retirement Study. From this figure, medical expense relative to income increases sharply with age. The most-educated group has higher expense, but the other groups are faced with very similar medical expenses relative to income.

The right panel of Figure 2 shows mortally risk as a function of age by education group. Consistent with the literature, see for example Lleras-Muney (2005) and Starr-McCluer (1996), mortality and health are correlated with education.

In the estimation of the model, these income, medical expense and mortality processes have means that depend on education. Moreover, the variance of income innovations varies by education class. As noted above, we restrict the variability of medical expenses post-retirement to be the same across education groups.

2.2 Patterns of Household Finance

Table 3 reports the averages of participation rate, stock share, adjustment rate and median wealth-income ratio by year of schooling. The Appendix provides details on data sources and calculations of these moments.

A household is a participant in asset markets if it either directly or indirectly owns stocks according to our sample from the SCF. The share of stocks in a household's total financial wealth is the ratio of stock holdings to the sum of stock and bond holdings.[7] Adjustment refers to the actual purchase or sale of stocks by the household as well as the reinvestment of dividends. This is measured bi-annually. This adjustment rate includes changes in IRA-holdings. Automatic reinvestments are not considered as adjustments. The wealth income ratio is presented both with and without the inclusion of net housing equity in wealth.

There are a couple of key features to note from Table 3. Participation rates and wealth-income ratios increase sharply with education attainment. The stock share and the adjustment rate increase as well, though not as much. The rise of median wealth-income ratio with education attainment is consistent with the finding that richer households save more, as in Dynan, Skinner, and Zeldes (2004).

The incentives for asset accumulation reflected in the wealth to income ratio are created by income risk, post-retirement medical expenditure risk and a bequest motive. The discount factor as well as risk aversion and the value attached to bequests will determine the financial response to income patterns.

The costs of asset market participation as well as the costs of portfolio adjustment are relevant for understanding the frequency of adjustment, the participation decisions as well as the portfolio shares. A unique feature of our study is the presence of both of these costs. Having moments on participation as well as adjustment rates will allow us to identify them. As with the savings decision, household preferences also influence adjustment and participation choices.

In the estimation, these data averages are informative moments for the estimation of household parameters. These moments have some life cycle dimensions as we study both pre- and post retirement behavior.

The Wealth/Income ratio is less precisely estimated than other moments. As a consequence, the weighting matrix will put less weight on matching these moments compared to others.

3 Model

To infer parameters from these moments requires an optimization model at the household level. Both the participation and adjustment decisions are discrete while the portfolio share is a continuous choice variable. We embed these discrete and continuous decisions into a life cycle framework.

3.1 Dynamic Optimization Problem

A household makes consumption, saving and financial choices during its working and retirement period. The retirement age, T^r, is exogenous in our analysis. In periods $t = 1, 2, 3, ...T^r$ the household is working and earns a stochastic income, characterized in Table 1 and Figure 1. At $t = T^r$ the household's income process switches to a stable retirement income according to Table 2, supplemented by stochastic medical costs. The household is faced with a death probability which is age- and education-specific. The death probability equals one at age $T + 1$ for each education group, so that the maximum life span is T.

[7] This measure is adjusted as explained below when housing is included in the data and the model. Here we do not consider the demand for money. See Aoki, Michaelides, and Nikolov (2012) for recent work integrating money demand into portfolio choice.

Table 3: Participation, Composition and Adjustment by Education

	Pre-retirement				Post-retirement			
	Years of Schooling				Years of Schooling			
	<12	=12	>12,≤ 16	>16	<12	=12	>12,≤ 16	>16
Stock Share	0.523	0.539	0.562	0.602	0.451	0.495	0.568	0.599
	(0.02)	(0.008)	(0.004)	(0.005)	(0.021)	(0.014)	(0.009)	(0.011)
Participation	0.173	0.322	0.560	0.814	0.221	0.451	0.734	0.851
	(0.01)	(0.007)	(0.006)	(0.006)	(0.013)	(0.014)	(0.012)	(0.012)
Adjust. Rate	0.560	0.563	0.615	0.701	0.397	0.417	0.558	0.646
	(0.02)	(0.02)	(0.011)	(0.014)	(0.03)	(0.034)	(0.03)	(0.035)
Wealth/Income	0.077	0.148	0.451	1.787	0.638	1.563	4.292	5.828
	(0.005)	(0.005)	(0.017)	(0.071)	(0.187)	(0.249)	(0.437)	(0.671)
With Home Equity								
Stock Share	0.261	0.361	0.353	0.425	0.262	0.296	0.418	0.448
	(0.025)	(0.063)	(0.007)	(0.032)	(0.029)	(0.022)	(0.013)	(0.015)
Wealth/Income	0.441	0.789	1.503	3.573	4.015	5.204	7.773	8.880
	(0.063)	(0.031)	(0.040)	(0.098)	(0.447)	(0.572)	(0.472)	(0.881)

This table reports the averages of participation rates, stock shares, stock adjustment rates and median wealth-income ratios by education attainment. The "With Home Equity" block includes housing in wealth and reports the correspondingly changed stock shares and wealth-income ratios.

Confronting the riskiness of income while working is a main motive for household finance choices. During retirement, the household faces stochastic medical expenses. As described above, following DeNardi, French, and Jones (2010), these medical expenses are treated as variations in household disposable income and thus are a source of risk during retirement.

The state of a household of age t in education group e is its current labor income y_t^e, its medical expenditure m_t^e, its current holdings of stocks, denoted A^s, and bonds, denoted A^b, and the return on assets R. Income and medical expenditures are superscripted by education attainment, e. These exogenous difference across education groups will lead to endogenous difference in saving and financial choices. Let $\Omega = (y_t^e, m_t^e, R, A)$ represent the current state, with $A = (A^b, A^s)$ being a vector of endogenous state variables. Notice that R is time (age) invariant and independent of education attainment.

A household currently not participating in the stock market has the choice in period (at age) t to remain outside of that market or to pay an entry cost for the right to trade stocks. That discrete choice is represented as:

$$w_{e,t}(\Omega) = \max\{w^n_{e,t}(\Omega), w^p_{e,t}(\Omega)\} \tag{2}$$

for all Ω. Here $w_{e,t}(\Omega)$ is the maximum of the values of participating, $w^p_{e,t}(\Omega)$, and not participating, $w^n_{e,t}(\Omega)$.

The value functions are subscripted by education attainment and age because of the finite-horizon nature of the optimization problem.

If the household chooses to remain outside of asset markets, the household can engage in consumption smoothing through its bond account and re-optimize in the following period. The value of that problem is given by:

$$w^n_{e,t}(\Omega) = \max_{A^{b\prime} \geq \underline{A}^b} u(c) + \beta E_{y^e_{t+1}, m^e_{t+1} | y^e_t, m^e_t} \left\{ \nu^e_{t+1} w_{e,t+1}(\Omega') + (1 - \nu^e_{t+1}) B(R^b A^{b'}) \right\} \tag{3}$$

for all Ω. Here β is the discount factor, v^e_{t+1} is the death probability, as indicated in the right panel of Figure 2. $B(b')$ is the value of leaving a bequest of size b' and is explained in detail below. Consumption is given by

$$c = y^e_t + TR - m^e_t + R^b A^b - A^{b\prime}. \tag{4}$$

Here TR is the transfer from the government from various social insurance programs. Following Hubbard, Skinner, and Zeldes (1995) and DeNardi, French, and Jones (2010), we assume the following functional form for this transfer

$$TR = \max\{0, \underline{c}_t - (y^e_t + R^b A^b - m^e_t)\} \tag{5}$$

where $\underline{c}_t$ is the consumption floor, the minimum level of consumption guaranteed by the government. In order to be eligible for the transfer, a household's means of living net of medical expenditure, $y^e_t + R^b A^b - m^e_t$, must be less than the floor. Therefore the transfer function captures asset-based, means-tested social programs such as Medicaid, food stamps and Temporary Assistance for Needy Families. This support program has implications for precautionary savings, particularly by low wealth households. The consumption floor is estimated for both the pre-retirement, $\underline{c}$ and post-retirement period, $\kappa\underline{c}$.

In this problem, there is a lower bound on bond holdings, $\underline{A}^b$. The household is not allowed to own stocks as it is a non-participant in the stock market. Hence in (3), $A^s = A^{s\prime} = 0$ is imposed.

If a household chooses to participate in the stock market, then it incurs an entry cost of Γ and becomes a participant with future value of $v_{e,t+1}(\Omega)$. This switch in status happens instantly and the household is in a position to make portfolio adjustment decisions. The value of participating is given by:

$$w^p_{e,t}(\Omega) = \max_{A^{b'} \geq \underline{A}^b, A^{s'} \geq 0} u(c) + \beta E_{y^e_{t+1}, m^e_{t+1}, R^{s'} | y^e_t, m^e_t, R^s} \left\{ \nu^e_{t+1} v_{e,t+1}(\Omega') + (1 - \nu^e_{t+1}) B(R^b A^{b'} + R^{s'} A^{s'}) \right\}$$

s.t.

$$c = y^e_t + TR - m^e_t + R^b A^b - A^{b\prime} - A^{s\prime} - \Gamma \tag{6}$$

$$TR = \max\{0, \underline{c}_t - (y^e_t + R^b A^b - m^e_t)\}. \tag{7}$$

Here the bequest value is a function of total wealth, including the liquidated value of stocks. The household chooses a bequest portfolio without knowing the stock return that will determine the full value of the inheritance.

A participant in asset markets has a discrete choice between adjusting, not adjusting its stock account or exiting asset markets. This choice is represented as:

$$v_{e,t}(\Omega) = \max\{v^a_{e,t}(\Omega), v^n_{e,t}(\Omega), v^x_{e,t}(\Omega)\} \tag{8}$$

for all Ω.

If the household adjusts, it is able to adjust both its stock and bond accounts. The household solves:

$$v^a_{e,t}(\Omega) = \max_{A^{b\prime} \geq \underline{A}^b, A^{s\prime} \geq 0} u(c) + \beta E_{y^e_{t+1}, m^e_{t+1}, R^{s\prime} | y^e_t, m^e_t, R^s} \left\{ \nu^e_{t+1} v_{e,t+1}(\Omega') + (1-\nu^e_{t+1}) B(R^b A^{b'} + R^{s'} A^{s'}) \right\}$$

s.t.

$$c = y^e_t + TR - m^e_t + \textstyle\sum_{i=b,s} R^i A^i - \sum_{i=b,s} A^{i'} - F \tag{9}$$

$$TR = \max\{0, \underline{c}_t - (y^e_t + \textstyle\sum_{i=b,s} R^i A^i - m^e_t)\}. \tag{10}$$

In this problem, there is again a lower bound to bond holdings which we assume is the same as that for non-participants. The household is not allowed to sell stocks short. The transfer function in (10) is the same as (5) for non-participants, except that the means of living now includes wealth from stock holdings.

The F in budget constraint (9) is the cost of adjusting stock account. It is assumed to be independent of education attainment, age and income. It is possible to include an additional adjustment cost proportional to income as in Bonaparte, Cooper, and Zhu (2012), as well as flow costs of asset market participation, as discussed in Vissing-Jorgensen (2002). For matching the moments that are the focus of this study, this fixed adjustment cost along with the participation cost are sufficient.[8] As we shall see, the cost of adjustment induces exit from stock participation. In addition, these costs are important for the forward-looking household's choice to participate in asset markets.

The adjustment cost should be interpreted as a comprehensive measure of commission, time cost of adjustment and cost of information search. Much of these costs are not directly observable, but are closely related to the observed infrequent adjustment of stock account. By matching the adjustment rates of different education groups, both pre- and post-retirement, we obtain quite precise estimates of the fixed cost.

A household that participates in asset markets but chooses not to adjust its stock portfolio is able to freely adjust its bond portfolio. The value of no-adjustment is given by:

$$v^n_{e,t}(\Omega) = \max_{A^{b\prime} \geq \underline{A}^b} u(c) + \beta E_{y^e_{t+1}, m^e_{t+1}, R^{s\prime} | y^e_t, m^e_t, R^s} \left\{ \nu^e_{t+1} v_{e,t+1}(\Omega') + (1-\nu^e_{t+1}) B(R^b A^{b'} + R^{s'} A^{s'}) \right\}$$

s.t

$$c = y^e_t + TR - m^e_t + R^b A^b - A^{b\prime} \tag{11}$$

$$A^{s\prime} = R^s A^s \tag{12}$$

$$TR = \max\{0, \underline{c}_t - (y^e_t + \textstyle\sum_{i=b,s} R^i A^i - m^e_t)\} \tag{13}$$

where $A^{s\prime} = R^s A^s$ since the return on stocks is (costlessly) reinvested into the stock account.

[8] See Gomes and Michaelides (2005) and Alan (2006), among others, for models with participation costs alone.

Finally, a household may choose to exit the stock market. This choice is particularly pertinent for agents late in life. The value of exit is given by:

$$v^x_{e,t}(\Omega) = \max_{A^{b\prime} \geq \underline{A}^b} u(c) + \beta E_{y^e_{t+1}, m^e_{t+1} | y^e_t, m^e_t} \left\{ \nu^e_{t+1} w_{e,t+1}(\Omega') + (1-\nu^e_{t+1}) B(R^b A^{b'}) \right\} \tag{14}$$

s.t.

$$c = y^e_t + TR - m^e_t + \textstyle\sum_{i=b,s} R^i A^i - A^{b\prime} \tag{15}$$

$$TR = \max\{0, \underline{c}_t - (y^e_t + \textstyle\sum_{i=b,s} R^i A^i - m^e_t)\}. \tag{16}$$

This dynamic discrete choice problem allows us to capture the pertinent choices of market participation and portfolio adjustment. One of the interesting tensions, explored in Bonaparte, Cooper, and Zhu (2012), in the household's problem is how to respond to income shocks. For small fluctuations in income, adjustment in the bond account will be adequate for consumption smoothing. For large fluctuations in income, the household will need to adjust its stock and bond holdings jointly, thus incurring that adjustment cost. The riskiness of income influences the portfolio choice: all else the same, a riskier income process implies a more liquid (a lower stock to bond ratio) portfolio.

There is also a richness in the participation decision. By participating in stock markets, household can take advantage of a higher average return. But that higher return comes at two costs: stocks are riskier and are more expensive to trade.

Differences between pre- and post-retirement come into play in a couple of ways. First, entry into asset markets is a type of investment and thus the gains to participation will depend on the horizon of the household, along with the discount factor. Second, the income process changes over the life cycle.

Finally, there is the exit decision from asset markets. Since retirement income is lower on average than that during working life, participation ought to fall during retirement. Further, due to the presence of large medical expenditure shocks during retirement (modeled as large income shocks), a household may be induced to liquidate stock holdings in low income states and then exit from asset markets.

3.2 Preferences

Three types of preferences are considered. Estimating preference parameters beyond the traditional CRRA specification is one of the contributions of this paper.

The first is the commonly used CRRA preference (power utility), with

$$u(c) = \frac{\gamma}{1-\gamma} c^{1-\gamma}. \tag{17}$$

The second one is CARA preference (exponential utility), with

$$u(c) = -e^{-\gamma c}. \tag{18}$$

As is well understood from Merton (1971), for example, these two preference structures impose certain properties on portfolio shares when markets are complete. Under CRRA the portfolio share of the risky asset is constant. Under CARA, the amount invested in the risky asset is constant so that its share is lower in larger portfolios. Neither of restrictions imposed by these two extremes fit the data well though both are used for convenience in theoretical and some empirical exercises. Further, we have incomplete markets: household's bear some risk due to idiosyncratic shocks.

Finally, the EZW representation of preferences, taken from Epstein and Zin (1989) and Weil (1990), is give by

$$V_{e,t} = \left\{(1-\beta)c^{1-1/\theta} + \beta\left[\nu^e_{t+1}[E_t V^{1-\gamma}_{e,t+1}]^{\frac{1-1/\theta}{1-\gamma}} + (1-\nu^e_{t+1})E_t[B(R^b A^{b'} + R^{s'} A^{s'})^{1-\gamma}]^{\frac{1-1/\theta}{1-\gamma}}\right]\right\}^{\frac{1-\gamma}{1-1/\theta}}, \quad (19)$$

where $V_{e,t}$ is a state-dependent value of the optimization problem. This is a generalization of the CRRA structure. It allows more flexibility by distinguishing risk aversion (γ) from the elasticity of intertemporal substitution (θ). Bhamra and Uppal (2006) discuss the portfolio implications of this preference structure. Among other things, they point out that in the face of stochastic returns, the portfolio choice depends jointly on the elasticity of substitution and the degree of risk aversion, i.e. the parameters (θ, γ). As in Weil (1990), non-interest income is deterministic in their analysis. Relatively few quantitative studies of household portfolio choice, Gomes and Michaelides (2005) being a prime exception, use this specification of preferences in a fully stochastic environment.[9]

3.3 Terminal Value

Denote wealth, and hence the bequest of an agent, at death by Z. The utility flow from a bequest, in the case of CRRA preferences, is:

$$B(Z) = L\frac{(\phi + Z)^{1-\gamma}}{1-\gamma}. \quad (20)$$

The parameters L and ϕ determine the utility flow from bequest. L measures the strength of the bequest motive.[10] When $\phi > 0$, the optimal choice may involve a zero bequest. One interpretation of ϕ is that it proxies for the expected income of beneficiaries. Financial choices, such as asset allocation, are very responsive to both parameters. For other preference specifications other than the CRRA, the specification in (20) changes accordingly.

[9] Gomes and Michaelides (2005) provide simulation results for a variety of parameterizations, illustrating the sensitivity of participation and portfolio shares to risk aversion and the intertemporal elasticity of substitution. Cocco, Gomes, and Maenhout (2005) consider EZW preferences in their simulations and study the sensitivity of portfolio shares to the EIS. In contrast to our paper, there is no estimation in either paper.

[10] This structure also appears in, *inter alia*, Gomes and Michaelides (2005), DeNardi, French, and Jones (2010) and Cagetti (2003).

4 Quantitative Results

The quantitative analysis of the model revolves around estimating the parameters of the household optimization problem as well as adjustment costs to match key moments from the data. To do so, the various representations in section 3.2 are studied.

4.1 Approach

The estimation of income processes, stock return process, out-of-pocket medical expenditure and mortality rate is presented in the Appendix. Preference parameters are estimated by simulated method of moments. The vector of parameters $\Theta \equiv (\beta, \gamma, \Gamma, F, L, \phi, \underline{c}, \kappa, \theta)$, solve the following problem:

$$\pounds = min_{\Theta}(M^s(\Theta) - M^d)W(M^s(\Theta) - M^d)' \tag{21}$$

where W is a weighting matrix, discussed in the Appendix.

In Θ, there are a set of preference parameters: β is the discount factor, γ is the curvature (risk aversion) of the utility function and θ is the EIS for the EZW specification. There are two parameters for the bequest function, (L, ϕ). There are two adjustment costs: Γ to participate in the stock market and F, the fixed trading cost. Finally, $\underline{c}$ is the consumption floor pre-retirement and $\kappa\underline{c}$ is the post-retirement floor.

The data moments, M^d, are those reported in Table 3. The simulated moments, $M^s(\Theta)$, are calculated from the simulated data set created by solving the household optimization problem specified in equations (2) to (20) given the parameter vector Θ and a representation of utility. The moments from the simulated data are calculated in the same was as the moments from the actual data.

The initial distribution of assets is important for the moments generated by the solution of the model. For example, a household may never participate in the stock market if it is not a participant initially, but may stay in the stock market until the end of life if it is in the market initially. This is because participation status itself has value due to entry cost. Hence the mean level of participation, a key moment, will depend on initial conditions.

We estimate the initial distribution of households on the product space of stock and bond holdings from the Survey of Consumer Finance. Using this initial condition, we simulate the paths of consumption, stockholding and bondholding for a large number of households to create a simulated panel given a vector of parameters. The moments in (21) are calculated from this panel and the objective function is evaluated for a given value of Θ.

4.2 Results

The estimation results are reported in Tables 4 and 5. The results for the three leading preference specifications are shown, CRRA, CARA and EZW. The last row, labeled EZW(I), is explained below.

Table 4 shows the parameter estimates as well as the fit. Under each of the parameter estimate is the standard error. As indicated by the last column of the table, the fit of the EZW specification is better than either of the alternatives.[11]

Regarding the parameter estimates, the discount factor is estimated at 0.731, below conventional estimates, and the estimated risk aversion is 12.175. For the EZW specification, θ controls the elasticity of inter temporal substitution and is nearly unity. The estimated γ is much larger than $\frac{1}{\theta}$ so the time separable CRRA model is rejected.

For comparison, the baseline calibration of Gomes and Michaelides (2005) assumes: $\beta = 0.96, \gamma = 5, \theta = 0.2, \Gamma = 0.025$. Binsbergen, Fernandez-Villaverde, Koijen, and Ramirez (2012) estimate a DSGE model with EZW preference based on the term structure of interest rate. The estimated γ ranges from 41-85 and the EIS ranges from 1.30-2.01, implying even larger risk aversion and inter-temporal substitution. Cagetti (2003) estimates a β around 0.98 for college educated while his estimated discount factor is between 0.85 and 0.90 for high school education and below. The estimated risk aversion ranges from 4.3 for high school grads to 2.4 for those not finishing high school.[12]

The participation, Γ, and adjustment costs, F, are each significant. The values reported are fractions of the average pre-retirement income of all households. Thus the entry cost is about 1.4% of average income or about \$700. The adjustment cost is much smaller, only 0.1%, or about \$50. In comparison, Bonaparte, Cooper, and Zhu (2012) estimate fixed trading costs of about \$900 though in that model there are no participation costs.

The estimated parameters for the bequest motive are both significant. This is important as bequests are a relevant factor in the savings decision. In contrast, DeNardi, French, and Jones (2010) report an insignificant bequest motive for their estimated model with CRRA preferences. Our estimate of L is significantly different from zero for the CRRA case as well, though it is not estimated very precisely.

The consumption floor is about 21% of income. Given the estimate of κ, the floor is 10% lower during retirement years. Here these parameters are fractions of overall mean income and thus are the same across education groups. Consequently, the floor is much closer to the mean income of the low education group compared to others.

In simulated data using the estimated parameters, about 10% of households in the low education group hit the consumption floor pre-retirement. In the post-retirement period, almost 50% of these households hit the consumption floor in response to adverse medical shocks. Though the other education groups do not hit the floor pre-retirement, 17% of the second group and 14% of the next to higher group hit the floor during retirement. Even the highest education group is supported through the floor in about 3.5% of the observations.[13]

[11] While the difference in the fit between the EZW and CARA specifications is not significant at the 5% level, the EZW specification is treated as the baseline model. For our main results, we discuss robustness to the CARA case.

[12] This is for the estimation which matches median wealth distribution.

[13] These rates are much lower under CARA preferences.

The CRRA and CARA models have considerably lower discount factors and lower estimates of risk aversion. In comparison, Alan (2006) estimates parameters to match the coefficients of a reduced form regression of participation on age and lagged participation. She estimates $\beta = 0.92$ and a CRRA parameter of 1.6.

The CRRA model has larger adjustment costs than the EZW specification and a larger point estimate (though it is imprecisely estimated) bequest motive. For the CRRA model, the consumption floor is higher pre-retirement but lower post-retirement. The CARA model estimates even higher risk aversion than the CRRA model and also sizable adjustment costs, compared to EZW. It is noteworthy that the consumption floor is not significant for CARA preferences.

Table 4: Estimation Results

	β	γ	Γ	F	L	ϕ	$\underline{c}$	κ	θ	£
CRRA	0.574	7.272	0.024	0.019	6.316	1.490	0.300	0.102		391.33
	(0.003)	(0.042)	(0.0001)	(0.0003)	(2.325)	(0.035)	(0.003)	(0.001)		
CARA	0.584	11.241	0.028	0.015	4.273	0.223	0.138	0.182		107.63
	(0.003)	(0.070)	(0.001)	(0.00005)	(0.196)	(0.007)	(0.390)	(0.967)		
EZW	0.731	12.175	0.014	0.001	3.275	0.487	0.212	0.902	0.968	85.37
	(0.001)	(0.066)	(0.0002)	(0.00002)	(0.103)	(0.013)	(0.004)	(0.143)	(0.014)	
EZW(I)	0.9045	3.8589	0.0185	0.0161	1.4449	4.2113	0.2043	0.1723	0.9880	0.073
	(0.010)	(0.290)	(0.001)	(0.001)	(0.891)	(1.080)	(0.018)	(0.731)	(0.038)	

This table reports the estimated parameter values and fit (distance between model and data moments) for the CRRA, CARA and EZW preferences. The inverse of variances is used as weighting matrix, except in the case of EZW(I) where the identity matrix is used.

Table 5 presents the data moments and those produced by simulating the models at the estimated parameter values. The EZW specification, as well as the others, succeeds in generating a stock share of around 60%, though the model misses the share of the most educated group during retirement. Given the mean differential in return between safe and risky assets of of 4.3 percentage points, researchers often struggle to match the stock share. In this analysis, the presence of the stock trading costs implies that the liquid asset has more value and thus motivates the holding of bonds.

Participation increases by education group in the data. And, for each education group, the participation rate is higher post-retirement. The EZW model, as well as the other specifications capture this pattern. But the predicted participation rate is much lower than in the data for the CRRA model.

The adjustment rate is also increasing by education in the data but is lower post-retirement for each education group. This pattern is also captured by the models. Here though the CARA representation does not match the data as well as the EZW model.

The median wealth to income ratio rises considerably with both education and retirement status. None of the models do a good job in matching these levels. The CARA model comes closest, particularly for the highest education group. This means that the models are not quite generating as much savings as in the data. Relative to the parameters, this could reflect a relatively low discount factor, as seems to be the case, and/or a low degree of risk aversion so that the precautionary savings motive is attenuated.

As noted earlier, the median wealth to income ratio moments are not as precisely estimated as other moments. Consequently, they are down-weighted in the estimation. It is interesting to see the parameter estimates under an alternative. The row denoted EZW (I) in Tables 4 and 5 present estimates and moments for the EZW case where the weighting matrix, W, in (21) is the identity matrix.[14] This weighting matrix also produces consistent estimates, though it is not as efficient in large samples.

The estimates with this alternative weighting scheme are quite different from the baseline. The estimated $\beta = 0.9045$ is much closer to conventional estimates and the risk aversion estimate is much lower than the baseline. The estimated portfolio adjust cost is an order of magnitude larger. A higher adjustment cost is needed to balance the discounted gains from adjustment once β is larger.

From Table 5, with the higher discount factor, the model has a much higher median wealth to income ratio and matches the data more closely except for the low education groups, pre-retirement. But, for these parameters, the stock share is much higher than in the data as is the participation rate for low education groups.

The analysis that follows will use the original estimates rather than those from the identity matrix. In this way we are closer to matching the portfolio and participation decisions of the household, which are of interest as well as the savings rate.[15]

5 Why does Education Matter?

This section returns to the key questions of our paper. Having estimated parameters using moments of financial choices that depend on education, we are now ready to understand the role of education attainment.

The only differences across these groups was in the mean income profile, mortality rates and medical expenses. We use the estimated model to study the impact of these differences in driving processes on financial choices. We further elaborate on the baseline model to allow some parameters to vary with education.

5.1 Mortality, Income and Medical Expenses

Tables 6 presents simulation results for alternative specification of income and medical expenses. These are simulation results using the baseline parameters for alternative specifications. There is no re-estimation.

Each row of the table has a different treatment of mortality, income and medical expenses across education groups. In the baseline model, all of these processes differ across education groups. The “Same Mortality”

[14]With $W = I$ in (21), the EZW model again outperformed the other preference specifications.

[15]The estimates from either matrix are consistent. Those using the original weighting matrix is close to the one that produces efficient estimates. But of course, the small sample properties may differ.

Table 5: Moments: Participation, Composition and Adjustment by Education

	Pre-Retirement				Post-Retirement			
School	<12	=12	>12 <=16	>16	<12	=12	>12 <=16	>16
	Stock Share							
Data	0.523	0.539	0.562	0.602	0.451	0.495	0.568	0.599
CRRA	0.599	0.615	0.654	0.712	0.701	0.830	0.787	0.816
CARA	0.693	0.696	0.619	0.587	0.517	0.752	0.662	0.632
EZW	0.466	0.575	0.613	0.644	0.485	0.457	0.542	0.445
EZW(I)	0.860	0.862	0.899	0.922	0.924	0.930	0.913	0.885
	Participation							
Data	0.173	0.322	0.560	0.814	0.221	0.451	0.734	0.851
CRRA	0.295	0.501	0.664	0.710	0.103	0.087	0.328	0.539
CARA	0.154	0.274	0.571	0.777	0.035	0.168	0.456	0.769
EZW	0.150	0.319	0.610	0.693	0.103	0.272	0.570	0.722
EZW(I)	0.346	0.504	0.650	0.751	0.280	0.628	0.794	0.911
	Adjustment Rate							
Data	0.560	0.563	0.615	0.701	0.397	0.417	0.558	0.646
CRRA	0.271	0.218	0.339	0.337	0.213	0.242	0.441	0.544
CARA	0.379	0.444	0.600	0.703	0.273	0.490	0.729	0.827
EZW	0.456	0.536	0.646	0.679	0.333	0.284	0.385	0.418
EZW(I)	0.313	0.308	0.438	0.505	0.596	0.515	0.563	0.547
	Median W-I ratio							
Data	0.077	0.148	0.451	1.787	0.638	1.563	4.292	5.828
CRRA	0.221	0.422	0.571	0.750	0.239	0.059	0.238	0.446
CARA	0.105	0.263	0.717	2.051	0.008	0.207	0.505	2.804
EZW	0.093	0.278	0.387	0.428	0.012	0.229	0.384	0.559
EZW(I)	0.235	0.513	0.929	1.437	0.045	1.713	4.134	5.843

This table reports the averages of participation rates, stock shares and stock adjustment rates and median wealth-income ratios by education attainment both in the real data and in the simulated data for the CRRA, CARA and EZW estimated models. The inverse of variances is used as weighting matrix, except in the case of EZW(I) where the identity matrix is used.

Table 6: Household Finance and Exogenous Processes: Baseline

	Pre-Retirement				Post-Retirement				Fit
School	<12	=12	>12 <=16	>16	<12	=12	>12 <=16	>16	
	Stock Share								
Full Model	0.466	0.575	0.613	0.644	0.485	0.457	0.542	0.445	85.37
Same Mortality	0.466	0.571	0.599	0.629	0.485	0.412	0.405	0.337	98.69
Same Medical Exp.	0.466	0.575	0.613	0.645	0.485	0.448	0.539	0.472	83.83
Same Stochastic Inc.	0.466	0.558	0.613	0.646	0.485	0.452	0.535	0.448	93.89
Same Determ. Inc.	0.466	0.481	0.433	0.388	0.485	0.514	0.581	0.606	1035.20
Same Timing of Inc.	0.466	0.588	0.623	0.644	0.485	0.457	0.542	0.445	92.37
	Participation								
Full Model	0.150	0.318	0.610	0.693	0.103	0.272	0.570	0.722	
Same Mortality	0.150	0.318	0.612	0.695	0.103	0.283	0.630	0.741	
Same Medical Exp.	0.150	0.319	0.610	0.693	0.103	0.275	0.570	0.723	
Same Stochastic Inc.	0.150	0.317	0.616	0.663	0.103	0.278	0.558	0.704	
Same Determ. Inc.	0.150	0.061	0.127	0.138	0.103	0.034	0.046	0.065	
Same Timing of Inc.	0.150	0.296	0.564	0.661	0.103	0.272	0.568	0.722	
	Adjustment Rate								
Full Model	0.456	0.536	0.647	0.679	0.333	0.284	0.384	0.418	
Same Mortality	0.456	0.539	0.643	0.682	0.333	0.312	0.376	0.512	
Same Medical Exp.	0.456	0.534	0.647	0.678	0.333	0.282	0.378	0.414	
Same Stochastic Inc.	0.456	0.523	0.653	0.669	0.333	0.285	0.391	0.414	
Same Determ. Inc.	0.456	0.336	0.365	0.348	0.333	0.282	0.329	0.355	
Same Timing of Inc.	0.456	0.552	0.659	0.683	0.333	0.284	0.386	0.418	
	Wealth-Income Ratio								
Full Model	0.093	0.280	0.393	0.435	0.012	0.228	0.372	0.546	
Same Mortality	0.093	0.282	0.409	0.456	0.012	0.248	0.614	0.822	
Same Medical Exp.	0.093	0.278	0.387	0.424	0.012	0.233	0.384	0.512	
Same Stochastic Inc.	0.093	0.275	0.383	0.402	0.012	0.235	0.382	0.542	
Same Determ. Inc.	0.093	0.099	0.074	0.172	0.012	0.012	0.000	0.008	
Same Timing of Inc.	0.093	0.276	0.384	0.426	0.012	0.229	0.384	0.559	

This table reports the model moments from counter-factual exogenous processes. “Same Determ. Inc.” case imposes the same deterministic income of the least educated group to the remaining three. Other cases are similarly defined.

treatment forces all education groups to have the same mortality rates. The "Same Medical Exp." treatment forces all education groups to have the same average expenditure relative to post-retirement income. The "Same Stochastic Inc." treatment assumes that all education groups have the same variance of their income process. The "Same Determ. Inc." treatment forces all education groups to have the same mean income profile. Finally, the "Same Timing of Inc." treatment gives all households the same shape of life cycle income profile but allows the means to differ by education.

For each of these treatments, the process for the lowest education group is used as the common element of the process. So, for example, in the "Same Determ. Inc." treatment, all education groups have the profile of the lowest education group. This choice of using the profile of the lowest education group is simply to provide a basis of comparison.

As this table makes very clear, the difference in deterministic income is the major factor explaining the diverse financial decisions across education groups. If all education groups shared the same (low education) income profile, the pre-retirement household finance moments are uniformly reduced. While differences across education groups remain, the high education group looks very much like the low education group. Differences between other groups are muted. For example, the wealth-income ratio, pre-retirement, is still predicted to be larger for high compared to low education households (0.172 vs. 0.093), though this difference is much less than in the baseline.

This treatment also impacts post-retirement decisions, in part because the deterministic post-retirement income is lower. In particular, the wealth-income ratio is lower for all education groups (except the lowest by construction) post-retirement.

Requiring all agents to have the same income profile as the low education group has two components: (i) the mean level of income and (ii) the shape of the profile over the life cycle. As is evident from Figure 1, the low education households have both a lower mean income and a profile that is relatively flat. As is clear from the last row of the table, the affect of the shape of income profile on household financial choice is quite small. Hence we conclude that mean income differences by education are key for observed differences in household financial decisions.

Forcing all agents to have the same mortality has a small affect on pre-retirement and a larger impact on post-retirement financial decisions. For a high education household, the increase in the mortality rate (to the level of the low education household) induces a lower stock share and a slightly higher participation rate. It also increases the wealth-income ratio. The higher rate of saving seems to be motivated by the large bequest motive.

Overall, we conclude that differences in mean income matter most for observed differences in household financial choices. Formally, this is made clear from the last column of Table 6, which shows how well the model fits the moments under the alternative processes. The fit in the "Same Det Inc." experiment is over 10 times worse than the baseline. This difference is statistically significant.

The influence of mean income comes, in part, from the participation and adjustment costs. Both of these costs, Γ and F, are independent of income.[16] Thus higher income groups face lower costs of participation and adjustment relative to their income and thus financial wealth. Consequently the high average income (high education) groups access the higher return processes and adjust portfolios as needed to buffer income shocks.

The consumption floor comes into play for the low education group much more than the higher education groups. This has an added affect of lowering the wealth to income ratio for the low education group.

5.2 Parameter Differences

The baseline model estimated identical parameters for all education groups. Yet one could argue that discount factor and adjustment costs could differ by education.[17] All else the same, more patient people will go to school. And more educated people might face lower adjustment costs. In addition, differences in risk aversion might underlie the differential finance choices across education groups.

Tables 7 and 8 report parameter estimates and moments, respectively, for the EZW preferences allowing parameters to vary across two education groups. For this re-estimation, the parameters differ for the low (subscript 1) and high education groups (subscript 4). The rows of the tables indicate which parameters vary.

For example, the (β, Γ) case allows these two parameters to vary across the education groups. The tables reports the moments from the re-estimated model as well as the parameter estimates for the two cases.[18]

In all treatments, the estimated discount factor for the lowest education group, β_1 is slightly higher than the baseline estimate of 0.731 while the discount factor for the higher education group, β_4 is considerably higher, between 0.83 and 0.84. This leads to a much higher wealth to income ratio for the high education group, relative to the baseline estimation.

The first and second treatments look at other differences in preferences. In the first treatment, the risk aversion of the households is allowed to vary by education class. The second treatment allows the intertemporal elasticities to vary. In both exercises, the differences in preference parameters are small and insignificant.

The last two treatment allow adjustment costs to differ. In the third treatment, the estimated participation cost (as a fraction of the average permanent income) is essentially the same for the two groups. That is, in the row labeled (β, Γ), the estimated values for Γ_1 and Γ_4 are about the same. Thus the differences in participation across the two education groups is not a consequence of differences in this parameter.

The last treatment allows portfolio adjustment costs to vary across groups. Here the point estimate of the adjustment cost is larger for the high education group, but the difference is not significant.

The key result here is that the discount factor is higher for the high education groups. While point

[16] To be clear, the estimates are reported as fractions of income but the costs are simply constants in the household problem for all education groups.

[17] Gomes and Michaelides (2005) and Cagetti (2003) also have heterogeneous groups.

[18] The model was re-estimated using moments only for these two extreme education classes.

Table 7: Results of Estimation with Heterogenous Preferences/Costs

	β_1	γ_1	Γ	F	L	ϕ	$\underline{c}$	κ	θ	β_4	γ_4
(β, γ)	0.746	15.460	0.013	0.002	0.589	1.429	0.290	0.557	0.528	0.829	13.163
	(0.007)	(0.030)	(0.009)	(0.0001)	(0.084)	(0.100)	(0.007)	(0.146)	(0.013)	(0.003)	(0.055)
	β_1	γ	Γ	F	L	ϕ	$\underline{c}$	κ	θ_1	β_4	θ_4
(β, θ)	0.735	13.492	0.011	0.0014	0.620	1.414	0.273	0.283	0.616	0.830	0.637
	(0.007)	(0.086)	(0.002)	(0.0001)	(0.160)	(0.093)	(0.008)	(1.093)	(0.029)	(0.003)	(0.009)
	β_1	γ	Γ_1	F	L	ϕ	$\underline{c}$	κ	θ	β_4	Γ_4
(β, Γ)	0.752	13.587	0.012	0.001	0.186	1.030	0.260	0.338	0.680	0.846	0.013
	(0.02)	(0.022)	(0.008)	(0.0002)	(0.043)	(0.150)	(0.006)	(0.689)	(0.016)	(0.004)	(0.002)
	β_1	γ	Γ	F_1	L	ϕ	$\underline{c}$	κ	θ	β_4	F_4
(β, F)	0.752	13.406	0.011	0.0013	0.305	1.175	0.257	0.321	0.686	0.841	0.0017
	(0.009)	(0.017)	(0.001)	(0.000)	(0.006)	(0.056)	(0.007)	(0.833)	(0.024)	(0.003)	(0.0002)

This table reports estimated parameters from the model with two education groups and heterogeneous preferences/costs. In parenthesis are standard errors.

estimates of various parameters seem to depend on education, these differences, taking into account the additional parameters, are not significant as indicated by the F-stat. Importantly, though one might conjecture that adjustment costs differ by education group, this is not found in the estimation.

We argued earlier that a main difference across households of different education groups was due to the higher levels of income by the higher education group. Given our estimation of a higher discount factor, and other parameter differences, for high education households, it is natural to see whether income differences remain key.

For the high education group, Table 9 reports the effects on the moments from switching the mean income to that of the low education group given the estimates for this education group from Table 7. The blocks in this table are the same combination of parameters as in Table 7. For each block, the first row, labeled "high", repeats the moments for the high education group from Table 7. The second row, labeled "low", shows moments for the same parameters, replacing the mean and income profile of the high education with the mean and income profile of the low education group.

As in the earlier analysis, there are substantial differences in the moments associated with changes in the mean of the income process for the high education group. This is not to say that the parameter differences reported in Table 7 do not matter. Rather, the affects of the parameter differences are relatively minor compared to the affects of mean income.[19]

This conclusion follows from the column labeled "fit" in this table indicates how the ability of the model

[19] Cocco, Gomes, and Maenhout (2005) argue that the utility loss from suboptimal portfolio decisions is costly because of the income profile rather than income risk.

Table 8: Moments from Model with Heterogenous Preferences/Costs

Case		Pre-retirement				Post-retirement					
		stock share	part. rate	adj. rate	W-I ratio	stock share	part. rate	adj. rate	W-I ratio	Fit £	F-stat
data	school<12	0.523	0.173	0.560	0.077	0.451	0.221	0.397	0.638	na	
	school>16	0.602	0.814	0.701	1.787	0.599	0.851	0.646	5.828		
baseline	school<12	0.466	0.150	0.456	0.093	0.485	0.103	0.333	0.012	42.82	
	school>16	0.644	0.693	0.679	0.428	0.445	0.722	0.418	0.559		
(β, γ)	school<12	0.433	0.209	0.532	0.074	0.518	0.048	0.369	0.000	22.210	1.928
	School>16	0.599	0.850	0.735	1.520	0.594	0.853	0.642	1.218		(0.13)
(β, θ)	school<12	0.525	0.220	0.537	0.076	0.439	0.034	0.287	0.0002	22.185	1.930
	School>16	0.601	0.845	0.734	1.373	0.594	0.842	0.635	1.108		(0.13)
(β, Γ)	school<12	0.520	0.231	0.514	0.069	0.494	0.047	0.309	0.012	20.263	2.113
	School>16	0.618	0.847	0.727	1.490	0.594	0.907	0.672	1.557		(0.10)
(β, F)	school<12	0.530	0.241	0.555	0.082	0.484	0.048	0.327	0.012	22.049	1.942
	School>16	0.619	0.843	0.678	1.397	0.598	0.885	0.621	1.359		(0.13)

This table presents the moments from the estimation reported in Table 7. Given that the fits follows Chi-square distribution under the null, with degree of freedom being 32-9=23 in the baseline model, and 16-11=4 in the model with heterogeneity, their ratio follows a F-distribution with degree of freedom (4,23). The p-value is defined as the probability $(F(4, 23) > ratio)$.

to match moments (for the low and high education groups) changes with the mean of the income process. The results are consistent with those reported in Table 6. For all of these combinations of parameters, the fit worsens by a factor of at least 20 when the income process is switched!

6 Experiments

The estimated model provides insights into the impact of government interventions on household financial decisions. Here we study three particular policies: a reduction in the consumption floor, a reduction in out of pocket medical expenses and a reduction in the uncertainty of these medical costs. The simulation results from these policies are summarized in Table 14.

6.1 Consumption Floor

The estimated consumption floor of about 21% of pre-retirement permanent income captures a wide range of government funded support programs. These are essentially insurance devices, used to support consumption for low income and low wealth households. Here we study the impact of this floor on household financial

Table 9: Moments From Imposing Low Income to High Education Group

		Pre-retirement				Post-retirement				
Case	Income	stock share	part. rate	adj. rate	W-I ratio	stock share	part. rate	adj. rate	W-I ratio	Fit £
(β, γ)	high	0.599	0.850	0.735	1.520	0.594	0.853	0.642	1.218	22.21
	low	0.606	0.362	0.625	0.000	0.788	0.306	0.672	0.090	526.02
(β, θ)	high	0.601	0.845	0.734	1.373	0.594	0.842	0.635	1.108	22.19
	low	0.573	0.371	0.632	0.059	0.798	0.327	0.660	0.202	506.13
(β, Γ)	high	0.618	0.847	0.727	1.490	0.594	0.907	0.672	1.557	20.26
	low	0.562	0.392	0.627	0.134	0.704	0.433	0.559	0.444	415.92
(β, F)	high	0.619	0.843	0.678	1.397	0.598	0.885	0.621	1.359	22.05
	low	0.5574	0.393	0.5443	0.1564	0.7416	0.383	0.5173	0.3551	446.85

This table reports household finance moments for the most educated groups. For the rows labeled "low", the income profiles of the most educated group is assumed to be the same as that of the least educated one.

decisions.

The experiment is to reduce the floor by 20%. Tax savings created by the reduction in government support are not included in the income process of the households.

The first block of Table 14 shows the response of households to a reduction in the consumption floor, $\underline{c}$, by 20%. Recall that this parameter influences the consumption floor both pre- and post-retirement.

Not surprisingly, the affects of changing the consumption floor are largely on the low education group. While all education groups have variability in income, the consumption of the low education group is near enough to the floor that variations in $\underline{c}$ influence the financial decisions of this group. As noted earlier, for the low education group about 10% of the observations are at the consumption floor and this rises to nearly 50% post-retirement.

The largest effect of the reduction in the consumption floor is on the wealth to income ratio of low education households. From Table 14, this moment increases about 150% for this education group pre-retirement and by over 535% post-retirement.[20] Further, the low education group has a lower stock share, a lower participation rate and adjust more frequently when the consumption floor is reduced. Basically, this group is creating a more liquid portfolio in response to the increased uncertainty, both by reducing the stock share and participating less.

[20]Hubbard, Skinner, and Zeldes (1995) study the effect of consumption floor on wealth accumulation, and find that consumption floor has the greatest negative effect on saving for lower-income groups.

Table 10: Policy Experiments (Baseline)

	Pre-Retirement				Post-Retirement			
School	<12	=12	>12 <=16	>16	<12	=12	>12 <=16	>16
	Consumption floor cut by 20 percent							
share	0.427	0.575	0.613	0.644	0.487	0.457	0.542	0.445
	(-8.42)	(-0.02)	(0.02)	(0.02)	(0.41)	(-0.02)	(-0.02)	(-0.07)
part.	0.141	0.319	0.610	0.693	0.101	0.272	0.568	0.722
	(-6.12)	(0.00)	(0.00)	(0.00)	(-1.56)	(0.00)	(-0.26)	(0.01)
adj.	0.512	0.536	0.646	0.679	0.336	0.286	0.384	0.416
	(12.31)	(0.06)	(0.00)	(0.03)	(0.90)	(0.53)	(-0.26)	(-0.45)
W/I	0.237	0.278	0.387	0.428	0.076	0.229	0.386	0.559
	(153.7)	(0.00)	(0.00)	(0.00)	(535.8)	(0.00)	(0.44)	(0.07)
	Medical cost cut by 20 percent							
share	0.466	0.575	0.614	0.644	0.492	0.463	0.570	0.481
	(0.02)	(0.02)	(0.07)	(0.12)	(1.53)	(1.27)	(5.24)	(8.05)
part.	0.150	0.319	0.609	0.693	0.110	0.272	0.564	0.715
	(0.00)	(0.00)	(-0.05)	(-0.03)	(7.60)	(0.04)	(-0.97)	(-0.91)
adj.	0.455	0.535	0.646	0.678	0.342	0.265	0.386	0.405
	(-0.22)	(-0.15)	(0.03)	(-0.10)	(2.73)	(-6.75)	(0.21)	(-3.20)
W/I	0.093	0.278	0.387	0.425	0.008	0.215	0.352	0.501
	(0.00)	(-0.04)	(-0.21)	(-0.61)	(-30.83)	(-6.06)	(-8.43)	(-10.38)
	Variance of Medical cost cut by 20 percent							
share	0.466	0.575	0.613	0.644	0.491	0.463	0.566	0.480
	(0.00)	(0.00)	(0.03)	(0.12)	(1.22)	(1.27)	(4.52)	(7.91)
part.	0.150	0.319	0.609	0.693	0.110	0.271	0.554	0.715
	(0.00)	(0.00)	(-0.05)	(-0.01)	(7.02)	(-0.55)	(-2.72)	(-0.91)
adj.	0.456	0.535	0.647	0.678	0.340	0.276	0.383	0.402
	(-0.07)	(-0.21)	(0.23)	(-0.12)	(1.89)	(-2.85)	(-0.55)	(-3.80)
W/I	0.093	0.278	0.387	0.425	0.012	0.215	0.344	0.496
	(0.00)	(0.00)	(-0.08)	(-0.51)	(-2.50)	(-6.06)	(-10.46)	(-11.32)

This table reports the effects of policy changes on household finance based on EZW preference. In parenthesis are percentage changes of moments relative to moments before policy changes.

6.2 Medical Expenses

Retirees face significant risk from out-of-pocket medical expenses. This exposure is partly an outcome of government policy through Medicare. These experiments can also be interpreted as changes in the process for medical needs, rather than insurance coverage.

For this exercise, we look at both reductions in the mean of out-of-pocket medical expenses and the uncertainty of those expenses. Both of these experiments are directed towards post-retirement medical expenses though these policies can influence household choice pre-retirement as well.

The second block of Table 14 reports moments using the baseline parameter estimates when average out-of-pocket medical expenses are reduced by 20%. The policy has a clear impact on wealth to income ratio. As medical expense risk is substantial, a reduction in the mean of this cost leads households of all education groups to reduce precautionary savings. Consequently, both the wealth income ratio and participation rates fall. The fall of post-retirement wealth income ratio is quite significant, ranging from $6 - 31\%$.[21] The stock share rises for all education groups, presumably because their liquidity needs are lower. Interestingly, asset market participation rates rise for the low education group. One interpretation of this is that under the policy low education groups are less likely to hit the consumption floor and thus be forced to sell assets.

The third block of Table 14 studies the affects of reducing the variability of medical costs. The results are quite similar to the reduction in the mean of medical expenses: precautionary savings is lower so that the wealth to income ratio falls and, except for the low education group, asset market participation is lower. As before, these effects are in the post-retirement period.

7 Robustness

The results on the role of education and the policy experiments have been conducted under two important assumptions. First, we have focused on the EZW preference specification though the CARA model also closely fit the data. Second, we have ignored housing.

This section of the paper explores the robustness of our key findings in two directions. First, we replace the EZW estimation results with those for CARA preferences. Second, we introduce housing. This section is organized around the economic issues: (i) why does education matter and (ii) policy experiments.

7.1 Why Does Education Matter?

Our earlier analysis, based on EZW preferences without housing, concluded that a important difference across education groups was the mean of the income process. Differences in income variability, the mortality rate and the life cycle profile were considerably less important. Here we study those findings for a model with CARA preferences and in another model in which housing is introduced.

[21] Recent studies show that out-of-pocket medical expenditure is important in explaining slow decumulation of assets after retirement. For example, DeNardi, French, and Jones (2010) and Kopecky and Koreshkova (2013).

7.1.1 CARA

The results for the CARA model are reported in Tables 4 and 5. Using the estimated parameters, we repeated the decompositions reported in Table 6. The results are reported in Table 11.

Clearly the findings reported for the EZW case are robust to CARA preferences. The main difference across household financial decisions comes from the mean income profile.

7.1.2 Housing

Thus far, we have ignored housing. This section introduces housing in the model and focuses on the connection between education and household finance when housing is included.

We introduce housing into the model both as a consumption good and as an asset. Returning to the household choice problem, let c represent the consumption flow of the household. As in Cagetti (2003), consumption is a composite of goods and services (x) as well as the service flow from housing (h). Assume a Cobb-Douglas function, $c = x^{\alpha} h^{1-\alpha}$, so that a constant fraction of expenditures is on housing services.

The return of housing as an asset has two components: price appreciation and (imputed) rental return. Various evidence show that long-run price appreciation is low and rental return is the major component.[22] Since housing rent is relative stable over time, the housing return resembles bonds.

With housing treated as an safe asset, the return to bonds needs to be re-calibrated. First, we take housing return to be 5% per annum. As noted before, the majority of housing return comes from rental income. Campbell, Davis, Gallin, and Martin (2009) show that rent-price ratio for the US residential market is about 0.05 on average, but appears to decline since the end of 1990s. Next, from SCF data, on average housing wealth takes up 69.5% of total wealth. Therefore the return of composite bond-housing asset is $69.5\% \times 5\% + (1 - 69.5\%) \times 2\% = 4.08\%$.

Two sets of moments are re-calculated from SCF data with housing equity included – stock share in total wealth and wealth-income ratio. These new moments are reported in the lower block of Table 3. Not surprisingly, shares are much lower and wealth-income ratios are much higher than without housing.

Table 12 presents the estimation results for this expanded model using EZW preferences. Comparing these results to the baseline in Table 4, there a number of important differences. The inclusion of housing leads to a larger estimated β and a smaller estimated degree of risk aversion, γ. The larger estimate of β accommodates the higher wealth to income ratios once housing is included. The estimated consumption floor post-retirement, κ, is not significantly different from zero and the estimated participation cost, Γ, is larger.

Looking at the simulation data, the fraction of households hitting the consumption floor is much lower once housing is in the model. For the low education post-retirement group, only 12% of the observations are at the consumption floor, compared to the nearly 50% prediction for the model without housing.

[22] For example, during 1987-2011, the Case-Shiller index at national level increased at an average rate of 0.285% per annum after inflation adjustment.

Table 11: Household Finance and Exogenous Processes: CARA W/O Housing Wealth

	Pre-Retirement				Post-Retirement				Fit
School	<12	=12	>12 <=16	>16	<12	=12	>12 <=16	>16	
					Stock Share				
Full Model	0.693	0.696	0.619	0.587	0.517	0.752	0.662	0.632	107.63
Same Mortality	0.693	0.695	0.618	0.585	0.517	0.747	0.652	0.625	107.22
Same Medical Exp.	0.693	0.696	0.619	0.586	0.517	0.759	0.650	0.616	106.62
Same Stochastic Inc.	0.693	0.696	0.613	0.609	0.517	0.755	0.654	0.653	111.79
Same Timing of Inc.	0.693	0.716	0.628	0.591	0.517	0.752	0.662	0.632	112.65
Same Determ. Inc.	0.693	0.663	0.655	0.664	0.517	0.323	0.432	0.479	981.89
					Participation				
Full Model	0.154	0.274	0.571	0.777	0.035	0.168	0.456	0.769	
Same Mortality	0.154	0.275	0.570	0.777	0.035	0.166	0.451	0.766	
Same Medical Exp.	0.154	0.274	0.571	0.776	0.035	0.176	0.457	0.763	
Same Stochastic Inc.	0.154	0.277	0.570	0.720	0.035	0.178	0.450	0.702	
Same Timing of Inc.	0.154	0.266	0.560	0.767	0.035	0.168	0.456	0.769	
Same Determ. Inc.	0.154	0.096	0.139	0.191	0.035	0.013	0.023	0.048	
					Adjustment Rate				
Full Model	0.379	0.444	0.600	0.703	0.273	0.490	0.729	0.827	
Same Mortality	0.379	0.443	0.600	0.703	0.273	0.485	0.727	0.828	
Same Medical Exp.	0.379	0.444	0.600	0.704	0.273	0.486	0.734	0.837	
Same Stochastic Inc.	0.379	0.458	0.609	0.678	0.273	0.498	0.737	0.814	
Same Timing of Inc.	0.379	0.457	0.608	0.712	0.273	0.490	0.728	0.827	
Same Determ. Inc.	0.379	0.261	0.287	0.193	0.273	0.137	0.227	0.241	
					Wealth-Income Ratio				
Full Model	0.105	0.263	0.717	2.051	0.008	0.207	0.505	2.804	
Same Mortality	0.105	0.264	0.721	2.049	0.008	0.224	0.541	2.688	
Same Medical Exp.	0.105	0.263	0.717	2.039	0.008	0.204	0.506	2.692	
Same Stochastic Inc.	0.105	0.254	0.699	1.689	0.008	0.209	0.500	1.829	
Same Timing of Inc.	0.105	0.262	0.716	2.048	0.008	0.207	0.505	2.806	
Same Determ. Inc.	0.105	0.071	0.041	0.072	0.008	0.007	0.004	0.010	

This table reports the model moments from counter-factual exogenous processes with CARA preferences. "Same Determ. Inc." case imposes the same deterministic income of the least educated group to the remaining three. Other cases are similarly defined.

Table 12: Estimation With Housing Wealth

β	γ	Γ	F	L	ϕ	$\underline{c}$	κ	θ	£
0.851	9.359	0.023	0.001	5.915	0.442	0.223	0.483	0.844	69.469
(0.001)	(0.070)	(0.0007)	(0.00003)	(0.558)	(0.024)	(0.006)	(0.693)	(0.006)	
		Pre-Retirement				Post-Retirement			
	School	<12	=12	>12 <=16	>16	<12	=12	>12 <=16	>16
Share	Data	0.261	0.361	0.353	0.425	0.262	0.296	0.418	0.448
	EZW	0.275	0.355	0.379	0.407	0.141	0.145	0.148	0.153
Part.	Data	0.173	0.322	0.560	0.814	0.221	0.451	0.734	0.851
	EZW	0.162	0.346	0.608	0.759	0.148	0.379	0.716	0.880
Adj.	Data	0.560	0.563	0.615	0.701	0.397	0.417	0.558	0.646
	EZW	0.534	0.496	0.576	0.604	0.782	0.762	0.747	0.753
W/I	Data	0.441	0.789	1.503	3.573	4.015	5.204	7.773	8.880
	EZW	0.749	0.991	1.251	1.516	2.450	2.886	3.160	3.285

This table reports parameter estimates and moments using EZW preferences when housing is included. In parenthesis are standard errors.

Returning to the question of why education matters, Table 13 reports the same decompositions of differences across education groups. Once again, the main differences across groups comes from mean income levels.

7.2 Policy Experiments

For the baseline model, three policy experiments were conducted: (i) a cut in the consumption floor, (ii) a reduction in mean medical expenses and (iii) a reduction in the variance of medical expenses. Here we study the robustness of those findings.

7.2.1 CARA

The policy experiments for the CARA case are reported in Table 14. For the CARA preferences, a reduction in the consumption floor has a very small impact, even on the lowest education group compared to the EZW case. This is because the estimated consumption floor is much lower with CARA preference, so that it is rarely hit. Based on the simulated data, the lowest education group has consumption at the floor in only 2.5% and 0.3% of the observations pre- and post-retirement respectively. It is not surprising then that a reduction in the floor has little impact.[23] Nevertheless, the policy impact the least educated group the most, as with EZW preference.

[23] Based on experimentation, the result is symmetric: an increase also allows matters very little.

Table 13: Household Finance and Exogenous Processes: EZW With Housing Wealth

	Pre-Retirement				Post-Retirement				Fit
School	<12	=12	>12 <=16	>16	<12	=12	>12 <=16	>16	
	Stock Share								
Baseline	0.275	0.355	0.379	0.407	0.141	0.145	0.148	0.153	69.47
Same Mortality	0.275	0.353	0.374	0.401	0.141	0.142	0.142	0.146	70.35
Same Medical Exp.	0.275	0.355	0.379	0.407	0.141	0.144	0.148	0.154	69.41
Same Stochastic Inc.	0.275	0.344	0.377	0.406	0.141	0.143	0.148	0.153	79.76
Same Timing of Inc.	0.275	0.364	0.386	0.409	0.141	0.146	0.149	0.153	70.72
Same Determ. Inc.	0.275	0.284	0.273	0.256	0.141	0.145	0.145	0.141	754.02
	Participation								
Full Model	0.162	0.346	0.608	0.759	0.148	0.379	0.716	0.880	
Same Mortality	0.162	0.346	0.607	0.759	0.148	0.371	0.693	0.875	
Same Medical Exp.	0.162	0.346	0.608	0.759	0.148	0.380	0.715	0.879	
Same Stochastic Inc.	0.162	0.345	0.609	0.702	0.148	0.366	0.695	0.789	
Same Timing of Inc.	0.162	0.314	0.558	0.726	0.148	0.367	0.712	0.880	
Same Determ. Inc.	0.162	0.082	0.163	0.230	0.148	0.069	0.152	0.186	
	Adjustment Rate								
Full Model	0.534	0.496	0.576	0.604	0.782	0.762	0.747	0.753	
Same Mortality	0.534	0.499	0.579	0.605	0.782	0.762	0.747	0.749	
Same Medical Exp.	0.534	0.496	0.576	0.603	0.782	0.755	0.749	0.758	
Same Stochastic Inc.	0.534	0.487	0.578	0.594	0.782	0.752	0.751	0.761	
Same Timing of Inc.	0.534	0.516	0.597	0.604	0.782	0.770	0.749	0.753	
Same Determ. Inc.	0.534	0.435	0.473	0.538	0.782	0.816	0.802	0.798	
	Wealth-Income Ratio								
Full Model	0.749	0.991	1.251	1.516	2.450	2.886	3.160	3.285	
Same Mortality	0.749	1.003	1.279	1.536	2.450	2.902	3.205	3.318	
Same Medical Exp.	0.749	0.991	1.251	1.513	2.450	2.863	3.163	3.322	
Same Stochastic Inc.	0.749	0.972	1.239	1.407	2.450	2.883	3.161	3.227	
Same Timing of Inc.	0.749	0.991	1.247	1.513	2.450	2.889	3.160	3.285	
Same Determ. Inc.	0.749	0.706	0.722	0.878	2.450	2.418	2.351	2.384	

This table reports the model moments from counter-factual exogenous processes with EZW preferences and housing. "Same Det Inc." case imposes the same deterministic income of the least educated group to the remaining three. Other cases are similarly defined.

As in the baseline EZW model, the effects of medical expenses are largely found post-retirement. For both the mean and variance reductions, the wealth to income ratio is lower. The response of this moment to the cut in the mean is muted in the CARA case compared to the EZW case. The participation rate falls for all education groups in both policy experiments. The increase in participation of the low education group no longer appears (in fact participation falls) as the consumption floor effect is irrelevant for the CARA preference structure.

7.2.2 Housing

The same experiments are conducted for the estimated model with housing, as a robustness check. Table 15 presents the results. Comparing this table with Table 14, there are a couple of significant differences .

First, the effects of the reduction in the consumption floor are smaller. This is again because the low education group is less likely to be at the consumption floor once housing is introduced in the model and housing wealth can be used to smooth consumption.

The reduction of medical expenditure, both mean and variance, again affect post-retirement household finance the most. The impact of cutting mean expenditure is robust to the inclusion of housing wealth, except that the wealth-income ratio is now slightly increased by the cut in the mean, rather than decreased as in the baseline model. The reason lies with different saving motives. Recall that the baseline model is estimated with a low discount factor (β=0.73) and high risk aversion (γ =12.2), hence saving is largely a precaution against income risk. In contrast, the model with housing is estimated with a relatively high discount factor (β=0.91) and low risk aversion (γ=3.9), so a large proportion of saving is due to household patience. In the latter case, when medical expenditures are cut, the saving rate is not reduced much, but household's cash outflow is reduced, leading to a higher post-retirement wealth-income ratio.

The reduction of the variance of medical expenditure causes a large drop in the wealth to income ratio in the base case, but not in the case with housing wealth. This is again due to the difference in estimated β and γ.

8 Conclusions

This paper studied household financial decisions for different education groups. Household differences in education are reflected in the profile of income over the life cycle as well as differences in the uncertainty over income, mortality rates and medical expenses. Household financial decisions, such as participation in asset markets, portfolio shares, stock adjustment rates and wealth to income ratios, differ across education groups.

The contribution of the paper is to characterize the mapping from exogenous differences across education groups to their financial decisions. This mapping goes through a dynamic choice model in which households face uncertainty in income and returns and make costly decisions regarding asset market participation as

Table 14: Policy Experiments (CARA, W/O Housing Wealth)

	Pre-Retirement				Post-Retirement			
School	<12	=12	>12 <=16	>16	<12	=12	>12 <=16	>16
	Consumption floor cut by 20 percent							
share	0.693	0.696	0.619	0.587	0.519	0.752	0.662	0.632
	(-0.03)	(0.00)	(0.00)	(0.00)	(0.31)	(0.00)	(0.00)	(0.02)
part.	0.155	0.274	0.571	0.777	0.035	0.168	0.456	0.769
	(0.26)	(0.00)	(0.00)	(0.00)	(0.28)	(0.00)	(0.00)	(0.00)
adj.	0.378	0.444	0.600	0.703	0.274	0.490	0.729	0.827
	(-0.24)	(0.00)	(0.00)	(0.00)	(0.26)	(0.00)	(0.00)	(0.00)
W/I	0.110	0.263	0.717	2.051	0.008	0.207	0.505	2.805
	(4.46)	(0.00)	(0.00)	(0.00)	(6.33)	(0.00)	(0.00)	(0.03)
	Medical expenditure cut by 20 percent							
share	0.693	0.695	0.618	0.586	0.493	0.747	0.657	0.632
	(-0.04)	(-0.14)	(-0.11)	(-0.14)	(-4.66)	(-0.66)	(-0.89)	(-0.03)
part.	0.154	0.274	0.571	0.776	0.034	0.162	0.450	0.755
	(-0.06)	(0.07)	(-0.02)	(-0.03)	(-3.98)	(-3.10)	(-1.27)	(-1.90)
adj.	0.379	0.444	0.600	0.703	0.261	0.488	0.724	0.836
	(-0.08)	(-0.09)	(0.02)	(0.13)	(-4.36)	(-0.47)	(-0.59)	(1.03)
W/I	0.105	0.263	0.716	2.043	0.008	0.204	0.495	2.669
	(0.00)	(-0.04)	(-0.26)	(-0.39)	(-2.53)	(-1.06)	(-2.02)	(-4.81)
	Variance of Medical expenditure cut by 20 percent							
share	0.693	0.696	0.619	0.586	0.490	0.749	0.658	0.633
	(0.01)	(-0.06)	(-0.06)	(-0.07)	(-5.26)	(-0.41)	(-0.62)	(0.14)
part.	0.154	0.274	0.571	0.776	0.034	0.164	0.453	0.756
	(-0.06)	(0.00)	(-0.02)	(-0.01)	(-3.13)	(-2.15)	(-0.57)	(-1.77)
adj.	0.379	0.444	0.600	0.703	0.262	0.494	0.726	0.838
	(0.00)	(0.02)	(-0.02)	(0.06)	(-3.99)	(0.86)	(-0.38)	(1.26)
W/I	0.105	0.263	0.716	2.046	0.008	0.204	0.495	2.691
	(0.00)	(0.00)	(-0.18)	(-0.22)	(-2.53)	(-1.50)	(-1.96)	(-4.02)

This table reports the effects of policy changes on household finance based on CARA preferences. In parenthesis are percentage changes of moments relative to moments before policy changes.

Table 15: Policy Experiments (EZW, With Housing Wealth)

	Pre-Retirement				Post-Retirement			
School	<12	=12	>12 <=16	>16	<12	=12	>12 <=16	>16
	Consumption floor cut by 20 percent							
share	0.263	0.355	0.379	0.407	0.141	0.145	0.148	0.153
	(-4.32)	(0.00)	(0.00)	(0.00)	(0.07)	(0.07)	(0.00)	(0.00)
part.	0.185	0.346	0.608	0.759	0.162	0.379	0.716	0.880
	(14.23)	(0.00)	(0.00)	(0.00)	(9.10)	(0.00)	(0.00)	(0.01)
adj.	0.542	0.496	0.576	0.604	0.784	0.762	0.748	0.753
	(1.46)	(0.00)	(0.00)	(0.00)	(0.15)	(-0.01)	(0.01)	(0.01)
W/I	0.962	0.991	1.251	1.516	2.464	2.886	3.160	3.285
	(28.34)	(0.00)	(0.00)	(0.00)	(0.59)	(0.00)	(0.00)	(-0.01)
	Medical expenditure cut by 20 percent							
share	0.275	0.355	0.379	0.407	0.144	0.146	0.149	0.154
	(0.00)	(0.03)	(0.00)	(0.00)	(1.77)	(1.04)	(0.27)	(0.79)
part.	0.162	0.346	0.608	0.759	0.151	0.384	0.717	0.882
	(0)	(0.00)	(0.00)	(-0.04)	(1.42)	(1.21)	(0.15)	(0.26)
adj.	0.533	0.496	0.576	0.603	0.801	0.770	0.752	0.751
	(-0.09)	(0.02)	(-0.07)	(-0.15)	(2.33)	(1.08)	(0.56)	(-0.28)
W/I	0.749	0.991	1.250	1.515	2.506	2.909	3.185	3.304
	(-0.05)	(-0.02)	(-0.07)	(-0.11)	(2.31)	(0.81)	(0.78)	(0.58)
	Variance of Medical expenditure cut by 20 percent							
share	0.275	0.355	0.379	0.407	0.142	0.145	0.149	0.154
	(0.00)	(0.00)	(-0.03)	(0.00)	(0.71)	(0.41)	(0.61)	(0.65)
part.	0.162	0.346	0.608	0.759	0.150	0.382	0.717	0.881
	(0.00)	(-0.03)	(0.02)	(-0.03)	(1.28)	(0.58)	(0.14)	(0.14)
adj.	0.534	0.496	0.577	0.603	0.802	0.769	0.750	0.749
	(-0.06)	(-0.04)	(0.03)	(-0.05)	(2.45)	(0.84)	(0.39)	(-0.58)
W/I	0.749	0.991	1.251	1.516	2.449	2.893	3.164	3.276
	(-0.03)	(-0.01)	(-0.02)	(-0.05)	(-0.04)	(0.24)	(0.11)	(-0.29)

This table reports the effects of policy changes on household finance based on EZW preferences when housing is included. In parenthesis are percentage changes of moments relative to moments before policy changes.

well as portfolio adjustment.

From our estimated model, the important exogenous difference across households is their mean income. Highly educated households have the highest mean income and this translates into a higher rate of asset market participation and a higher wealth to income ratio. The recursive utility representation of household preferences fits the data best. When the parameters of preferences are allowed to vary across education groups, the highest education group discounts the future much less than the lowest education group.

The estimated model is used to study some policy interventions. Reductions in the consumption floor have a considerable affect on the savings of low education households. Reductions in the mean of out-of-pocket post-retirement medical expenses and/or reductions in the variance of these expenses leads to a reduction in the savings of retired households. Interestingly, the model does not predict a large response to these policies affecting out-of-pocket medical expenses.

There are a couple of areas for further research based upon our findings. First, while housing is considered as a robustness check, the potential adjustment costs associated with adjustments in the stock of housing are not included. This is partly due to tractability problems from having too large of a state space. Adding housing with its own adjustment costs to an optimization problem with costs of stock adjustment would be of considerable interest.

Second, the model focuses only crudely on the life cycle: looking at behavior pre and post-retirement. The model can be used to fit age-dependent moments, thus matching the profiles of each of the financial decisions by education group. Matching these additional features of the data is left to future work.

Finally, the model is estimated using moments aggregated across households. It would be of interest to complement this exercise using moments created from individual decisions. For example, using data that included household choices of adjustment, participation etc as well as relevant state variables, one could create moments from estimating an approximate decision rule and then use these moments in a SMM exercise to estimate structural parameters.

9 Appendix

9.1 Exogenous Processes

Income process before retirement We estimate household's income process from PSID during the period of 1989-2009, corresponding to the time periods from which we construct household finance moments.[24] Compared with most of the relevant studies, we include more recent waves of the survey. Household income is defined as the sum of labor income of both spouse and transfers, adjusted for inflation based on CPI, so that income is in 1998 dollar before being re-scaled.

From PSID, we extract a balanced panel of 1245 households. Households with the following traits are excluded:(i) in low-income (SEO) subsample (ii) with invalid information on age, education, and race of

[24] The survey has been bi-annual since 1997.

head (iii) younger than 30 or older than 65 in 2009, the last wave of survey (iv) zero income in any year (iv) income growth below 1/20 or over 20 in any year.

To estimate the deterministic income profile and stochastic processes of income, we break the data into four education groups. For each education group, data from various years are pooled together. Then the logarithm of income is regressed on age dummies, year dummies and dummies for race.

The education-specific deterministic income profile comes from the coefficients of age dummies, re-scaled so that average income equals education-specific average income. Then we pool the income profiles of the four education groups together, re-scaled the data again, so that the mean income of the four groups equals one. The profiles in Figure 1 are the smoothed versions. We use a Hodrick-Prescott filter with smoothing parameter of 400.

It should be noted that the deterministic income profiles are a mixture of age effect and cohort effect. In the dummy regression, year effect is specifically controlled for. Due to the well-known identification problem among year effect, cohort effect and age effect, we are unable to control for cohort effect once year effect is in the regression.

The residuals from the regression, denoted $y_{i,t}$ are assumed to be income shocks that follows the stochastic process in equation(1) To estimate ρ, σ_ϵ^2 and σ_η^2, we employ the standard minimum distance method, matching the variance-covariance of $\{y_{i,t}\}$ from the econometrics model with that in the data. For details about moments construction and estimation method, see Guvenen (2009).

Income replacement ratio by education attainment Recent waves of PSID survey (2005, 2007, 2009) provide quite detailed information about the after-retirement income of respondents. We select households whose heads are retirees in 2005, or 2007, or 2009, and calculate their income replacement ratios. Then we average over households in the same education group to obtain the mean values. When selecting retirees, we include all the households with valid information on pre-retirement income, post-retirement income, year of retirement and education attainments of the heads. Households whose calculated income replacement ratio is above 20 are excluded. The total number of observations is 2201.

Take a retiree in 2009 as an example, we first calculate the after-retirement income, denote Y_i^r. Then we trace the labor income of this household before retirement based on the reported year of retirement. Ten observations of pre-retirement labor income are used with the mean denoted Y_i^b. Then the replacement ratio of this i^{th} household is $\frac{Y_i^r}{Y_i^b}$. If one or more of the 10 observations of income is zero, then we excludes them and calculate Y_i^b from the remaining.

Our definitions of Y_i^r is consistent with our model setup. Unlikely the conventional definition, we exclude income from defined contribution accounts (e.g.,IRAs) and other accounts of financial assets. The reason is, we treat such accounts as either stocks or bonds in the model, as well as in the calculations of life cycle patterns from the data. Therefore our definition of post-retirement income is narrower than, for example, Smith (2003). Specifically, our Y_i^r includes (i) non-veteran pension (ii) veteran pension (iii) social security income (iv) supplemental income from social security (v) alimony.

Medical Expenditure Information on medical costs is based on University of Michigan Heath and Retirement Study (HRS). This is a longitudinal panel study that surveys a representative sample of more than 26,000 Americans over the age of 50 every two years. Supported by the National Institute on Aging and the Social Security Administration. Out-of-pocket medical expenditure is defined as the sum of what the household spends on insurance premia, drug costs, and costs for hospital, nursing home care, doctor visits, dental visits, and outpatient care. The waves of survey used in this paper are: 1996, 1998, 2000, 2002, 2004, 2006 and 2008.

We assume the same stochastic process for each education group, and take the persistence and variances of shocks directly from French and Jones (2004). The variance of transitory shocks is large with $\sigma^2_{\epsilon_M} = 0.442$. The variance of the persistent shocks is $\sigma^2_{\eta_M} = 0.0503$ with serial correlation of $\rho_M = 0.922$. Importantly, the same process applies for each education group. Deterministic out-of-pocket medical expenditure differ significantly cross education groups.

For our model we need the ratio of out-of-pocket expenditure over post-retirement income. To estimate the profiles of this ratio, we take the data used in French and Jones (2004). Education attainment information is not available from the online data of French and Jones (2004), so we obtain it from HRS website (`http://hrsonline.isr.umich.edu/`) and merge it with other variables by matching household identities. From the match data we delete respondents whose ratio is not positive or greater than 10. Totally there are 11866 respondents. For each education group, we regress the ratio on age dummies, and take the coefficients of age dummies as the age profile. The profile is then re-scaled so that the mean ratio equals mean value in the data. Since the data from French and Jones (2004) contain only respondents aged 70 or older, we extrapolate the profile between age 66-69 using spline method.[25]

Mortality Rate Mortality rate of each education group is estimated based on the data and method in DeNardi, French, and Jones (2006).[26]. The data is augmented with education attainment information from HRS via matching household identities. Minimum age in the data is 69. For each education group, we obtain the profile of mortality rate from age 50-68 through extrapolation.

Asset Returns The return process for stocks is taken from Robert Shiller's online data of $S\&P500$ for the period 1947-2007. The return is defined as the sum of annual dividend return and capital gain, deflated by CPI. The estimated mean and standard deviation of annual stock return are 6.33% and 15.5% respectively. The return on bonds is assumed to be non-stochastic and is set at 2% annually.

[25] The profiles in Figure 2 is the smoothed profiles using Hodrick-Prescott filter with smoothing parameter being 400.

[26] We are grateful to Eric French for sharing the data and stata code with us.

9.2 Moments

9.2.1 Participation, stock share and wealth-income ratio

We obtain household level stock market participation, stock share in financial wealth for stockholders and median wealth-income ratio from seven waves of Survey of Consumer Finances: 1989, 1992, 1995, 1998, 2001, 2004 and 2007.[27] From each wave of survey, data with one of the following traits are excluded: (i) not having valid information on asset holding, non-asset income, age of head, and education attainment of head; (ii) stock holding being negative; (iii) bond holding being non-positive; (iv) house heads being younger than 25 or older than 85.

We define stock as the sum of three categories (i) publicly trade stock (including those with brokage account,employment related stock and foreign stock) (ii) mutual fund and trust or managed investment account that are investment in equity market (iii) IRA and annuity. Part of IRA and annuity may not be invested in equity, but we include them in our definition of stock because these assets are costly to adjust, which is consistent with our model definition of stock. We define bond as the sum of assets in two broad categories: (i) checking account, savings account, CDs, bond market account and whole insurance (ii) mutual fund and trust or managed investment account that are investment in bond markets or CDs.

To break asset in mutual fund and trust or managed investment account into our definition of stock and bond, we follow Gomes and Michaelides (2005). Specifically, based on the answer of respondents to survey question "how is [this money] invested?", if most of the asset is in stocks, then it is included in our definition of stock. If most of the asset is in bonds or money market or CDs, it is included in our definition of bond. If the investment is reported as a combination or mixed or diversified, then half of that asset is included in stock and the other half in bond. For other answer to the survey, we assume the asset is non-financial.[28]

Our definition of stock and bond covers the majority of financial assets held by US households. We define stock market participants as those who own have positive stockholding by our definition. For the participants, we define stock share in financial wealth as $\frac{stock}{stock+bond}$. Both stockholding and bondholding are adjusted to 1998 dollar based on CPI urban series.

To compute median-income ratio, we define income as total family income minus asset income reported in SCF. The following are included as asset income: income from non-taxable investments such as municipal bonds, income from dividends, income from stock, bond and real estate and other interest income.

[27] We also obtain the two profiles from PSID data introduced below. The resulting profiles have very similar shape as in SCF, but of different scales. For example, the mean stock market participant rate for working households is 47.6% in PSID, but it is 59.2% in SCF. For working households, the mean stock share is 44.2% in PSID, but 70.3% in SCF. The major reason for such differences should come from different sampling strategy. In addition to a standard multistage area-probability design, which leads to a representative sample, SCF selects a second sample based on tax data from the Statistics of Income Division of the Internal Revenue Service, which leads to a representative sample of approximately 1,500 high-wealth households. Consequently, SCF has a larger sample of wealthier households.

[28] Other ways of investment include life insurance, fixed contract, annuities, tangible assets other than real estate, intangible assets, business investments and others.

Table 16: Basic statistics of SCF data

Survey year	1989	1992	1995	1998	2001	2004	2007
sample size	1393	2457	3632	3728	3966	4011	3923
mean age	56.6	43.1	49.5	49.5	49.7	50.3	51.0
mean participation rate	0.501	0.496	0.500	0.548	0.564	0.559	0.575
median W/Y	1.391	0.350	0.337	0.479	0.683	0.555	0.602
mean stock share (participants)	0.379	0.501	0.543	0.627	0.606	0.578	0.581

Table 17: Basic statistics of PSID data used to estimate adjustment rate

Survey year	2001	2003	2005	2007
sample size	2496	2541	2473	2518
mean age	47.4	47.8	48.5	48.8
mean adj. rate	0.639	0.574	0.577	0.581

Table 16 presents the basic information on data from SCF.

9.2.2 Adjustment rate

We obtain stock adjustment rate of stockholders from four waves of Panel Study of Income Dynamics: 2001, 2003, 2005, 2007. Starting from 1997, PSID survey includes a set of questions regarding households' wealth status and its dynamics since last survey. These questions enable us to estimate adjustment rate for each education group. Stockholders are defined in a similar way as with SCF data. Stock is defined as the sum of "non-IRA stock (variables ER15007 ER19203 ER22568 ER26549 ER37567)" and "IRA/annuity (variables ER15014 ER19210 ER22590 ER26571 ER37589)". Since we are obtaining stock adjustment information for stockholders, households with zero stockholings are dropped from the sample. Low income families (SEO subsample), as well as those with invalid information on stockholding and stock adjustment are also dropped. Finally, in each wave of survey we drop households whose heads are either younger than 20 or older than 80. Basic statistics about the data are presented in Table 17.

PSID asks a set of questions about the changes in stock account. For non-IRA stocks, it asks the following questions
(i)"[Since January of last survey], did you (or anyone in your family) buy any shares of stock in publicly held corporations, mutual funds, or investment trusts, including any automatic reinvestments–not including any IRAs?"
(ii)"Did you (or anyone in your family) also sell any such assets?"
(iii)"Did you buy more or sell more–that is, on balance, did you put money into stocks, mutual funds, or investment trusts, take money out of them, or put about as much in as you took out?"
For IRA and annuity, the following questions are asked:

(i) "[Since January of last survey], did you (or your family) put aside money in any private annuities or IRAs?"
(ii) "did you (or anyone in your family) cash in any part of a pension, private annuity, or IRA?"
We define household level adjustment as a binary variable. The variable is assigned "1" if a household reported to have bought or sold shares in non-IRA stock, or have put aside money in or cash in private annuities or IRAs. It should be noted that our definition is the "net adjustment", in the sense that it excludes the adjustment of individual stocks within the stock portfolio, whether it is done by the household or mutual fund manager.

9.2.3 Weighting matrix

In the basic model, we use the inverse of the variances of the moments as the weighting matrix. This is a diagonal matrix. The usual variance-covariance matrix is not used for two reasons. First, the moments are from two data sets: PSID and SCF, so it is not possible to calculate covariances of moments from different sources. Second, stock shares from SCF are based on a small sample containing only stockholders, while participation rates and wealth-income ratios are based on a larger sample including non-participants. Therefore one can only have covariances of moments for stockholders only, weighting matrix from which may not be more informative than diagonal matrix for our estimation.

9.3 Sensitivity of Moments to Parameters

To illustrate identification, we pick the best fitting model and see how the moments respond to parameter variations. This is shown in Table 18. For example, from the block labeled "β", variations in this parameter has large effects on the participation and wealth to income ratio moments. Not surprisingly, variations in Γ have the biggest affect on the participation decision. Variations in the adjustment cost have a smaller impact on participation but influence the adjustment rates.

Table 18: Elasticity of Moments with respect to Parameters

		Pre-Retirement				Post-Retirement			
	School	<12	=12	>12 <=16	>16	<12	=12	>12 <=16	>16
β	share	-0.391	-0.090	3.856	1.638	-3.274	-4.638	-1.294	-7.372
	part.	15.530	3.546	6.236	3.740	23.131	11.216	22.570	3.579
	adj.	2.072	1.985	2.107	0.610	9.741	2.269	-2.692	3.403
	W/I	18.074	5.841	6.863	6.147	96.997	13.492	37.168	14.425
γ	share	-1.747	-1.450	-2.457	-1.051	-0.378	-1.451	-1.625	-1.125
	part.	-3.819	0.109	-0.905	-0.034	-14.43	-1.084	-0.521	0.041
	adj.	0.773	-1.539	-1.274	-0.111	-1.992	1.376	0.650	-0.618
	W/I	0.089	1.220	1.123	0.602	-0.393	0.582	0.076	0.367
Γ	share	-0.099	-0.038	-0.785	-0.060	0.350	0.000	-0.190	-0.003
	part.	-2.660	-0.095	-1.089	-0.161	-7.269	0.000	-0.182	-0.010
	adj.	-0.112	-0.116	-0.455	-0.019	-0.283	-0.001	-0.131	0.009
	W/I	-0.122	0.003	-0.211	-0.001	0.000	0.000	-0.278	0.000
F	share	-0.068	-0.120	-0.435	-0.044	0.014	0.200	-0.185	-0.044
	part.	-0.047	-0.056	-0.019	-0.015	-0.613	-0.168	-0.120	-0.100
	adj.	-0.399	-0.831	-0.958	-0.451	-1.084	-1.084	-0.772	-0.685
	W/I	0.009	-0.025	-0.027	-0.068	-0.846	0.073	-0.155	0.072
L	share	-0.143	-0.056	-0.040	-0.074	-0.160	-0.941	-0.803	-0.623
	part.	-0.008	0.070	0.000	-0.041	-0.246	0.337	0.891	0.133
	adj.	0.045	0.219	-0.008	0.044	-1.401	0.706	-0.386	-0.528
	W/I	0.015	0.027	0.091	0.130	7.234	1.038	1.722	0.988
ϕ	share	-0.007	-0.001	0.066	0.021	0.383	0.853	0.477	0.434
	part.	0.375	0.152	-0.004	-0.007	2.332	0.202	0.038	-0.147
	adj.	-0.020	-0.081	-0.077	0.154	-0.056	-1.629	0.114	0.316
	W/I	-4.142	-0.014	-0.100	-0.083	-39.47	-2.517	-1.350	-0.621
$\underline{c}$	share	0.222	0.004	-0.004	0.000	-0.051	0.016	-0.019	0.009
	part.	-0.592	0.000	0.001	0.000	0.906	-0.014	0.040	-0.003
	adj.	-2.062	0.046	0.037	-0.001	-0.443	-0.170	0.080	-0.212
	W/I	-6.636	-0.001	-0.014	0.000	-21.53	0.001	0.030	0.026
κ	share	0.017	0.004	-0.004	0.000	-0.106	0.016	-0.019	0.009
	part.	-0.001	0.000	0.001	0.000	-0.013	-0.014	0.040	-0.003
	adj.	0.189	0.046	0.037	-0.001	-0.310	-0.170	0.080	-0.212
	W/I	0.009	-0.001	-0.014	0.000	-8.226	0.001	0.030	0.026
θ	share	-0.322	0.245	-0.378	0.107	0.687	-0.873	-0.295	-0.260
	part.	-1.609	-0.084	-0.572	-0.216	0.477	0.469	0.393	0.034
	adj.	0.348	-0.186	-0.622	-0.439	-2.159	2.505	-0.301	0.009
	W/I	-5.730	-0.924	-0.703	-0.726	-10.61	0.514	0.941	0.731

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