Retirement Investments Through the Life Cycle and Individual Risk Aversion in a Defined Contribution Retirement System

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Abstract

I develop a dynamic model of individual lifetime behavior and jointly estimate a set of correlated dynamic equations for observed risk aversion, wealth-related decisions (employment, occupation, investment, and savings), and other characteristics that an individual may value independently of wealth (family and health) in a setting with a defined contribution retirement system. In the estimable model, I allow correlation through observed and unobserved permanent and time-varying individual heterogeneity. In an empirical model that allows risk preferences to be an endogenous determinant of investment decisions, I propose alternative time-varying default investment schemes showing that, over seven years, slightly riskier investment strategies may increase individual asset accumulation by eight percent or more. I find that individuals react to riskier investment strategies, despite the observed inertia in their behavior. Increases in mandatory contribution rates by three and five percent generate statistically significant increases in asset accumulation of 10 and 16 percent, respectively, generating little crowd-out effects in investments, savings, and employment outcomes. Other policy experiments show that part-time job opportunities for women with children who are currently not employed significantly increase wealth accumulation by 10 percent over 7 years.

Keywords: retirement income policy, default investment schemes, risk tolerance, elicited risk aversion.

JEL Classification: C30, D91, E21, G11, J26, J32.

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1 Introduction

As local, state, and national budgets have experienced fiscal stress, private retirement systems have gained importance around the world. Fiscal insolvency has become a risk and as a result policy-makers in the United States, Europe, and Asia have discussed the idea to transition from traditional pay-as-you-go systems to a fully privatized retirement system (Todd and Vélez-Grajales, 2008). Chile was pioneer in this transition as it replaced its old pay-as-you-go system with a system of individual private savings accounts in 1980 and it has served as a prototype for the implementation of privatized systems in Latin America and in Eastern Europe.[1] Developed countries have also discussed implementing Chile's model.[2] One of the critics that the Chilean system has received is that retirees' pensions are not as high as expected when the system was implemented. In this settings, one of the challenges for policy-makers is to achieve an increase in retirement wealth for future retirees. Following this scenario, by using Chile's long history and unique data, I analyze mandatory financial investments and wealth accumulation for retirement through the life cycle and I evaluate policies whose objective is to increase retirement wealth. The results of these evaluations are useful for the design of policies in countries with contributory retirement systems.

This paper develops and estimates a dynamic model of individual life-cycle behavior where individual make wealth-related decisions through the life cycle that directly impact their retirement wealth accumulation (e.g., employment decisions, occupation selection, mandatory financial investment for retirement, and optional savings decisions). I allow these decisions to endogenously depend on risk preferences and I explicitly account for an individual's level of risk aversion in the estimation. The resulting set of jointly-estimated equations also includes subjective assessments such as risk aversion and duration of life, as well as stochastic health and family characteristics. I allow for correlation through observed and unobserved permanent and time-varying individual heterogeneity. The estimates are used to evaluate policies such as: wealth effect and individuals responses to implementing new default investment schemes through the life cycle, wealth gains and crowd-out effect of increasing contributory mandatory rates, wealth effect for women fixing with children who are currently not employed when holding a part-time job, and evaluation of wealth loss due to health and family characteristics.

A novelty of this research is that I incorporate observed measures of individual risk aversion in the estimation of the model. I consider how to incorporate these measures into an estimable empirical model, and how to reconcile the use of these observed measures with the economic theory of behavior over time. Specifically, I compare the estimated marginal effects of policy variables of interest when these measures are excluded or included assuming exogeneity or endogeneity to wealth-related decisions. Since risk aversion is manifested in

[1]For instance, Peru (1993), Colombia (1993), Argentina (1994), Mexico (1997), Czech Republic (1994), Hungary (1998), Poland (1999), among others.

[2]e.g., the U.S. in 2005.

preferences, it influences behavioral decisions when individuals deal with uncertainty and income variation. Additionally, on its foundations, private retirement systems recognize that individual savings and investment decisions are influenced by one's level of risk aversion.[3] When designing policies associated with investments in retirement funds, it is important to account for risk preferences, its evolution through the life cycle, and its correlation with wealth accumulation. I use the first four waves (2002-2009) of the Chilean Survey of Social Protection (EPS), complemented with administrative data of the Chilean Superintendence of Pensions. The EPS besides including rich information about individual characteristics and history, it is a unique dataset that contains observed measures of risk aversion for a representative sample of the population over time. Empirically, it has been found that risk preferences play a role in individual retirement investments (Bernasek and Shwiff, 2001; Arano et al., 2010) as well as in other decisions that affect an individual's wealth. For instance, risk aversion also explains individual employment decisions, job change, and occupation and industry choice (Kihlstrom and Laffont, 1979; Guiso and Paiella, 2008) or saving decisions (Gollier, 2004).

Although the use of observed measures of risk aversion in empirical models has increased in the last 10 to 15 years, datasets tend to be cross sections of information, and the ones that contain measures of risk aversion for the same individuals over time are scarce.[4] This limitation challenges applied researchers for the modeling and estimation of life-cycle models. The most common issues are the typically unaddressed endogeneity between risk preferences and observed individual behavior and the infrequently studied evolution of risk aversion through the life cycle. This paper allows risk preferences to be an endogenous determinant of observed wealth-related behaviors and other outcomes, reducing several potential sources of estimation bias by jointly estimating a set of correlated equations.[5] Moreover, in the same spirit than in Van der Klaauw and Wolpin (2008) and following Bommier and Rochet (2006) model of risk aversion through the life cycle, I incorporate a self-reported measure of expected duration of life to proxy for the length of the planning horizon of the dynamic problem. In particular, I allow it to be correlated with risk aversion and wealth-related

[3]For example, the Chilean private retirement system offers five different investment accounts that varies in their financial risk so that individuals can invest their money in accounts that better match their risk tolerance

[4]Examples of survey with observed measures of risk aversion are: Panel Study of Income Dynamics (wave of 1996), National Longitudinal Survey of Youth (waves of 1993 and 2002), Health and Retirement Survey (waves 1992, 1994, 1998, 2000, and 2002), Italian Survey of Household Income and Wealth (1995), German Socio-economic Panel (waves of 2004 and 2006).

[5]Specifically, the model addresses endogeneity, selection, and measurement error bias. Several theoretically-relevant explanatory variables for the behaviors or outcomes I model are endogenous. For example, investment vehicles determine wealth accumulation, yet investment amounts and portfolio allocation (i.e., levels of risk) are chosen by the individual. Selection bias results from participation behaviors that may be correlated with other modeled behaviors (e.g., participation in optional savings accounts and earnings). Measurement error might also be present in the survey measures for subjective assessments as well as reported savings. To address these biases stemming from unobservables, I use the Discrete Factor Random Effects (DFRE) estimation method, which I describe in Section 5.6, to jointly estimate 22 correlated equations that capture wealth-related behaviors and outcomes, subjective assessments, family characteristics, and health characteristics.

dynamic decisions. To the best of my knowledge, this is the first paper to reduce this source of bias by endogenously incorporating observed measures of individual risk aversion when studying retirement investment decisions. The scope of its effect is important. For instance, I find that due endogeneity bias we could over estimate the effect of a policy that increases mandatory contribution rates in a defined contribution setting, in about 40 percent of its effect.

An important contribution of this paper is that I simulate the wealth effect and individual responses to several policy experiments that have not taken place. I use a dynamic decision model that allows me to model the process by which individuals invest and accumulate wealth over time. Specifically, I focus the analysis on investment decisions for retirement through the working life cycle. Under the Chilean system, it is mandatory for every dependent worker to save a ten percent of her employment income. These money is credited to a retirement account that can be liquidated only when the individual retires. Every period, individuals invest these savings in financial accounts managed by private firms (AFPs) whose sole objective is to manage workers' investments for retirement. I incorporate these institutional characteristics and due to the rational dynamic model of behavior I am able to simulate individual responses to policy experiments.

The simulation results indicate that individuals are accumulating retirement wealth at safe rates of returns and that the Chilean system's default investment scheme is an important vehicle for individual investment choices. I propose alternative time-varying investment schemes and simulate wealth accumulation under these regimes. I show that slightly riskier investment strategies may increase asset accumulation by 8 percent or more over seven years, or 1.1 percent per year. This finding is a substantial result since the wealth gain directly impacts individual retirement wealth and it continues accumulating over one's life cycle. Other policy simulations show that increases in mandatory contribution rates by 3 and 5 percent generate statistically significant increases in asset accumulation of 10 and 16 percent over the same period of time, or 1.3 and 2.2 percent per year, respectively. I find that increasing mandatory contribution rate causes little crowd-out effect in financial investments, employment behavior, and in optional savings outside the retirement system. When simulating women with children who are currently not employed to hold a part-time job, wealth accumulation increases by 10 percent over a seven year time frame for women in the treatment group.

This paper directly contributes to the literature that analyzes the use of the default option in retirement saving programs, specially in the 401(k) system. Based on the evidence documented in the literature on the status quo and inertia in investment over time (e.g., Samuelson and Zeckhauser (1988); Ameriks and Zeldes (2004)) the use of default schemes have been implemented and its advantages have been documented. In the context of the American 401(k) system, Madrian and Shea (2001) find that by changing the default sign-up system from a opt-in to a opt-out, increased saving participation from 49 to 86 percent;

while Bernartzi and Thaler (2004) find that once individuals enter a savings program, few opt out. This is also consistent with the findings of Carroll et al. (2009) in which after an opt-out default is implemented, enrollment increases in 28 percent. Much of this literature has focused on the participation (or enrollment) effect and crowd-out effect as default mandatory contributions increase over time. There are different reasons that may cause this behavior. Sethi-Iyengar et al. (2004) show that offering multiple investment choices might produce *choice overload*. For some individuals, the number of investment options might be overwhelming and therefore that could caused them to reduce their participation in savings program or to follow the default scheme. Chetty et al. (2014) find that after an automatic increase in the default mandatory contribution, most individuals do not respond by changing voluntary pension contributions. Since enrollment in the Chilean retirement system is mandatory for workers in the formal sector, rather than focusing on the participation effects of default schemes, I study individual responses to changes in the default when financial risk increases. To the best of my knowledge this is the first paper to estimate such elasticities of response. I find that more than 60 percent of individuals opt-out from the default as they are moved to riskier funds. This is a relevant result as it provides evidence for the literature that studies inertia in financial investment. I provide evidence that individuals might be optimally choosing safe financial instruments.

This paper also contributes to the strand of the literature that analyzes policies for the Chilean private retirement system. Among others recent works, Mitchell et al. (2007) study the determinants of switching across AFPs, Todd and Vélez-Grajales (2008) study the effect of institutional settings, such as pension rules or fees, on savings, Joubert (2015) studies the effect of increasing contribution rates on informality, and Attanasio et al. (2011) and Joubert and Todd (2016) the effect of social solidarity pensions on labor force participation and savings. Luco (2015) and Illanes (2016) study the effects of switching costs on individual investment choices. I find that there is a persistence effect on investment decisions. Some of the variables that explain this behavior are work experience as well as accumulated assets. An interesting result of this research is that individuals are more responsive when riskier default schemes are implemented. This suggests that an individual's risk tolerance and the financial risk level associated with retirement accounts have a substantial impact in an individual's inertia. I also find that family and health characteristics are statistically significant in explaining investment decisions through the life cycle. This motivates the evaluation of policies associated with individual characteristics that may be valued independently of wealth. For instance, simulation results show that family characteristics and health status generate statistically significant changes in wealth accumulation. I quantify their contribution to retirement disparity and found that an additional child has a negative significant effect on wealth accumulation only for the first decile of the wealth distribution, while being married significantly increases wealth accumulation starting in the first quartile. This information is relevant for the design of policies such as the "bonus per child".[6]

The rest of the paper is organized as follows. Section 2 reviews the main aspects of the Chilean Retirement System and Section 3 presents a discussion on the relevant literature for this paper. In Section 4 I present the economic and empirical conceptualization of risk aversion. In Section 5, I present a dynamic model of individual life-cycle decisions that reconciles risk preferences with observed risk aversion. I derive the set of structural, correlated equations to be estimated, and present the estimation strategy. Section 6 presents the data and the research sample. The estimation results are presented in Section 7. Section 8 uses the estimated model to analyze simulated policies associated with wealth accumulation for the Chilean private retirement system. Finally, Section 9 concludes.

2 The Chilean Private Retirement System

The Chilean retirement system is based on individual private capitalization. It was introduced in 1981 to replace the old pay-as-you-go pension system managed by the state. In the current system, it is mandatory for each dependent worker to have an individual savings account associated with the system.[7] Upon start working, dependent workers are automaticaly enrolled without the option of opting out. It is required for every worker to contribute to this savings account with a ten percent of her income, up to a cap. These mandatory savings can only be cashed after retirement. Minimum retirement age also varies according to gender: 60 years old for women, 65 years old for men.[8]

Individuals savings are capitalized and managed by private companies known as Pension Fund Administrators (AFPs). The AFPs' profits are protected from financial risks and its sole objective is to manage workers' investments for retirement. Up to the 2000s, the AFPs offered one investment account. Starting in the 2000s, the AFPs offer a set of investment accounts and every period they invest the workers' savings in the financial market based on investment decisions made by the workers. In 2002 the multi-account system was introduced and since then is required for each AFP to offer at least four out of five investment funds.[9,10] For these matters, the worker can choose one of the five investment funds (accounts A, B, C, D, and E), or a combination of two of these funds (e.g., half in account A and half in

[6] the bonus per child (named *bono por hijo* in Spanish) was introduced in Chile after the reform of 2008 for providing extra retirement wealth to women with children. It provides around 950 dollars per child to mothers upon retirement.

[7] Through this paper I refer to dependent workers as employed workers, as opposed to self-employed (or independent) workers.

[8] For a complete description of the system, see Berstein (2010).

[9] Only the riskier fund, Account A, is voluntarily to offer, although each AFP offers it. Account A invest between 40 and 80 percent in equities; account B 25 and 60 percent; account C 15 and 40 percent; account D 5 and 20 percent; and account E less than 5 percent

[10] Before the introduction of the multi-accounts in 2002, the AFP invested all the savings in the equivalent to Account C and in Account C or E for a couple of years.

account B). Since the introduction of the multi-accounts, all firms have offered the five investment accounts. These investment accounts differ in their level of financial risk as the share of investment on equities varies across funds. The design of the system relies on the idea that individuals make financial investments influenced by their level of risk aversion in financial accounts that better match her level of risk aversion.

Workers also have the option of not making an explicit investment decision and just follow the system's default investment scheme. This scheme is pre-established and have not change since its introduction in 2002. The default depends on individual exogenous characteristics, such as age and gender, and that is applied to individuals who do not explicitly chose financial funds. Women and men younger to 35 years old should invest in the second riskier account (Account B), that women between 36 and 50 years old, and men between 36 and 55 years old should invest in the intermediate fund (Account C), and older individuals in Account D. The default was designed under the idea that financial investments through the life cycle should vary according to individual risk tolerance based on age, gender, and according to the length of the planning horizon.

Contributors naturally face a financial risk in their savings accounts. It is expected that riskier accounts will generate a higher financial return, while the fluctuations in returns is also expected to be higher. The system assumes that individuals make financial decisions over their life cycle that match their level of risk aversion.

3 Related Literature

Default Investment Schemes in Private Retirement Systems

There is a strand of the literature that studies the effect on participation and savings of different system rules. Much of this research has concentrated in the 401(k) American retirement system where workers typically make two decisions: first to enroll into a savings program and second to chose an investment strategy. A seminal paper in this area is Madrian and Shea (2001). They study the effect of a change in the company enrollment policy at a large U. S. corporation between 1997 and 1999, finding that by changing the default sign-up system from a opt-in to a opt-out, savings participation increases from 49 to 86 percent. Choi et al. (2004) use the same companies than in Madrian and Shea (2001) and extended the period of analysis. They find that participation rates exceed 85 percent and that automatic enrollment does not impact average wealth accumulation or contribution rates over the 4 year period, but it reduces the share of individuals with zero balance. Choi et al. (2002) study the effect of the company design of the 401(k) plans using administrative records from 200,000 individuals that worked in large firms who implemented changes changes in their plan rules between 1997 and 2001. They find that employees follow the easiest path and manifest little resistance (they called these passive decision). For instance, few workers opt-out of default saving rates and default investment funds. They also find a bias in individuals reported desire to take an action versus taking the action. These results are also consistent with the findings of Carroll et al. (2009). They study the effect of an active decision enrollment strategy (individuals must explicitly declare their enrollment preferences) as opposed to standard enrollment (the default is to not enroll and individuals can opt into a plan) and automatic enrollment (by default individuals are enrolled and they can opt out). By using a natural experiment at a national financial services company in the U.S. in 1997 in which the firm switched from an active decision to a standard enrollment policy without previous announcement, they measure the impact on participation rates. They find that enrollment is 28 percent higher under an active enrollment than under an opt in default.

The impact of increasing contribution rates in the future by enrolling at a program today, and where individuals have the option to opt-out in the future was study by Bernartzi and Thaler (2004). They evaluate the effects on saving rates of the implementation of a program designed for increasing contribution rates over time (Save More Tomorrow). They implemented the program at a midsize manufacturing American company in 1998 and a large Midwestern company in 2001. They find that once individuals enter a savings program, few opt out (about 80 percent stay in the program). A 78 percent of workers agreed to enter the program and as a result savings rates increased from 3 to 10 percent. The plan was offered to government workers by the Save Tomorrow Act of 2012 (Benartzi and Thaler, 2013). These results are consistent with more recent contributions. Chetty et al. (2014) study the crowd-out effect of retirement policies such as subsidies and mandatory contribution plans, using a panel data set on retirement and non-retirement savings accounts in Denmark within 1995 and 2009. Similarly to the U.S., the Danish retirement system has an individual and employer defined contribution system and a public defined benefit system. They find that about 85 percent of individuals are passive savers and do not respond to subsidies, and that increasing contribution rates with no action, increases wealth accumulation as savings increases but also because individuals do not change their voluntary retirement savings. They document that higher-income individuals are the ones that tend to opt-out from employers defaults and individuals with higher levels of wealth are the ones that respond more in changing their levels of voluntary savings.

It has been found that lower income individuals are the ones that tend to follow the default (as in Madrian and Shea (2001), Bernartzi and Thaler (2004) or Choi et al. (2004)) however this behavior could be driven because lower income individuals are less responsive or because they are more likely to optimally behave as in the default. To explore who are the individuals more influenced by default rules, Beshears and Choi (2012) implement three different methods to study heterogeneity in responses using different defined contribution retirement savings plans provided by three different employers. The main finding is that higher income individuals are always more responsive in opting out. When the default is designed to suit lower income individuals, higher income individuals quickly opt-out; moreover, when the default is designed to suit higher income individuals, they still opt-out faster relatively to lower income individuals.

The literature suggests that there are both economic and behavioral factors explaining the inertia and stickiness in individual behavior (Madrian and Shea, 2001; Mitchell and Utkus, 2004). One explanation is the effect of the desire of acting versus taking the actual choice (Choi et al., 2002). Duflo and Saez (2003) analyze the impact of information and social interaction in enrolling in 401(k), using an experiment in which random individuals across departments at a firm were encouraged to attend to information sessions. They find a substantial effect of information sessions and a significant effect of peers inside a department. It is expected that default enrollment may cause spill over effects on other enrollments. Sethi-Iyengar et al. (2004) show that offering multiple investment choices might produce *choice overload*: some individuals become overwhelmed by the options and therefore reduce their participation or follow the default scheme. There is also evidence of financial literacy/knowledge effects. Individuals might be more responsive depending on how the information is presented. For instance, using a randomize experiment from Chile, Hastings et al. (2010) show that individuals are more responsive to information when it presents relative benefits of different investment choices. Luco (2015) provides a switching cost explanation. He empirically distinguishes two sources of costs for switching investment funds in the Chilean private retirement system: the cost associated with analyzing financial information and choosing a pension fund and the cost associated to the time-consuming process of switching funds. He finds that the former is more important in affecting individuals' inertia.

Risk Aversion and Wealth-related Behaviors

Elicited measures of risk aversion have been useful in explaining different wealth-related behaviors in the economic literature. As a starting point, researchers have attempt to study heterogeneity in risk aversion between individuals, focusing on exogenous individual characteristics such as gender or age. Many studies have found that women are more risk averse than men (Grable, 2000; Halek and Eisenhauer, 2001; DeLeire and Levy, 2001; Grazier and Sloane, 2008; Dohmen et al., 2005, 2011; Le et al., 2011). However, some other studies have found mixed results or no gender differences (Harbaugh et al., 2002; Andersen et al., 2006; Harrison et al., 2007; Tanaka et al., 2010). Holt and Laury (2002) find that women are more risk averse than men only in low-payoff conditions. Arano et al. (2010) find significant differences only between married women and their spouses.

With respect to age, there is more consistency among results. Harrison et al. (2007) and Dohmen et al. (2005, 2011) find that willingness to take risks has its maximum among middle-age individuals. Albert and Duffy (2012) find that young individuals are close to risk neutral while older individuals are more risk averse.

An important point of interest has been the relationship between individual risk aversion and labor market outcomes. Some authors have explored the idea that more risk averse individuals are less likely to be self-employed than to be a dependent worker. This hypothesis suggests that starting a business naturally entails more risk and earnings variation. There is evidence that supports this idea (Cramer et al., 2002; Ekelund et al., 2005; Brown et al., 2011). Grazier and Sloane (2008) find that workers seem to have preferences for risky jobs based on family composition and gender, which are assumed to be proxies for risk aversion. In an attempt to explain the gender wage gap, Le et al. (2011) analyze the role of risk aversion in explaining wages received. They find that females are more risk averse than males and that workers with more favorable attitudes towards risk are associated with higher earnings. They suggest that gender differences in risk attitudes can account for a small part of the standardized gender pay gap.

In addition, the financial economics literature has used individual investment decisions, such as observed participation in financial markets and risky asset holdings, as proxies for individual risk aversion to test the correlation between risk aversion and individual wealth levels. Using six waves of the Panel Study of Income Dynamics, Brunnermeier and Nagel (2008) test whether wealth fluctuations generate time-varying risk aversion. They proxy for risk aversion using an individual's risky asset share over total investments in the stock market. They find evidence that changes in liquid wealth have a significant effect on the probability of entering or exiting the stock market but have little effect on asset allocation for households that already participate in the market. A natural limitation of Brunnermeier and Nagel (2008) research is that it focuses on one risky behavior, such as investments in the stock market. There is also a selection issue, since their conclusion is based only on a sample of individuals who have chosen to participate in the financial market.

Guiso and Paiella (2008) use a cross-sectional dataset on household willingness to pay for a hypothetical risky security as an elicited measure of risk aversion and find that absolute risk aversion is decreasing in individual's endowment. They reject the CRRA specification as a framework for explaining lifetime individual risk aversion. Chiappori and Paiella (2011) use longitudinal data on individual's wealth invested in risky and safe assets. Using a first difference approach, they test how changes in wealth affect share of risky assets when time-invariant unobserved heterogeneity is eliminated. They find that investment in risky assets does not change as financial wealth changes. This conclusion does not hold as they expand the wealth measure to include business equities and housing, where investment in risky assets increases as wealth increases. They recover the distribution of risk aversion for households with risky assets, and they find a negative and significant correlation between risk aversion and wealth. There is also evidence that past consumption levels explain current risky asset holdings (Lupton, 2003; Ravina, 2005).

Sahm (2012) is one of the few authors that uses elicited measures of risk aversion from a longitudinal dataset for the U.S. She corrects endogeneity by assuming that unobserved heterogeneity is time-invariant and due to data availability, she focus on individuals over the age of 50. She finds that changes in household income and wealth, as well as other variables that affect income such as a serious health condition or job displacement, have little impact on measured risk tolerance. She also finds that risk tolerance increases with improvement in macroeconomic conditions. These results are consistent with the findings of **?**, **? ?**, and **?**.

Risk Aversion and Other Individual Behaviors

There is also empirical evidence on the correlation between risk preferences and other characteristics that individuals may value independently of wealth, such as family characteristics, health status, and cultural backgrounds. However, the results are not informative about the direction of causality between these variables and risk aversion. Using a matching approach and a longitudinal dataset for correcting for selection and reverse causality, **?** find that health shocks significantly increase individual risk aversion, consistent with other results . Eisenhauer and Ventura (2003) find that risk aversion is higher among single individuals and among individuals with poor health. Spivey (2010) hypotheses that, due to the uncertainty in searching for a partner, a more risk averse individual should get married sooner than a less risk averse individual. Her empirical findings support this idea. Despite some data limitations, she runs regressions to test for reverse causality and she suggests that being married does not affect an individual's risk aversion. There is also evidence that more risk averse individuals are less likely to divorce (Light and Ahn, 2010). Doepke and Tertilt (2016) correlate family structure (marital status, divorce risks, number of children) with individuals' and family savings and labor supply decisions over time, which we know are affected and affect risk aversion as it impact wealth. They also recognize the impact that these decisions may have on aggregated savings and labor supply and how macroeconomic variable may also affect individual's decisions. With respect to children, the causality is less clear. Schmidt (2008) finds that more risk averse individuals are more likely to get married sooner and that more risk averse young woman are more likely have children sooner, yet the opposite is true for woman at the end of their fertile age. Spivey (2010) finds that individuals become more risk averse after having children; which is consistent with the findings of **?**, who find that parenthood leads to changes in individual risk aversion over time. Very importantly, **?** suggest that we should be careful in interpreting causal effects of incorporating observed risk aversion as an explanatory variable for economic outcomes.

There is also evidence that individuals with higher cognitive ability are more willing to take risks, and that cultural background, such as religion, nationality and migration status, have an impact on risk taking behavior (Jaeger et al., 2010; Dohmen et al., 2008; Noussair et al., 2013; Weber, 2013).

4 Conceptualization of Risk Aversion

4.1 Economic Modeling of Risk Aversion

The roots of our modern understanding of risk aversion date back to the writing of Bernoulli in 1738. Its subsequent development was formalized by the contributions of Morgenstern and Von Neumann (1953) (Gollier, 2004). Pratt (1964) and Arrow (1965) introduced the absolute and relative measures of risk aversion. These measures rely on the shape of the per-period utility function in a static setting. They define the coefficient of absolute and relative risk aversion as: $A(\omega) = -\frac{u''(\omega)}{u'(\omega)}$ and $R(\omega) = -\omega\frac{u''(\omega)}{u'(\omega)}$ where $u'(\cdot)$ and $u''(\cdot)$ are the first and second derivatives, respectively, of the per-period utility function, and ω denotes wealth.[11]

To make optimization problems tractable, researchers often impose assumptions about the utility function and, hence, about risk aversion. Among all the many classes of utility functions, a functional form that has received special attention is the constant relative risk aversion (CRRA) specification. The general representation of this functional form is:

$$u(\omega) = \begin{cases} \frac{\omega^{1-\rho}}{1-\rho} \text{ if } \rho \neq 1 \\ \ln(\omega) \text{ if } \rho = 1 \end{cases} \tag{1}$$

where ρ is a constant parameter that is commonly refer to as "the (relative) risk aversion parameter" or simply "*rho*." This representation has been widely used in the economics, psychology, and health literatures for modeling risk aversion (Wakker, 2008). Pratt and Arrow's static framework restricts how risk aversion evolves through the life cycle. In this model, risk aversion may change over time only if the argument (e.g., wealth) of the static utility function changes. Such changes are typically assumed to be exogenous.

Bommier and Rochet (2006) expand the analysis by defining an individual intertemporal risk aversion measure. This measure incorporates the horizon length, or the remaining number of periods, to study how risk aversion varies during the life cycle.[12] In Bommier and Rochet (2006), the maximal value of the discounted lifetime utility at age n is $V_n(\omega_n) = \max_{C_n,...,C_N} U(C_1^*, ..., C_{n-1}^*, C_n, ..., C_N)$ subject to $\omega_n = \sum_{t=n}^{N} p_t C_t$, where ω_n denotes wealth and p_t is the price of a composite good consumed in period t. Present and future consumption is denoted by $(C_n, ..., C_N)$, the optimal past consumption path by $(C_1^*, ..., C_{n-1}^*)$, and N is the horizon length. The dynamic absolute and relative measures of risk aversion are: $A_n^D(\omega_n) = -\left[\frac{V_n''(\omega_n)}{V_n'(\omega_n)}\right]$ and $R_n^D(\omega_n) = -\omega_n\left[\frac{V_n''(\omega_n)}{V_n'(\omega_n)}\right]$ where $V_n'(\omega_n)$ and $V_n''(\omega_n)$ are the first and second derivatives of the value function. The dynamic versions of the absolute and

[11]It assumes that the utility function captures individual preferences over wealth, and that it is twice continuously differentiable with a positive first derivative.

[12]They assume that individuals are rational, time consistent, forward-looking, and have preferences over consumption, that each period an individual behaves in a way that maximizes her lifetime utility subject to her budget constraint, and that there is no uncertainty.

relative measures of risk aversion depend on the shape of the value function, as well as values of wealth and the number of remaining periods at age n, both of which vary over the life cycle.

The authors discuss three mechanisms that may impact risk aversion through the life cycle: wealth, age, and the horizon length. Time t values of wealth not only define risk aversion at the current period but also determine subsequent values of wealth and hence investment and savings behaviors. The marginal utility of wealth may change with age, and with the number of remaining years in one's decisionmaking problem. They show that relative risk aversion decreases as age increases. They also show that relative risk aversion increases as the horizon length increases. Importantly, if other variables in addition to wealth or consumption, such as leisure or lifestyle variables, impact utility; then risk aversion also depends on the chosen values of those inputs. Moreover, since these optimally chosen behaviors are endogenous (i.e., as they are determined by the optimization of one's lifetime utility) they also depend on preferences, including risk preferences.

The conceptualization of risk aversion in this paper is based on the extended dynamic model of Bommier and Rochet (2006). In Section 5 I extend the classic notion of risk aversion to be dependent only on wealth and consumption and allows interaction with other characteristics that an individual may value independently of wealth such as family or health. The empirical model allows for correlation in the unobservables that affect risk aversion, horizon length, wealth, and lifestyle characteristics.

4.2 Empirical Measures of Risk Aversion

Since Pratt (1964) and Arrow (1965) introduced their measures of risk aversion, several empirical papers have attempted to estimate or to elicit these values. Empirical methodologies, contexts, types of data, and results have been quite varied (Eisenhauer and Ventura, 2003).

Researchers have used a variety of ways to elicit direct measures of risk attitude. There are generally three approaches for measuring risk attitude: the investment portfolio approach, the lottery choice menu approach, and the pricing task approach (Holt and Laury, 2014). The investment portfolio approach asks respondents to choose between alternative financial gambles. One alternative is always less risky than the rest. The lottery choice menu builds the individual's risk attitude based on a structured list of binary choices between safe and risky gambles. The pricing task approach asks respondents to name a certainty equivalent money amount for a gamble. Risk attitude is inferred using this value and the expected value of the gamble. The three approaches are similar since binary choices in a menu list can be thought of as pairs of alternative portfolios and one can be asked to elicit a certainty equivalent instead of a price or a choice (Holt and Laury, 2014). Observed measures of risk aversion from these approaches are available from both, experimental settings and in surveys where individuals are asked to chose between alternative gambles or scenarios.

The experimental measure of Holt and Laury (2002) is widely used, while the use of survey measures have increased in the past decade as questions of hypothetical gambles derived from Holt and Laury (2002) have been included in surveys. These survey measures have been validated as controls of risk preferences for many different behaviors (see **?** and references therein). Survey measures on risk aversion first appeared in the Health and Retirement Survey (HRS), representative of the American population over the age of 50. It was also introduced for the National Longitudinal Survey of Youth (NLSY) and in the Panel Study of Income Dynamics (PSID) but not with the same periodicity for constructing longitudinal information. Outside the U.S., the German Socio-economic Panel allows 2 waves of information for risk aversion, while the Italian Survey of Household Income and Wealth allows a cross-section. This research uses the lottery choice menu using 2 questions from the Chilean Survey of Social Protection. This a unique dataset as it allows to construct a 3-category elicited measure of risk aversion observed 4 times for the same individuals, between the years 2002 and 2009, for a representative sample of the adult population. A critique on elicitation methods is that it may be noisy capturing risk preferences. **?** studies the correlation between these two popular approaches for eliciting risk aversion and find no significant correlation between experimental measures and survey measures. Importantly, they find that effort or ability may partially explain correlation across different types of measures. For partially solving these issues, Sahm (2012) accounts for measurement error in the HRS measure. This paper allows correlation across equation to also capture, among other factors, measurement error in individual's risk preferences.

A different approach is to recover primitive parameters governing an individual's decision making process. Barsky et al. (1995) compute the relative risk aversion parameter of a CRRA static utility function by directly using survey measures of elicited risk aversion. They calculate bounds on the relative risk aversion parameter by solving an equation so that the individual is indifferent between the two options of a hypothetical gamble. This is a different way of calculating an observed risk aversion measure, based on survey questions. Other authors estimate the relative risk aversion parameter from a CRRA specification without using observed measures of risk aversion. Rather than directly computing bounds, they parametrized the contemporaneous utility function, model decisions through the life cycle, and estimate the risk aversion parameter *rho*. This is computationally a more demanding approach. It has the advantage that authors can study how risk aversion varies as exogenous characteristics change. Some examples of the latter approach can be found in Keane and Wolpin (2001); Todd and Wolpin (2006); Blau and Gilleskie (2006, 2008); Van der Klaauw and Wolpin (2008).

There is a connection between measures of risk aversion coming from lottery choice menus with the conceptualization of risk aversion. These survey answers are viewed as resulting from an expected utility calculation (Barsky et al., 1995; Spivey, 2010). Typically a respondent will be asked: *What do you prefer, a job with a certain lifetime-stable salary or a job where you have p chances of earning λ_1 of your lifetime income or $(1-p)$ changes* *of earning* λ_2 *of your lifetime income?* where $\lambda_1 \geq 1$ and $0 < \lambda_2 < 1$. Assuming U be the utility function and c the permanent consumption (equal to lifetime stable salary), then the indifference point between options solves: $p \times U(\lambda_1 c) + (1 - p) \times U(\lambda_2 c) = U(c)$. Some authors assume a static framework using a CRRA form for U and directly compute the relative risk aversion parameter by normalizing wealth, replacing the survey information, and solving for the indifference *rho* (Barsky et al., 1995). This is a simplified analysis as it uses a static model to solve for risk preferences over lifetime consumption and one can only solve for *rho* between bounds (i.e., with two questions about preferences toward hypothetical gambles, we end up with only one computation of *rho*). To avoid making assumptions about the functional form of the utility function and about the evolution of risk aversion over time, rather than following that approach, this paper categorizes risk aversion based on individual's answers.

5 Empirical Model and Estimation Strategy

This section presents a dynamic model of life-cycle decisions that directly impact wealth accumulation in a defined contribution retirement system. In particular, individuals make decisions with respect to employment status, occupation category, investment portfolio for retirement, and savings. The model includes other characteristics that an individual may value independently of wealth, such as family and health characteristics. The model serves as a basis for studying the incorporation of observed measures of risk aversion. From the theoretical framework I derive a correlated set of estimable equations that captures individuals sequential behavior over the life-cycle, for studying wealth accumulation for retirement and the effect of counterfactual policies.

5.1 The Modeling of Risk Aversion

The theoretical and estimable model in this paper is build up upon the evidence find in empirical papers of risk aversion and consistently with the models of individual economic behavior (see Section 3). I consider risk aversion through the life cycle to be determined by an individual's wealth level, and I allow interaction with other characteristics that may affect decisions independently of wealth (family and health characteristics).

Rather than focusing in one behavior or outcome, the estimable model in this paper allows for correlation between an observed measure of risk aversion with real life observed behaviors that partially could capture individual's risk preferences (e.g., financial investments). It also allows for correlation with other behaviors and outcomes that the literature has used as proxies for risk aversion, such as health and family structure. I explore the role of permanent and time varying individual unobserved heterogeneity in wealth-related decisions, survey measures of risk aversion, and other outcomes related with individual's health and family characteristics. Importantly, I also allow for unobserved components to be correlated between all these observed variables.

5.2 Timing and Notation

An individual enters each period t with information about her history of past choices and relevant knowledge about current individual and market characteristics, denoted by the vector Ω_t. The choice history includes accumulated wealth for retirement (A_t^r), chosen financial investments for retirement last period (i_{t-1}), optional savings last period (s_{t-1}), and work experience up to period t (E_t). Her current characteristics are summarized by marital state (M_t), number of children (N_t), health status (H_t), individual exogenous characteristics (X_t) (e.g., gender and age), and other exogenous market-level characteristics (Z_t) (e.g., prices). I denote $\tilde{\Omega}_t$ as the set of endogenous variables influencing the individual's decision (i.e., Ω_t includes $\tilde{\Omega}_t$, X_t, and Z_t).

I define w_t to be the hourly wage rate and h_t hours worked per month. It is mandatory for every dependent worker to save ten percent of her employment income. If the individual is affiliated to the retirement system, she makes 5 investment decisions every period, $i_t = (i_t^A, i_t^B, i_t^C, i_t^D, i_t^E)$, that consist of whether or not to invest in each of the accounts. If an individual is not employed in t but was in the past, she does not contribute to the account ($w_t = 0$), but she still makes the investment decisions.

In addition to mandatory savings, individuals may choose to hold voluntary savings (s_t). These savings can be cashed at any time, before or after retirement. Therefore an individual's wealth entering the period has two components. The first component is the value of accumulated assets for retirement, $A_t^r = A_{t-1}^r \cdot R_{t-1}^r(i_{t-1}) + a_t^r$, which depends on the return of required investments for retirement on previous assets, $R_{t-1}^r(i_{t-1})$, and the worker's contribution in $t-1$, denoted by a_t^r. R_{t-1}^r is a function of the chosen investments last period, i_{t-1}. The second component is the value of accumulated optional savings, $s_{t-1} \cdot R_{t-1}^o$ where the return for optional savings is denoted by R_{t-1}^o. When an individual is making the investments and savings decisions, she does not know the rates of return as they depend on the performance of the financial market. I assume that she observes the rates of return from the previous period when entering period t.[13]

At the beginning of each period the individual receives, for each occupation, a wage offer, w_t^*, which is unobserved by the econometrician and drawn from an occupation-specific wage distribution. She also receives a draw, denoted k_t from the medical care consumption distribution which represents stochastic necessary consumption within the current period. The individual realizes her level of risk aversion (r_t) and forms her expected duration of life (T_t^e) which are important for solving the expected utility maximization problem. Simultaneously, the individual decides her employment state (e_t), occupation category (o_t), investment fund (i_t), and optional savings (s_t). Elicited risk aversion and

[13] These rate of returns are public information and individuals do indeed receive this information.

expected duration of life are realized at the time the individual faces wealth uncertainty and makes the decisions. The per-period alternatives are $e_t = \{0, 1, 2\}$ indicating non-employed, working part-time, and working full-time, respectively; $o_t = \{1, 2, ..., 6\}$ indicating occupation categories (elementary occupations; legislators, senior officials and managers, professionals, technicians and associate professionals; clerical support workers; service and sales workers; skilled agricultural, forestry and fishery workers, craft and related trade workers; and plant and machine operators and assemblers); $i_t^A = \{0, 1\}$, $i_t^B = \{0, 1\}$, $i_t^C = \{0, 1\}$, $i_t^D = \{0, 1\}$, $i_t^E = \{0, 1\}$, indicating no investment or investment in that fund, and $s_t = \{0, 1\}$ indicating no optional savings or some optional savings. According to the survey answers that the individual provides for the hypothetical lotteries, r_t takes one of three values, $r_t = \{1, 2, 3\}$ where 1 is the most risk averse category and 3 is the least risk averse category. Expected duration of life, T_t^e, is reported in years.

The period t marital status (m_t), changes in family size (n_t), and health status (H_t) are observed entering period t. In order to focus on the role of wealth-related decisions, I assume that their future values are stochastic outcomes that are realized at the end of each period, prior to entering the next period. These transitions may depend on the current period decisions, as well as previous behaviors and outcomes, but are not explicitly modeled as choice variables. For example, health status entering next period may be a function of current period employment status and health consumption. Past marriage realizations are summarized by the marital history vector M_t. This vector includes the marriage state entering the period, m_t, number of years married if married, number of marriages, and interaction terms with gender. Past child realizations are summarized by the child history vector N_t which include the number of children up to period t, and interaction terms with gender.

After making the period t decisions and subjective assessments, and realizing the period $t+1$ stochastic values, the individual updates her information set to Ω_{t+1}. Figure 1 depicts the timing of endogenous decisions, stochastic realizations and subjective assessments.

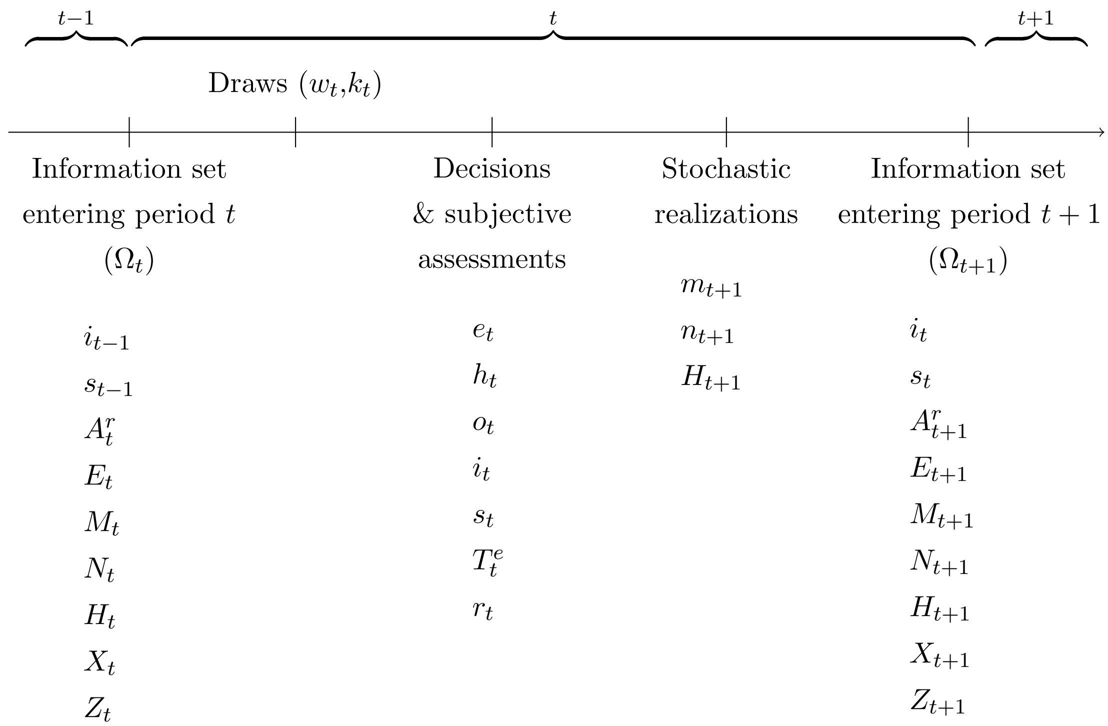
5.3 Theoretical Framework

I assume that each period t the individual receives utility (U_t) as usual, from consumption (c_t) and leisure (l_t). In addition, I allow interaction with family characteristics, such as marital status (m_t) and number of children (N_t); and with health status (H_t). The per-period utility function is:

$$U_t = U\left(c_t, l_t; X_t, m_t, N_t, H_t, \epsilon_t, r_t^*\right) \tag{2}$$

where ϵ_t is an alternative-specific preference error and r_t^* defines the curvature of the per-period utility function which defines risk aversion. Consumption and leisure (c_t, l_t) are endogenous arguments of the utility function. The marginal utility of these inputs depends on exogenous individual characteristics, marital status, number of children, and health status.

Figure 1: Timing of Decisions, Subjective Assessments and Stochastic Realizations



The individual faces a time constraint and a budget constraint given in equations 3 and 4.

$$\Gamma_t = l_t + e_t h_t + f(m_t, N_t) \tag{3}$$

$$c_t + a^r_t + s_t + K(k_t) + g(m_t, N_t) = w_t h_t + A^r_{t-1} R^r_{t-1}(i_{t-1}) + a^r_{t-1} + s_{t-1} R^o_{t-1} + m_t Y_t \tag{4}$$

where s_t is optional savings, and a^r_t defines the required savings each period if a person is employed. That is

$$a^r_t = \alpha w_t h_t \tag{5}$$

where α represent the fraction of required savings for retirement. Each period (currently, $\alpha = 0.1$).

Total time, Γ_t, is distributed between leisure, working hours, and family time $f(m_t, N_t)$. An employed individual receives earned income (Y_t) equal to $w_t h_t$, where w_t is the hourly wage and h_t denotes hours worked per period. She receives non-earned income from her spouse, if married (m_t). She also receives interest income on previous savings, with rates of returns R^o_{t-1} for optional savings, and $R^r_{t-1}(i_{t-1})$ for required savings which is a function of the chosen investment funds. The individual allocates her earnings and wealth between consumption, savings, medical care consumption expenditures $K(k_t)$, and family expenditures $g(m_t, N_t)$ each period.

I assume that each individual is rational and chooses e_t, h_t, o_t, i_t, and s_t by maximizing the discounted value of her expected lifetime utility, given her information and beliefs and state variables, and subject to her time and budget constraints. The value of alternative $eois$ (where $e_t = e$, $o_t = o$, $i_t^A = i^A$, $i_t^B = i^B$, $i_t^C = i^C$, $i_t^D = i^D$, $i_t^E = i^E$, $s_t = s$) is denoted by $d_t^{eois} = 1$. The value of this alternative at period $t = T$ and period $t < T$ are presented in equations 6 and 7.

$$V_T^{eois}(\Omega_T, \epsilon_T, w_T, k_T) = U_T^{eois} \text{ if } t = T \tag{6}$$

$$\begin{aligned} V_t^{eois}(\Omega_t, \epsilon_t, w_t, k_t, R_t^o, R_t^r) = U_t^{eois} + \\ \beta \int_{R_{t+1}^r} \int_{R_{t+1}^o} \int_{w_{t+1}} \int_{k_{t+1}} \int_{\epsilon_{t+1}} \left[\max_{eois'} V_{t+1}^{eois'}(\Omega_{t+1}, \epsilon_{t+1}, w_{t+1}, k_{t+1}, R_t^o, R_t^r | d_t = eois) \right] \\ dF(\epsilon_{t+1}) dF(k_{t+1}) dF(w_{t+1}) dF(R_{t+1}^o) dF(R_{t+1}^r), \\ \forall t = 1, 2, ..., T-1 \end{aligned} \tag{7}$$

where $dF(\epsilon_{t+1})$, $dF(k_{t+1})$, $dF(w_{t+1})$, $dF(R_{t+1}^o)$, and $dF(R_{t+1}^r)$ are the probability density functions over the alternative-specific preference error, medical consumption, wages, return on optional savings, and returns on required savings, respectively.

Risk Aversion

In a static framework, risk aversion would be measured using Pratt (1964) and Arrow (1965). Risk aversion would depend only on the curvature of the per-period utility function (r_t^* at period t) and wealth level. In a dynamic setting, an individual's level of risk aversion may vary over the life-cycle due to the different mechanisms discussed in Section 4.1. Risk aversion depends on the curvature of the current period utility as well as the curvature of the discounted future utility. In the empirical framework, I denote r_t to be elicited risk aversion and it is modeled as a realization of risk preferences in a dynamic framework. Elicited risk aversion (r_t) is affected by the curvature of the per-period utility function (r_t^*) and by the curvature of future utility (r_t^* for $t \geq t+1, t+2, ..., T$). Note that since I am not estimating the primitives of the utility function I am assuming a general form for the utility function. This is an important element of this research as I am not imposing any assumption on the structure of risk preferences. The approach taken by this paper consist on developing a framework for the incorporation of observed measures of risk aversion in the estimation of a set of correlated equations derived from a structural problem.

5.4 Estimable Structural Equations

Demand equations

The solution to the individual optimization problem presented above yields eight demand equations in period t that are a function of the individual information set coming into period t, Ω_t, and the primitive (structural) parameters of the utility function.

In order to derive the estimable set of choice probabilities equations, I approximate these non-linear demand functions by a n^{th}-order Taylor series expansion of its arguments. Because these behaviors are chosen jointly, they are all specified as a function of exogenous and predetermined endogenous variables contained in the information set. Additionally, these demands are correlated through unobserved heterogeneity. I decompose the unobserved heterogeneity into three components: 1) permanent individual correlated unobserved heterogeneity (μ), 2) time-varying individual correlated unobserved heterogeneity (ν_t), and 3) idiosyncratic unobserved heterogeneity (ε_t). The equation specific idiosyncratic terms for the demand equations are assumed to be e Type-I Extreme Value distributed. I allow the correlated unobserved heterogeneity distribution to be approximated by discrete step-wise functions rather than assuming an specific distributional form (Heckman and Singer, 1984; Mroz and Guilkey, 1992; Mroz, 1999).

By allowing for this correlation in unobservables, I am able to estimate individual decisions and account for estimation biases due to endogeneity, selection, and measurement error. Several theoretically-relevant explanatory variables for the behaviors or outcomes I model are endogenous. For example, investment vehicles determine wealth accumulation, yet investment amounts and portfolio allocation are chosen by the individual and depend on their wealth levels. Selection bias results from participation behaviors that may be correlated with other modeled behaviors (e.g., participation in optional savings accounts and wealth). The demand functions are presented in equations 8 to 11.

$$\ln\left[\frac{p(e_t=j)}{p(e_t=0)}\right] = e^j(i_{t-1}, s_{t-1}, A_t^r, E_t, M_t, N_t, H_t, X_t, Z_t, \mu, \nu_t) \quad j=\{1,2\} \tag{8}$$

$$\ln\left[\frac{p(o_t=j)}{p(o_t=1)}\right] = o^j(i_{t-1}, s_{t-1}, A_t^r, E_t, M_t, N_t, H_t, X_t, Z_t, \mu, \nu_t) \quad j=\{2,...,6\} \tag{9}$$

$$\ln\left[\frac{p(i_t^j=1)}{p(i_t^j=0)}\right] = i^j(i_{t-1}, s_{t-1}, A_t^r, E_t, M_t, N_t, H_t, X_t, Z_t, \mu, \nu_t) \quad j=\{A,B,C,D,E\} \tag{10}$$

$$\ln\left[\frac{p(s_t=1)}{p(s_t=0)}\right] = s(i_{t-1}, s_{t-1}, A_t^r, E_t, M_t, N_t, H_t, X_t, Z_t, \mu, \nu_t) \tag{11}$$

Subjective Assessments

I allow correlation through unobservable between two subjective assessments (elicited risk aversion,r_t, and self-reported expected duration of life,T_t^e) and observed wealth related behaviors. Elicited risk aversion is calculated from survey responses to hypothetical gambles and expected duration of life is self-reported by individuals in the sample. I treat these subjective assessments as jointly realized with the observed wealth related decisions (i.e., at the moment the individual faces the uncertainty). This modeling assumption implies that r_t and T_t^e can be expressed as functions of variables contained in Ω_t as well as the permanent and time-variant unobserved components.

I consider elicited risk aversion (r_t) to be a proxy for an individual's risk preferences and I model it as a realization of risk attitudes and as an endogenous determinant of observed individual behaviors. I model T_t^e is a realization of the value of the length of the planning horizon that rationalizes her decisions .

This procedure allows me to account for many sources of estimation bias that may show up. First, there is bias due to omitted information (the estimable parameters of the set of correlated equations 8 to 11 are functions of the primitive parameters of the model, including the unobserved curvature of the utility function and the length of the planning horizon). Second, bias may show up due to endogeneity between risk preferences and observed behaviors (e.g., risk preferences affect individual investment decisions which affect wealth levels, and accumulation of wealth through the life cycle affects future wealth and risk preferences) and between risk aversion and the length of the planning horizon (Bommier and Rochet (2006) show that the horizon length is one of the determinants of the individual's dynamic risk aversion). A third source of bias is due to selection in behaviors (e.g., risk preferences affect individual optional savings decisions, which affect wealth levels). Finally, there is expected to be bias due to measurement error which may be important when considering individual subjective assessments.

Elicited risk aversion and expected duration of life are defined in equations 12 and 13.

$$T_t^e = T^e(i_{t-1}, s_{t-1}, A_t^r, E_t, M_t, N_t, H_t, X_t, Z_t, \epsilon_t^T, \mu, \nu_t) \tag{12}$$

$$\begin{aligned} ln\left[\frac{p(r_t=j)}{p(r_t=1)}\right] &= r^j(i_{t-1}, s_{t-1}, A_t^r, E_t, M_t, N_t, H_t, X_t, Z_t, \mu, \nu_t) \\ & \qquad j = \{2, 3\} \end{aligned} \tag{13}$$

Stochastic Outcomes

At period t there is uncertainty about future stochastic outcomes: wage draw, future marital status, number of children, health care consumption and health status. I assume that the individual does not know these future values, but she does know the stochastic process they follow. I allow the realization of these values to be affected by previous choices as well by decisions at period t. The objective of incorporating family and health characteristics is to include the effect that other characteristics that individuals may value independently of their wealth may have on wealth accumulation. These densities and probability functions are presented in equations 14 to 18.

The density of wages is a function of work experience, occupation category, health status, and other individual's exogenous individual characteristics, such as age, gender and education. It also depends on a vector of employment demand side shifters, Z_t^E such as unemployment rates.

$$w_t = w(E_t, o_t, H_t, X_t, Z_t^E, \epsilon_t^w) \tag{14}$$

where ϵ_t^w is an uncorrelated error term. The probability of being single in period $t+1$ ($m_{t+1} = 0$) relative to being married ($m_{t+1} = 1$) is given in equation 15 and depends on endogenous and exogenous individual characteristics. While not modeled explicitly, I assume that there is a marriage market such that supply side factors, Z_t^M, also impact marriage probability.

$$\ln\left[\frac{p(m_{t+1} = 1)}{p(m_{t+1} = 0)}\right] = m(d_t, \tilde{\Omega}_t, X_t, Z_t^M) \tag{15}$$

The probability of decreasing or increasing the number of children in period $t+1$ ($n_{t+1} = \{-1, 1\}$) relative to not ($n_{t+1} = 0$) is defined in equation 16 and depends on endogenous and exogenous individual characteristics, as well on exogenous supply side factors.

$$\ln\left[\frac{p(n_{t+1} = j)}{p(n_{t+1} = 0)}\right] = n^j(d_t, \tilde{\Omega}_t, X_t, Z_t^N), \qquad j = \{-1, 1\} \tag{16}$$

The density function at period $t+1$ of health consumption is a function of endogenous and exogenous individual characteristics, and health market supply side factors, Z_t^K.

$$k_{t+1} = k(d_t, \tilde{\Omega}_t, X_t, Z_t^K, \epsilon_t^k) \tag{17}$$

where ϵ_t^k is an uncorrelated error term. The probability of being in health status j in period $t+1$ ($H_{t+1} = j$ where $j = \{2, 3, 4\}$ represent categories good, regular, and poor respectively) relative to being in a very good health status ($H_{t+1} = 1$) is

$$\ln\left[\frac{p(H_{t+1} = j)}{p(H_{t+1} = 1)}\right] = H^j(H_t, k_t, e_t, o_t, X_t, Z_t^H), \qquad j = \{2, 3, 4\} \tag{18}$$

and depends on current health and medical care consumption which represents medical care inputs. The period t employment and occupation choice, as well as other individual exogenous characteristics, also impact health transitions. Employment behavior may directly affect health or may proxy for omitted non-medical care inputs such as nutrition and exercise.

I allow correlation across all fifteen equations through theoretically-relevant observed variables, and permanent and time-varying individual unobserved heterogeneity.

Returns on required, R_t^r, and optional, R_t^o, savings are stochastic and exogenous to the individual as they depend on financial markets and are fund specific (e.g., two individuals investing in account A accumulate wealth at the same rate of return). Retirement wealth evolves outside the model according to equation 19.

$$A_{t+1}^r = A_t^r \cdot R_t^r(i_t) + a_t^r \tag{19}$$

5.5 Initial Conditions

Because individuals are aged 25 to 59 years old when they are first observed in 2002, some of the state variables that explain endogenous behavior are non-zero. However, I cannot use a dynamic equation (i.e., all that depends on past values) to estimate this initially-observed variation. Thus, I model the initial conditions as static equations (i.e., initial employment status, initial work experience, initial occupation category, initial savings decision, initial marital status, initial number of children, and initial health status.) All of them are modeled as a function of exogenous individual and market characteristics, and are jointly estimated with the rest of the equations by allowing the initial conditions to be correlated through individual permanent unobserved heterogeneity.

Exogenous individual characteristics for initial employment status, initial work experience, and initial occupation category include age, gender, education, parent's years of schooling, interaction terms between gender and parent's education, self-reported socioeconomic status of household when growing up. Market characteristics include the vector $Z_I = (Z_I^E, Z_I^M, Z_I^N, Z_I^K, Z_I^H)$. The same individual characteristics are included for initial health status, which depends also on characteristics of the health market include Z_I^K and Z_I^H. Exogenous individual characteristics for initial marital status and initial number of children include age, gender, education, parent's education, interaction terms between gender and parent's education, socioeconomic status of household and number of children in household when growing up. Characteristics of the marriage market for initial marital status and characteristics of the children market for initial number of children are included (Z_I^M or Z_I^N, respectively).

5.6 Estimation Strategy

The set of estimated equations consists of 22 equations: 8 demand behaviors, 2 subjective assessments, 5 stochastic outcomes, and 7 initial conditions. The demand, assessments and outcomes are correlated through permanent and time-varying unobserved heterogeneity while the initial conditions equations are correlated through the permanent component. This heterogeneity represents an individual's characteristics and attitudes that are unobserved by the econometrician and that affect simultaneously an individual's behavior and observed outcomes. As mentioned, the joint estimation of this set of equations is one of the features of this paper since it accounts for different sources of estimation bias that the literature typically does not approach. I also estimate the model under alternative modeling assumptions for the unobserved heterogeneity. The details of these specifications are presented in Section 7.

These equations are estimated using the Discrete Factor Random Effects (DFRE) method. The DFRE method does not impose distributional assumptions over the correlated error terms across equations. Rather, the support of the unobserved heterogeneity distribution is discretized and the mass point locations as well as their probabilities are estimated jointly with parameters on the observed heterogeneity in each equation (Mroz and Guilkey, 1992; Mroz, 1999). The DFRE method perform as well as maximum likelihood estimation assuming normality when the true distribution of the error term is jointly normal. When the distribution is not normal, the DFRE performs better both in precision and bias (Mroz, 1999).

It is assumed that the error in each demand, subjective assessment, and stochastic outcome equation has the form:

$$\epsilon_t^z = \mu^z + \nu_t^z + \varepsilon_t^z,\ z = \{1, ..., 15\} \tag{20}$$

and that the error in each initial condition equations has the form:

$$\epsilon_t^{z_i} = \mu^{z_i} + \varepsilon_t^{z_i},\ z_i = \{1, ..., 7\} \tag{21}$$

where z represents the per-period equation, z_i the initial conditions equation, μ captures permanent unobserved heterogeneity, ν_t captures time-varying unobserved heterogeneity, and ε_t is an independently and identically distributed component.

The advantage of the DFRE method in this setting is that it allows us to estimate the decisions and observed outcomes derived from the individual's optimization problem without assuming specific functional forms for the utility function, constraints, and expectation processes, and without assuming any specific distributional form for the correlated error terms. Importantly, it does not impose any assumption on the individual's risk preferences. Additionally, it allows for both the permanent and time-varying unobserved components in a flexible way. Moreover, this method allows us to account for, among other unobserved factors, measurement error in endogenous variables as one of the components of the modeled individual unobserved heterogeneity.

Identification

The identification of the set of equations relies on various sources. First, identification comes from the exclusion of certain explanatory variables from each outcome equation. Assumptions regarding the timing of decision-making in the individual's optimization problem allow for the exclusion of particular variables from particular equations. Theory suggests that the predetermined variables and exogenous price and supply-related variables enter the behavioral equations. Some of these variables are excluded from the outcome equations. For instance, I assume that medical care decisions are made after the main behaviors and their associated prices are realized. Thus, I condition medical care expenditures on the observed period t behaviors, and assume that the supply side variables that determined the behaviors do not have an independent effect of medical care expenditures.

The vector of prices and supply-side variables that serve as the identifying variables in the behavioral equations, $Z_t = (Z_t^E, Z_t^M, Z_t^N, Z_t^K, Z_t^H)$, include theoretically relevant market level supply-side factors that affects individual decisions, such as unemployment rates, health market characteristics, marriage market characteristics, and costs associated to family (e.g., tuition prices). Z_t enters the information set Ω_t at the beginning of period t and affects all individual demands and subjective assessments (equation 8 to equation 13). The coefficients on these included variables are jointly significant at a 1 percent level in equations 8–13 (p-values < 0.0003 for the joint significance Wald tests). For equation 10 (outcome $j = D$) the included variables are jointly significant at a 10 percent level (p-value $= 0.0539$ for the joint significance Wald test). The exception is equation 10 (outcome $j = B$) for which the joint insignificance of the coefficients cannot be rejected (p-value $= 0.1203$ for Wald test). The detail is presented in Table C1.

Additionally, the dynamic specification of wealth-related decisions and subjective assessments include lagged endogenous variables that are functions of market-level exogenous variables (e.g., the vector Z_{t-1} is included in explaining decisions at period $t-1$) such that the history of exogenous variables provides another source of exogenous variation (**?**). I test the significance of lagged exogenous market characteristics in period t behavior and subjective assessment equations by adding them to the equation specification one at a time and re-estimating the model. Most of the coefficients on the lagged Zs are insignificant in explaining period t decisions and assessments, conditional on Z_t. The detail is presented in Table C2.

For the stochastic outcomes (equation 14 to equation 18), conditional on the behavior at period t, only the a subset of Z_t that directly affects the outcome of interest enters into the probability function. For instance, conditional on the observed behavior in t, only characteristics of the marriage market (Z_t^M) affect the probability of being married next period. For each stochastic outcome, I have an equation-specific set of exclusion restrictions denoted by Z_t^E, Z_t^M, Z_t^N, Z_t^K, or Z_t^H. In equation 17 for medical consumption I include a specific vector Z_t^K which exclude 4 variables from the vector Z_t. The variables included in Z_t^K capture medical care market characteristics such as number of medical doctors and hospital beds by geographical region. Z_t^K is excluded from the health status equation at the end of period t as health at t is a function (among other variables) of medical consumption at period t, health status at $t-1$, and its own vector Z_t^H. I run separate regressions by adding the excluded variables one by one in equations 17 and 18. For equation 17, the coefficients on the excluded variables in Z_t^E and Z_t^H are insignificant (p-values of 0.6290 and 0.1510, respectively) supporting the exclusion. The coefficients on the variables in Z_t^M and Z_t^N are significant at a 1 percent level. For equation 18 one variable in Z_t^K is significant at a 1 percent level and the other one is insignificant (p-value $= 0.2157$).

Identification also comes from the functional form assumption on the distribution of the idiosyncratic component of the error term in each equation (ε_i^z and ε_t^z) and from the restriction on the number of factors allowed for approximating the distribution of correlated individual unobserved heterogeneity.

Likelihood Function

The likelihood function conditional and unconditional to the unobserved heterogeneity is given by equations 22 and 23, respectively.

$$L_{ct}(\mu,\nu_t) = f_w(\epsilon_t^W|\mu,\nu_t) f_k(\epsilon_t^K|\mu,\nu_t) \prod_j^J \left\{ Pr\left(I(d_t^j = d^j)|\mu,\nu_t \right) f_j(\epsilon_t^j|\mu,\nu_t) \right\}^{I(d_t^j = d^j)} \quad (22)$$

where d_t^j represents a choice, $j = \{E, O, I^A, I^B, I^C, I^D, I^E, S, T^e, R, M, N, H\}$, $f(\cdot)$ represents the density function of the error term of each equation, $Pr(\cdot)$ is the cumulative distribution function for each choice, and $I(d_t^j = d^j)$ is an indicator of a particular choice.

$$L_t = \sum_{q=1}^{Q} PW_{\mu q} \sum_{r=1}^{R} PW_{\nu r} \prod_{t=1}^{T} L_{ct}(\mu,\nu_t) \quad (23)$$

where $PW_{\mu q}$ is the probability of observing q mass points for the permanent component μ and $PW_{\nu r}$ is the probability of observing r mass points for the time-varying component ν_t. These approximate the true distributions of μ and ν_t.

6 Data and Research Sample

The main source of data are the first 4 waves of the EPS (Encuesta de Protección Social). This survey is an individual longitudinal dataset for the years 2002, 2004, 2006, and 2009. It is administered by the Ministry of Labor and Social Security in Chile jointly with the University of Chile and the Institute for Social Research from the University of Michigan. I complement the EPS with administrative data from the Chilean Superintendence of Pensions (Superintendencia de Pensiones).

The EPS 2002 was designed to obtain a representative sample of individuals who are affiliated with the Chilean retirement system. Beginning in 2004, the EPS is a representative sample of the entire adult population since the sample was extended to include those individuals who are not affiliated with the retirement program (i.e., any individual who has not worked as a dependent worker for at least one month since 1981).

An important feature of the EPS is that it allows to observe individual measures of risk aversion. The provides EPS information about individual preferences over hypothetical gambles. A measure of risk aversion for every individual aged 15 years-old and above can be created from this information, and it is measured every wave. This allows to incorporate this information in the estimation of retirement investment decisions in order to reduce the endogeneity bias of omitted information and unmodeled correlation.

6.1 Description of Elicited Measure of Risk Aversion

Elicited risk aversion can be derived from a set of questions in the EPS that require respondents to report preferences toward hypothetical gambles over their lifetime income following the lottery choice menu approach. Appendix A presents the survey questions that allow one to obtain the measures for elicited risk aversion and discusses in detail how the measure is constructed. The questions are slightly different in the first wave, but the same in waves 2, 3, and 4. However, since some hypothetical scenarios are the same for all waves, it is possible to construct a comparable risk attitude measure at each wave.

Respondents are separated into three distinct risk preference categories. Depending on the option that the individual accepts, she is more or less risk averse than another individual. The three categories takes values 1, 2, and 3, and are labeled "most risk averse," "intermediate risk aversion," and "least risk averse." Table 1 presents the distribution of the index of risk aversion for the whole sample. A majority (78%) of individuals belong to the most risk averse category.

Table 1: Distribution of Elicited Risk Aversion for the Whole Sample

Elicited Risk Aversion	2002	2004	2006	2009	Total
Most Risk Averse	14,604	12,099	11,258	9,545	47,506
(category = 1)	(90.25%)	(74.42%)	(74.22%)	(74.02%)	(78.52%)
Intermediate	377	1,142	1,194	1,073	3,786
(category = 2)	(2.33%)	(7.02%)	(7.87%)	(8.32%)	(6.26%)
Least Risk Averse	1,201	3,016	2,716	2,278	9,211
(category = 3)	(7.42%)	(18.55%)	(17.91%)	(17.66%)	(15.22%)
Observations	16,182	16,257	15,168	12,896	60,503

Note: (a) Elicited Risk Aversion goes from 1 to 3, being 1 the highest level of risk aversion. This measure was constructed using two questions about preferences over hypothetical lotteries in the four waves of EPS. (b) The whole sample is used. (c) In this paper, elicited risk aversion from the first wave does not enter the estimation.

An advantage of this measure is that it is constructed over the individual's willingness to gamble using her lifetime income. It avoids the problem in the existing literature where laboratory experiments with small payouts have little effect on the individual lifetime resources and therefore it should not exhibit a risk premium. Additionally, individuals are asked to gamble assuming that they are the only income earners of their households. This wording eliminates the potential problem that the respondent would be more or less likely to gamble with her spouse's income (Barsky et al., 1995; Spivey, 2010). An specific strong advantage of EPS is that it contains the same questions to elicit risk aversion for the same individuals over 7 years. This allows to analyze risk aversion through the life-cycle and to approach typically unmodeled factors. This paper additionally allows correlation between this elicited measure of risk aversion constructed based on hypothetical scenarios with real-life decisions that may also reflect an individual's level of risk aversion.

6.2 Description of Research Sample

The research sample used in the estimation consists of all individuals aged between 25 and 59 years old (limits included) in 2002 who are observed in all four waves of EPS (no attrition nor deaths) and who have no missing information for the variables: health status, optional savings, work experience, marital status, and region of residence. The research sample contains 7,168 individuals observed four times (28,672 person-year observations). Table 2 details determination of the research sample. Table 3 presents summary statistics describing the demographics of the reference sample (individuals observed more than one period and in age range) and the research sample. The average age and percent of female are similar across the two samples. There is a higher share of individuals in the lower education category in the research sample than in the reference sample.

Table 2: Construction of Research Sample

Sample	# Individuals
Reference sample	
Age between 25 and 59 years old in 2002*	13,178
And observed in 3 consecutive periods	
First three waves	8,545
Last three waves	8,869
And no attrition no death	
Observed in all four waves**	7,238
And Information available for key variables	
Research Sample***	7,168

Note: (a) * Individuals who show up more than one period. ** Death rates are small for individuals aged between 25 and 59 years old in 2002. *** No missing information in the following variables: health status, optional savings decisions, work experience, marital status, and region of residence. (b) The variables are defined in detail in Appendix B.

Table 3: Summary Statistics for Demographic Variables Between Reference and Research Sample (2002)

Variable	Reference Sample		Research Sample	
	Mean	Std. Dev.	Mean	Std. Dev.
Age	40.633	9.461	40.715	9.275
Female	0.497	0.500	0.462	0.499
Education category				
Less than High School	0.413	0.492	0.531	0.499
High School	0.259	0.438	0.285	0.452
Technical College	0.104	0.305	0.109	0.311
College or Post College	0.067	0.250	0.065	0.247
Missing	0.158	0.365	0.010	0.098

Table 4 describes the dependent variables for the 15 equation set. The number of observations differs per equations as individuals may have missing information in some dependent variable(s). I assume that this missing information is random. Table 5 describes the explanatory variable used in estimation, entering period t.

Table 4: Summary Statistics of Dependent Variables for Research Sample

Variable	Estimator	Mean	Std. Dev.	Min.	Max.	N
Employment (e_t)	mlogit					21,504
Full-time employed		0.690	0.462	0	1	
Part-time employed		0.031	0.174	0	1	
Not working		0.278	0.448	0	1	
Occupation (o_t) (if working)	mlogit					15,327
Elementary occupations		0.219	0.414	0	1	
Legis., Prof., Tech., other		0.185	0.388	0	1	
Clerical support workers		0.107	0.309	0	1	
Service and sales workers		0.147	0.354	0	1	
Agricultural, craft and trade		0.057	0.231	0	1	
Operators and assemblers.		0.286	0.452	0	1	
Investment (i_t)	logit					21,504
Account A (Riskier)		0.104	0.305	0	1	
Account B		0.231	0.422	0	1	
Account C		0.495	0.500	0	1	
Account D		0.215	0.411	0	1	
Account E (Safest)		0.037	0.189	0	1	
Savings outcomes (s_t)	logit					21,490
Any Optional Savings		0.263	0.441	0	1	
Expected Duration of Life (T_t^e)	OLS	75.780	10.091	30	110	17,287
Elicited Risk Aversion (r_t)	mlogit					20,557
Most Risk Averse		0.747	0.435	0	1	
Intermediate Risk Averse		0.076	0.265	0	1	
Least Risk Averse		0.177	0.381	0	1	
Log of wage (w_t)	OLS	0.657	1.440	-10.219	5.255	14,705
Marital status (m_{t+1})	logit					21,504
Married		0.571	0.495	0	1	
Variation in number of children (n_{t+1})	mlogit					21,060
No change		0.788	0.408	0	1	
Decrease		0.184	0.387	0	1	
Increase		0.028	0.165	0	1	
Medical consumption (k_{t+1})	OLS					21,438
Number of Medical Visits		6.697	12.639	0	240	
Health status (H_{t+1})	mlogit					14,336
Very good		0.147	0.354	0	1	
Good		0.519	0.500	0	1	
Regular		0.266	0.442	0	1	
Poor		0.068	0.252	0	1	

Table 5: Summary Statistics of Explanatory Variables Entering Period t for Research Sample

Variable	Mean	Std. Dev.	Min.	Max.
Work experience (years)	15.646	8.111	0	30
Employment Status at period t				
Full-time Worker	0.691	0.462	0	1
Part-time Worker	0.032	0.177	0	1
Not employed	0.277	0.447	0	1
Occupation Category in period t				
Elementary occupations	0.117	0.322	0	1
Legis., Prof., Tech., other	0.099	0.298	0	1
Clerical support workers	0.057	0.232	0	1
Service and sales workers	0.078	0.269	0	1
Agricultural, craft and trade, other	0.030	0.172	0	1
Operators and assemblers	0.153	0.360	0	1
Lagged Investment Decision				
Account A (Riskier)	0.059	0.235	0	1
Account B	0.135	0.341	0	1
Account C	0.495	0.500	0	1
Account D	0.095	0.293	0	1
Account E (Safest)	0.021	0.144	0	1
Value of Assets	5.906	12.487	0	241
Any Optional Savings	0.218	0.413	0	1
Married	0.569	0.495	0	1
Duration of marriage (years)	11.444	12.626	0	56
Number of Children	1.009	1.083	0	8
Number of Medical Visits in period t	5.007	11.31	0	240
Health Status				
Very Good	0.139	0.346	0	1
Good	0.536	0.499	0	1
Fair	0.266	0.442	0	1
Poor	0.059	0.236	0	1
Age	43.965	9.628	25	66
Female	0.462	0.499	0	1
Education Category				
Less than High School	0.536	0.499	0	1
High School	0.334	0.472	0	1
Technical College	0.097	0.296	0	1
College and Post-Graduate	0.025	0.156	0	1
Exclusion Restrictions				
Unemployment rate	9.226	2.261	4.200	15
Number of hospital beds (# per 1,000 population)	2.345	0.373	1.300	3.900
Number of doctors (# per 1,000 population)	0.978	0.220	0.580	1.870
Number of marriages (# year per 1,000 population)	3.486	0.437	2.500	5.100
Inches of rainfall (thousand inches per year)	17.501	13.705	0.000	65.450
College tuition (thousand dollars)	3.240	0.641	0.000	4.300
Missing Indicators				
Missing: Number of Children	0.021	0.142	0	1
Missing: Education	0.007	0.082	0	1
Missing: Occupation	0.261	0.439	0	1
Missing: Marriage Duration	0.005	0.069	0	1
Missing: Number of Medical Visits	0.252	0.434	0	1

7 Estimation Results

7.1 Specification and Parameter Estimates

Table 6 presents the empirical specification for the preferred model which joint estimates the 22 equations. A model that does not allow for correlation across equations estimates each of the 22 equation separately. Not matter the correlation structure that is allowed across equations, there is always an independent random error in each equation. Tables C3-C10 in Appendix C presents the parameter estimates for the per-period equations.[14]

The estimation results for investment decisions equations of required retirement savings show that the estimated coefficients on work experience and its square have a statistically significant effect on some of the investment decisions, especially for safest accounts. For most of the investment decisions the coefficients on the value of accumulated assets at the time of making the decision and the coefficients on investment decisions in the previous period are statistically significant, particularly when the individual invested in that same fund. This suggests that there is a persistence effect. These results are consistent with other results discussed in the retirement literature (Hastings et al., 2013; Luco, 2015). The estimated parameters on health status and family characteristics are also statistically significant.

Table 7 presents the contemporaneous marginal effects (model with no updating of current endogenous behaviors in response to past behaviors and outcomes) computed at the observed values for lagged decisions in holding optional savings and investment in the 5 alternatives of financial accounts, and for increases of one unit in work experience, age, and accumulated assets. Standard errors are calculated using predictions based on 100 draws of the estimated coefficients from the estimated variance-covariance matrix. The model allows us to recover unbiased marginal effects by accounting for unobserved characteristics and by including subjective assessments to better approximate this distribution. For accounts B, C, and D, the estimated coefficients on lagged investment in the accounts have a statistically significant effect in explaining this period investment decision. The same is observed for optional savings.

Table C7 presents the estimation results for the subjective assessments. Consistent with other results in the literature I find that women are less like than men to be in the most risk averse category. I find that as age increases and as work experience increases, individuals are less likely to be in the least risk averse category. Individuals that have higher levels of educations, they are more likely to less risk averse. I find that been in very good health status significantly increases the likelihood of been in the least risk averse category, while been in poor health significantly decreases the likelihood of been in the least risk averse category. I find no significant effect of wealth levels and of previous investment decisions on an individual's level of risk aversion. This result suggests that previous financial conditions

[14]Estimates for the initial conditions equations are available from the author. The model allows for four permanent and four time-varying mass points for capturing the distribution of correlated unobserved heterogeneity.

in mandatory retirement investments do not affect an individual's realization of risk aversion. There is a body of the literature that explores the relation between macroeconomic conditions and risk aversion. In this framework, I find that as unemployment rates increases, individuals are more likely to be less risk averse.

Most of the coefficients for the endogenous predetermined explanatory variables are statistically insignificant, while the coefficients that capture unobserved characteristics are statistically significant. In order to further explore these results I examine the correlation between the unobserved heterogeneity components across subjective assessments and the decisions and outcomes of the model using the estimated mass points and probability weights from the joint distribution of unobservable characteristic. In particular, I compute the correlation between risk aversion and expected duration of life, with employment decision, occupation selection, investment decisions for retirement, savings decisions, earnings, family characteristics, medical care consumption, and health status. There is correlation across both, the permanent and time-variant components of the subjective assessments and decisions and outcomes of the model (see Table C11). This suggests that researchers should account for the correlation across outcomes when measures of elicited risk aversion are included.

For both categories of elicited risk aversion there is correlation with occupational categories, in particular in the component that captures permanent unobserved heterogeneity. The least risk averse individuals are also more likely to be employed as legislators, senior officials, managers, professionals, and technicians, and in service and sales occupations; and less likely to be in skilled agricultural, forestry and fishery, craft and trade occupations, than the intermediate risk averse individuals. There is correlation between employment status and expected duration of life, negative for the permanent component and positive for the time-varying component. Unobservable characteristics for individuals in the least risk averse category are positive correlated with unobservable in investments in accounts A, and B (permanent); and negatively correlated with accounts B (time-variant), C, D, E. There is also correlation with savings, medical care consumption, health, and family characteristics. The correlation matrices are available from the author.

Table 6: Specification of Set of Equations in Preferred Empirical Model: Endogenous Subjective Assessments

Equation	Estimator	Explanatory Variables		
		Predetermined Variables	Exogenous Variables	Unobserved Heterogeneity
Wealth-related decisions at period t				
Employment (e_t)	mlogit	i_{t-1}, s_{t-1} A^r_t, E_t, M_t, N_t, H_t	X_t, $Z^E_t, Z^M_t, Z^N_t, Z^K_t, Z^H_t$	μ^E, ν^E_t, ε^E_t
Occupation (o_t)	mlogit	i_{t-1}, s_{t-1} A^r_t, E_t, M_t, N_t, H_t	X_t, $Z^E_t, Z^M_t, Z^N_t, Z^K_t, Z^H_t$	μ^O, ν^O_t, ε^O_t
Savings (s_t)	logit	i_{t-1}, s_{t-1} A^r_t, E_t, M_t, N_t, H_t	X_t, $Z^E_t, Z^M_t, Z^N_t, Z^K_t, Z^H_t$	μ^S, ν^S_t, ε^S_t
Investment in A (i^A_t)	logit	i_{t-1}, s_{t-1} A^r_t, E_t, M_t, N_t, H_t	X_t, $Z^E_t, Z^M_t, Z^N_t, Z^K_t, Z^H_t$	μ^{I^A}, $\nu^{I^A}_t$, $\varepsilon^{I^A}_t$
Investment in B (i^B_t)	logit	i_{t-1}, s_{t-1} A^r_t, E_t, M_t, N_t, H_t	X_t, $Z^E_t, Z^M_t, Z^N_t, Z^K_t, Z^H_t$	μ^{I^B}, $\nu^{I^B}_t$, $\varepsilon^{I^B}_t$
Investment in C (i^C_t)	logit	i_{t-1}, s_{t-1} A^r_t, E_t, M_t, N_t, H_t	X_t, $Z^E_t, Z^M_t, Z^N_t, Z^K_t, Z^H_t$	μ^{I^C}, $\nu^{I^C}_t$, $\varepsilon^{I^C}_t$
Investment in D (i^D_t)	logit	i_{t-1}, s_{t-1} A^r_t, E_t, M_t, N_t, H_t	X_t, $Z^E_t, Z^M_t, Z^N_t, Z^K_t, Z^H_t$	μ^{I^D}, $\nu^{I^D}_t$, $\varepsilon^{I^D}_t$
Investment in E (i^E_t)	logit	i_{t-1}, s_{t-1} A^r_t, E_t, M_t, N_t, H_t	X_t, $Z^E_t, Z^M_t, Z^N_t, Z^K_t, Z^H_t$	μ^{I^E}, $\nu^{I^E}_t$, $\varepsilon^{I^E}_t$
Subjective assessments at period t				
Duration of Life (T^E_t)	ols	i_{t-1}, s_{t-1} A^r_t, E_t, M_t, N_t, H_t	X_t, $Z^E_t, Z^M_t, Z^N_t, Z^K_t, Z^H_t$	μ^{T^e}, $\nu^{T^e}_t$, $\varepsilon^{T^e}_t$
Elicited Risk Aversion (r_t)	mlogit	i_{t-1}, s_{t-1} A^r_t, E_t, M_t, N_t, H_t	X_t, $Z^E_t, Z^M_t, Z^N_t, Z^K_t, Z^H_t$	μ^R, ν^R_t, ε^R_t
Stochastic outcomes at period t				
Log Wage ($w_t \mid e_t, o_t$)	ols	E_t, H_t	X_t, Z^E_t	μ^W, ν^W_t, ε^W_t
Medical consumption (k_t)	ols	H_t	X_t, Z^K_t	μ^K, ν^K_t, ε^K_t
Stochastic outcomes at the end of period t				
Marital status (m_{t+1})	logit	e_t M_t, N_t	X_t, Z^M_t	μ^M, ν^M_t, ε^M_t
Change in # children (n_{t+1})	mlogit	e_t M_t, N_t	X_t, Z^N_t	μ^N, ν^N_t, ε^N_t
Health status (H_{t+1})	mlogit	e_t, o_t, k_t E_t, H_t	X_t, Z^H_t	μ^H, ν^H_t, ε^H_t
Initial conditions (at period $t = 1$)				
Employment (e_1)	mlogit		X_1, $Z^E_1, Z^M_1, Z^N_1, Z^K_1, Z^H_1$	μ^{E_i}, ε^{E_i}
Work experience (E_1)	ols		X_1, $Z^E_1, Z^M_1, Z^N_1, Z^K_1, Z^H_1$	μ^{EX_i}, ε^{EX_i}
Occupation (o_1)	mlogit		X_1, $Z^E_1, Z^M_1, Z^N_1, Z^K_1, Z^H_1$	μ^{O_i}, ε^{O_i}
Savings (s_1)	logit		X_1, $Z^E_1, Z^M_1, Z^N_1, Z^K_1, Z^H_1$	μ^{S_i}, ε^{S_i}
Marital status (m_1)	logit		X_1, Z^M_1	μ^{M_i}, ε^{M_i}
Number of children (n_1)	ols		X_1, Z^N_1	μ^{N_i}, ε^{N_i}
Health status (H_1)	mlogit		X_1, Z^K_1, Z^H_1	μ^{H_i}, ε^{H_i}

Table 7: Contemporaneous Marginal Effects on Financial Investment and Savings Outcomes (%)

Variable	Current Period Decisions					
	Investments in					
	Account A	Account B	Account C	Account D	Account E	Savings
Lagged						
Investment A	13.82	0.20	-3.07***	-0.39	-1.38	3.79**
	(8.58)	(1.79)	(0.21)	(1.51)	(1.59)	(1.65)
Investment B	0.76	15.84***	-7.98***	0.72	0.05	2.12
	(1.25)	(3.32)	(0.68)	(1.24)	(1.35)	(1.34)
Investment C	1.77	3.59**	6.62***	-1.13	0.14	3.28**
	(2.44)	(2.17)	(0.80)	(1.69)	(1.49)	(1.58)
Investment D	-0.19	3.97	-11.84***	10.06***	-0.34	2.56
	(2.12)	(2.50)	(1.30)	(3.33)	(1.49)	(2.11)
Investment E	2.37	6.35**	-0.80	-1.98	7.15	2.25
	(3.05)	(3.38)	(1.42)	(2.15)	(5.65)	(2.51)
Savings	1.09	0.22	-0.76***	-0.81*	-0.16	16.24***
	(1.27)	(0.45)	(0.24)	(0.43)	(0.62)	(3.79)
Experience	-0.31	0.10	1.44***	-0.86***	-0.02	0.41
	(0.37)	(0.15)	(0.12)	(0.17)	(0.14)	(0.38)
Age	-0.10	-1.72***	-0.48***	2.02***	0.03	-0.53***
	(0.08)	(0.20)	(0.10)	(0.14)	(0.03)	(0.13)
Assets	0.05	0.14***	0.02	-0.06***	0.03	0.10***
	(0.04)	(0.03)	(0.02)	(0.02)	(0.03)	(0.03)

Note: (a) Marginal effects computed at the observed values. (b) Model with no updating of current endogenous behaviors in response to past behaviors and outcomes. (c) Simulated with 100 repetitions. (d) Bootstrapped standard errors are in parentheses using with 100 draws.

* Significant at the 10 percent level. ** Significant at the 5 percent level. *** Significant at the 1 percent level.

7.2 Fit of The Model

Table 8 presents the summary of the observed and simulated behavior. The simulated values are obtained using observed values of explanatory variables, with no updating of current endogenous behaviors in response to past behaviors and outcomes, and with 100 replications for the types probabilities. The standard errors are calculated using predictions based on 100 draws of the estimated coefficients from the estimated variance-covariance matrix.

7.3 Alternative Specifications of the Model

To study the incorporation of observed measures of risk aversion I estimate alternative specifications of the model under different structures of correlated unobserved heterogeneity and

Table 8: Summary of Fit of the Model

Outcome	Observed		Simulated	
	Mean	St. Error	Mean	St. Error
Employment				
Full-time employed	0.690	0.462	0.695	0.159
Part-time employed	0.031	0.174	0.033	0.191
Not working	0.278	0.448	0.272	0.128
Occupation				
Elementary occupations	0.219	0.414	0.248	0.093
Legis., Prof., Tech., other	0.185	0.388	0.174	0.131
Clerical support workers	0.107	0.309	0.096	0.126
Service and sales workers	0.147	0.354	0.144	0.193
Agricultural, craft and trade	0.057	0.231	0.069	0.128
Operators and assemblers.	0.286	0.452	0.270	0.209
Investments				
Account A (Riskier)	0.104	0.305	0.104	0.070
Account B	0.231	0.422	0.223	0.083
Account C	0.495	0.500	0.512	0.064
Account D	0.215	0.411	0.207	0.065
Account E (Safest)	0.037	0.189	0.038	0.050
Optional Savings	0.263	0.440	0.262	0.121
Expected Duration of Life	75.780	10.091	75.775	2.347
Elicited Risk Aversion				
Most Risk Averse	0.747	0.435	0.747	0.175
Intermediate Risk Averse	0.076	0.265	0.076	0.141
Least Risk Averse	0.177	0.381	0.176	0.155
Log of Wage	0.657	1.440	0.534	0.154
Marital status (married)	0.571	0.495	0.575	0.028
Variation in number of children				
No change	0.788	0.408	0.784	0.052
Decrease	0.184	0.387	0.184	0.043
Increase	0.028	0.165	0.032	0.035
Medical consumption	6.697	12.639	6.681	1.564
Health status				
Very good	0.147	0.354	0.145	0.046
Good	0.519	0.500	0.521	0.157
Regular	0.266	0.442	0.268	0.179
Poor	0.068	0.252	0.066	0.141

Note: (a) Simulated values are obtained using observed values of explanatory variables, with no updating of current endogenous behaviors in response to past behaviors and outcomes, and with 100 replications for the types probabilities. (b) Bootstrapped standard errors are calculated using 100 repetitions.

different assumptions about the exogeneity of subjective assessments on individual decisions and compare the contemporaneous marginal effects for the models. The benchmark is the preferred model derived from the optimization problem where risk aversion is endogenous to decisions and individual unobserved heterogeneity has a permanent and a time-varying component. The contemporaneous marginal effects (model with no updating of current endogenous behaviors in response to past behaviors and outcomes) are computed at the observed values for lagged decisions in holding optional savings and investment in the 5 alternatives of financial accounts, and for increases of one unit in work experience, age, and accumulated assets. Standard errors are calculated using predictions based on 100 draws of the estimated coefficients from the estimated variance-covariance matrix. In Section 8 I study the effect of the alternative models in the evaluation of retirement counter-factual policies.

The summary of the alternative versions of the model are presented in Table 9. I allow correlated unobserved heterogeneity to take three forms: no correlation through unobserved heterogeneity, correlation just through permanent unobserved heterogeneity, and correlation through both permanent and time-variant unobserved heterogeneity. An independent random error is always included. The specifications for the subjective assumptions are: jointly determined, exogenous to decisions and as explanatory variables, and predetermined (lagged subjective assessments) as explanatory variables. The objective is to disentangle the role that the estimation structure and the assumptions that we put on subjective assessments have on the marginal effects of interest. I focus on the effect on the marginal effect of lagged investment decisions on this period investment and savings decisions.

Model 1 is considered as a basic comparison framework of a model for explaining behaviors. The coefficients on this model are expected to be biased as assessments do not play a role on the investment decision equations. Model 2 and 3 allows different specifications for the correlation across equations and do not includes subjective assessments. THe objective is to test, when measures on individual risk aversion are not available, if correcting through individual unobserved heterogeneity will let us account for the estimation bias of omitting risk preferences. Model 5 corresponds to the preferred model developed in Section 5 which reconciles observed subjective assessments with a model of economic behavior over time. Model 4 assumes the same specification for assessments and does not allow for time-varying CUH. The purpose is to test whether the structure on the CUH plays a role after including subjective assessments into the estimation. Models 6-8 assumes that subjective assessments are exogenous to decisions and outcomes and are used as additional explanatory variables. These models are compared with Models 1-5 to analyze the impact of the modeling assumptions on assessments on the coefficients of interest. Models 9-10 assumes that predetermined assessments explain wealth decisions and the results are compared to models 6-8 to test the effect of assuming exogeneity of current period assessments.

Tables D1, D2, and D3 in Appendix D specified the set of equations estimated in

Table 9: Alternative Specifications of the Model

	Unobserved Heterogeneity (CUH)		Subjective
	Permanent	Time-Variant	Assessments
Model 1	No	No	Included: Not Jointly
Model 2	Yes	No	Not included
Model 3	Yes	Yes	Not included
Model 4	Yes	No	Included: Jointly
Model 5*	Yes	Yes	Included: Jointly
Model 6	No	No	Included: RHS
Model 7	Yes	No	Included: RHS
Model 8	Yes	Yes	Included: RHS
Model 9	Yes	No	Included: Jointly and Lagged RHS
Model 10	Yes	Yes	Included: Jointly and Lagged RHS

Note: (a) CUH refers to correlated individual unobserved heterogeneity. (b) Jointly = subjective assessments at time t are jointly estimated with the decisions and outcomes, allowing correlation across equations according to the structure assumed on permanent and time-variant unobserved heterogeneity. (c) RHS = subjective assessments at time t are assumed to be exogenous and included as explanatory variables for wealth-related decisions at time t. (d) Lagged RHS = subjective assessments at time $t-1$ are included as explanatory variables for wealth-related decisions at time t. (e) * Model 5 corresponds to the preferred model developed in Section 5.

each model, the correlation allowed across equations if any, the empirical specification of exogenous and endogenous explanatory variables, and the probability weights for the CUH components. Table D4 presents the complete point contemporaneous marginal effects of lagged investment decisions on this period investment and savings decisions and the test for differences between marginal effects for the 10 models with respect to the preferred. The parameters estimates for all equations and models and the information for the test for differences in means for every model are available from the author.

A simple model with no risk aversion and no correlated unobserved heterogeneity: We can expect the marginal effects of the model without correlated unobserved heterogeneity to be biased due to missing information. The significance of the marginal effects changes when estimating the model with and without CUH. Additionally, most of the marginal effects between the two models are statistical different. This suggests that accounting for correlation across outcomes adds information for identifying the coefficients of interest. Importantly, the preferred model allows us to recover marginal effects by accounting for unobserved characteristics and by including subjective assessments to better approximate this distribution. For accounts B, C, and D, the estimated coefficients on lagged investment in the accounts have a statistically significant effect in explaining this period investment decision. The same is observed for optional savings.

Incorporation of observed measures of risk aversion: Most of the marginal effects for lagged investment decisions are statistically different when comparing Models 1, 2, and 3. These models are estimated as if measures on elicited risk aversion and expected duration of life are not available. Accounting for permanent and time-variant CUH is important in these simply specifications. As well, most of the marginal effects are statistically different when comparing the preferred Model 5 with Models 1 and 4, which assume different structure for the CUH. This suggests that including subjective assessments and controlling for CUH (preferred model) reduces the estimation bias. This is expected as elicited risk aversion and expected duration of life is correlated with the decisions, affects the primitives of the model, and helps to approximate the distribution of the remaining unobserved heterogeneity. This results suggest that although the incorporation of risk aversion provides explanatory power, it requires using econometric methods that account for unobserved correlation through non-idiosyncratic avenues. The same role is found for the two alternative specifications for the subjective assessments (Model 8 compared with Model 6 and 7, and Model 10 compared with Model 9).

Exogeneity assumption: The assumptions on the exogeneity of subjective assessments should be an important consideration in modeling elicited risk aversion. From the conceptualization of risk aversion we know that it is a strong assumption to use elicited measures of risk aversion as exogenous explanatory variables. Empirically, as shown above, I find that observed risk aversion exhibit correlation with decisions and outcomes. The objective of these alternative specification is to test whether the estimates are different when we do not endogenously incorporate risk aversion into an empirical model. For this matters I compare Model 5, Model 8, and Model 10. (Contrary to the evidence and to the conceptualization of risk aversion), in Model 5 I assume that risk aversion is exogenous to an individual's decisions and I included as an additional right-hand side variable. Model 10 relaxes the exogeneity assumption by using predetermined elicited risk aversion as explanatory variables. I found that the marginal effects of policy variables are substantively different under these alternative specifications. When longitudinal measures of risk aversion are available the modeling assumption on Model 10 could be a solution to avoid the previous assumption (Model 5). Despite the fact that the estimate vary, one needs to be careful about the interpretation as the conceptualization of dynamic risk aversion does not suggest that predetermined (lagged) risk aversion directly affects this period decisions. It rather suggest that lagged risk aversion affected lagged decisions and those decisions affected this period decisions.

8 Policy Experiments

The dynamic decision model estimated allows me to model the sequential process by which individuals invest and accumulate wealth over time. In this section, I use the model developed in Section 5 as the data-generating process and simulate behaviors for 7 years. The simulated outcomes are used to update next period's endogenous explanatory variables. Each individual is replicated 100 times allowing draws from the unobserved heterogeneity distribution. Every individual enters the first period with their initial observed characteristics, except when otherwise specified. As a baseline for comparison, unless other specified, I use the simulated behaviors and outcomes of 100 replications of each individual, where the updating goes according to the estimated model. I use a yearly model, assuming that individuals save a 10 percent of their annual wage (except when other specified), and accumulating assets at the annualized mean-real rate of return of investment funds for the periods October of 2002 to December of 2009. For each simulation, I compute the percentage change in accumulated assets with respect to the baseline simulation at the end of the 7th period.

8.1 Introducing New Default Investment Paths

Table E5 presents the percent changes in accumulated assets at the end of the 7th year under different investment paths with respect to the default. I propose two alternative time-varying default investment schemes and I evaluate the wealth gains or loses of changing the current default. The schemes evaluated are: (1) *baseline* which is predicted by the model, (2) the *riskier default* adds one level of financial risk to the system default following the same trajectory (e.g., if the default suggest B, the riskier default uses A); (3) the *riskier gender-equated* is financially more aggressive for young individuals than the current system's default and equates conditions between men and women; (4) the *all* C in which every individual invests in account C every period (no multi-accounts); and (5) the *all* E in which every individual invests in account E every period (i.e., risk-free return). Table 10 presents in detail the investment strategy for each simulation and Table E5 presents the results.

Individuals are getting statistically the same retirement wealth than if they follow the system's default path. This is expected as the default is under a "opt out" regime since its implementation and it is consistent with the discussion with respect to the importance of default schemes (Madrian and Shea, 2001; Thaler, 2016). The riskier default and the riskier gender-equated strategies generate statistically significant increases in asset accumulation, with means of 8.07 and 8.39 percent respectively (1.11 and 1.16 percent per year, respectively). This is the effect of holding riskier financial positions through the life-cycle. These are substantial results since the wealth gain directly impacts individuals welfare through retirement income. When simulating the no multi-accounts option, at the mean, individuals would get an statistical significant increase in asset accumulation of 1.10 percent. These are interesting results. Individuals are on average investing in safe instruments and their returns are similar to what the default regime generates. This again recognizes the importance of adjusting the current default scheme. For the last simulation, I do not allow individuals to invest in risky financial investments. The percent loss of asset accumulation if everyone receives the risk-free return is significant and substantial (12.76 percent in 7 years, or 1.73 percent per year). The effect is bigger as one moves forward in the asset distribution. This result confirms the importance of accessing to financial instruments for retirement investments in retirement systems.

Table 10: Investments Paths For Retirement Asset Accumulation Simulations

Investment Path	Portfolio Composition		
	Investment	Men	Women
System's Default	Account A	—	—
	Account B	age$\leq$ 35	age$\leq$ 35
	Account C	$36 \leq$ age ≤ 55	$36 \leq$ age ≤ 50
	Account D	age$\geq$ 56	age$\geq$ 51
	Account E	—	—
Riskier Default	Account A	age$\leq$ 35	age$\leq$ 35
	Account B	$36 \leq$ age ≤ 55	$36 \leq$ age ≤ 50
	Account C	age$\geq$ 56	age$\geq$ 51
	Account D	—	—
	Account E	—	—
Riskier Gender-Equated	Account A	age$\leq$ 45	age$\leq$ 45
	Account B	$46 \leq$ age ≤ 55	$46 \leq$ age ≤ 55
	Account C	$56 \leq$ age ≤ 60	$56 \leq$ age ≤ 60
	Account D	age$\geq$ 61	age$\geq$ 61
	Account E	—	—
All C	Account A	—	—
(no multi-accounts)	Account B	—	—
	Account C	all ages	all ages
	Account D	—	—
	Account E	—	—
All E	Account A	—	—
(risk-free return)	Account B	—	—
	Account C	—	—
	Account D	—	—
	Account E	all ages	all ages

8.1.1 Individuals' Responses to Changes in the Default

In this section I estimate individuals' elasticities of response to changes in the default investment scheme. Individuals start with their observed initial conditions in period 1. In period 2, individuals in the treatment group are shocked with a new default for one period.

After this treatment (starting in period 3) individuals are free to chose the investment fund that better match their preferences and maximization problem. By letting the life cycle model to update behaviors, I then simulate for each period the proportion of individuals that stay in the default and the change in accumulated wealth.

Experiment 1: All individuals observed to be in the default are treated. In this experiment all individuals that are observed to be in the default in period 2 are treated. Table E6 presents the share of individuals that stay in the default investment scheme each period. From what is observed in the data we know that most individuals follow the system's default and they tend to stay in that path. However, more than a 60 percent of individuals opt-out from the default as they are moved to riskier funds. This is a relevant result as it provides evidence for the literature that studies inertia in financial investment. Some of the explanations are the switching costs for changing funds. Additionally, this research provides evidence that individuals may be optimally choosing to stay in the default as it may match their risk tolerance level.

Experiment 2: All individuals in the system are treated. I now estimate the same response to changes in the default when all individuals are treated. There response is not different to what is observed when only individuals that are observed to be in the default are in the treatment group. More individuals tend to stay in the current default, but the same share of individuals switch as they are forced to face higher financial risks. These responses are presented in Table E7.

8.2 Increasing Contribution Rates

Currently every worker is required to contribute 10 percent of her salary into their retirement account. Policy makers are discussing increasing the contributory rate to achieve better pension outcomes. Here I simulate four different scenarios in which individuals are required to contribute 11, 13, 15, and 20 percent of their wages and compute the gains in retirement wealth. Table E8 presents the change in accumulated assets under these policies. These are relevant results for policy makers as even small increases in the contribution rate generate important differences in asset accumulation. An increase of the contribution rate in 1 percent generates significant increases of 3.21 percent at the mean, with bigger effects in the first quartile. An increase in the mandatory contributions of 3 and 5 percent generate on average a statistically significant increase of 9.64 and 16.09 percent, respectively (1.32 and 2.15 percent per year, respectively).

Crowd-out effect: One of the concerns of increasing mandatory contribution rates is that individuals may actively switch their behavior as systems settings are modified (Chetty et al., 2014). For instance, when forced to contribute more, individuals may decide to invest in safer accounts or to hold less optional savings. To explore this prediction, I estimate changes in behavior in terms of financial funds selected by individuals, their optional savings decisions and they employment behavior. I find little crowd-out effect in investment accounts, optional savings behaviors, and employment outcomes as contribution rates are increased in 1, 3, 5 and 10 percent. I find that a small share of individuals, significantly, switch to invest in riskier accounts and to hold optional savings.

8.3 Part-Time Job Opportunities to Not-employed Women With Children

In this scenario every women with children who is not working, is simulated to hold a part-time job. An issue of relevance for policy makers is the wealth-loss of woman who exit the labor market after having children. This wealth-loss directly impacts their retirement income. On average, there is a statistically significant increase of 1.02 percent in asset accumulation for the total population including men and women over a 7 year period and a statistically significant increase of 9.54 percent for women in the treatment group. Table E10 presents the results.

8.4 The Effect of Family and Health Characteristics On Wealth Accumulation

I compare asset accumulation under different family and health characteristics to test the impact that they have in explaining retirement disparities. For family characteristics I compare three alternative scenarios: (1) every individual is married in the first period, compared with respect to observed initial values; (2) every individual is permanently married starting at period 2, compared with respect with being permanently single; and (3) every individual is first observed with an additional children, compared with respect to observed initial values. For health characteristics: (1) an initial improvement in the individual health status and (2) a permanent improvement in health status during the 7 years starting the first period. These results may be relevant for the design and evaluation of policy instruments that attempt to ameliorate retirement income disparities.[15]

Wealth accumulation increases by 0.64 and 2.66 percent when the individual is initially or permanently married, respectively. An additional child in the first period has a significant negative effect on asset accumulation for the lowest percentile of the asset distribution. Asset accumulation increases by 0.48 and 2.57 percent for an initial and permanent improvement in health status, respectively. Table E11 and E12 presents the results for the family and health characteristics simulation.

[15]For instance, the "bonus per child" (named *bono por hijo*) was introduced in Chile for providing extra savings for retirement to women with children.

8.5 Policy Simulations for Alternative Specifications of the Model

I compare these simulation results with the ones obtained using the alternative specifications of the model. In particular, for the data-generating process I use the model with no correlated unobserved heterogeneity and a model in which subjective assessments are included as exogenous explanatory variables without allowing CUH. At the mean, the simulations for the alternative default investment schemes are stable across models, while the difference for policies than increase contributory rates is substantially (see Tables E13 to E16). The same phenomenon is observed for policies that promote part-time jobs to currently not-employed women with children are substantially. Differences are also considerably for the effect of family characteristics.

9 Conclusion

I find that introducing slightly riskier default investment schemes may increase asset accumulation in more that 1 percent per year for the ones that stay in the default. I find that most individuals respond to these implementation of policies and they opt-out of the default. This is a relevant result for the literature that explores the inertia in investment decisions: individuals might be rationally sticking to their previous decisions according to their risk tolerance level. In future work, it would be interesting to evaluate whether individuals would react in the same way if they know the gains in wealth that riskier strategies may cause.

I also find that increasing contribution rates in 3 to 5 percent may increase retirement wealth in more than 1 or 2 percent per year, respectively. I find little evidence of crowd-out effects in investment decisions when individuals are forced to save more. Other policy experiments show that allowing women with children who are currently not employed to hold a part-time job, generate a mean significant increase by 10 percent in asset accumulation, over 7 years. It is found that other characteristics such as health status and family characteristics also have a significant effect on wealth accumulation.

This paper allows for extensions in order to analyze in greater detail retirement income. One extension consists of incorporating empirical measures that capture individual knowledge about the retirement system, information available in EPS. This knowledge should impact investments decisions and asset accumulation and it is likely correlated with other behaviors. The inclusion of this information may help to get neater effects. A second possible extension is to incorporate objective measures of expected duration of life from insurance markets and compare how close they are to the individuals' subjective measures. The objective measures are the ones being used for computing pensions and retirement incomes after an individual retires.

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Appendix

A Construction of Elicited Risk Aversion

Individuals are classified into a category of elicited risk aversion based on their answers to three hypothetical gambles. The questions asked in EPS follow.[16]

The first question asks:

> *Suppose that you are the only income earner in the household. You need to choose between two jobs. Which option do you prefer? (Option A) a job with a lifetime-stable and certain salary or (Option B) a job where you have the same chances of doubling your lifetime income or earning only 1/4 of your lifetime income.*

If the answer to the question is "option A", the interviewer continues.

> *Now what do you prefer? (Option A) a job with a lifetime-stable and certain salary or (Option B) a job where you have the same chances of doubling your lifetime income or earning only half of your lifetime income.*

The least risk averse categories comes directly from question 1. Elicited risk aversion equals 3 for individuals who selected "option B" in the first question. If the individual chooses "option A" in the first question, the index of risk aversion is constructed using the second question. Individuals who chose "option B" in the second question belong to the second category (elicited risk aversion of 2), and individuals who chose "option A" in the second question belong to the most risk averse category as individuals assigned to this category exhibited that they are not willing to accept any gamble (elicited risk aversion equals 1).

In the first wave, instead of "earning only 1/4 of your lifetime income" for the first question, the survey proposes "decreasing up to 75%." The second question is asked to every individual regardless of the previous answer. For constructing the risk attitude index, this category is created only for those individuals who answered "option A" in the first question

The change in the wording between the first wave and the subsequent ones potentially leads to measurement error bias. Although mathematically the questions in every wave are equivalent and therefore also the elicited measures of risk aversion, some argue that there could be a bias in the answer as individuals could have different aversions to loss (Kahneman and Tversky, 1979). This does not present an issue in this paper since the first

[16] The questions presented in this section where translated from their original wording in Spanish.

wave is only used to set the initial conditions and elicited risk aversion from the first wave does not enter the model. There is one specification of the estimated model in which initial elicited risk aversion (from the first wave) is jointly estimated with the system and it enters as an explanatory variable in the per-period decision in the second wave. This specification accounts among other potential sources of bias, for measurement error.

B Definition of variables

Employment category (e_t): 0 = non-employed, 1 = working part-time, and 2 = working full-time. Full-and part-time categories depend on the reported weekly hours typically worked in period t. More than 20 hours a week is considered full-time.

Occupation category (o_t): $\{1, 2, ..., 6\}$ based on a regrouping of the 1-digit ISCO classification in period t. 1 = Elementary occupations, 2 = Legislators, senior officials and managers, professionals, technicians and associate professionals. 3 = Clerical support workers. 4 = Service and sales workers. 5 = Skilled agricultural, forestry and fishery workers, craft and related trade workers. 6 = Plant and machine operators and assemblers.

Investment category (i_t): This is a set of five variables: $(i_t^A, i_t^B, i_t^C, i_t^D, i_t^E)$. Each of these variables take 1 of 2 values, $\{0, 1\}$, where 0 represents no investment in that account and 1 represents investment in that account. It is based on all the investment options that an individual affiliated with the retirement system in Chile has. Each variable reflects participation in each of the available accounts. Participation in account A is represented by i_t^A and it is the riskier account. participation in account B is represented by i_t^C, in C by i_t^C, in D by i_t^D, and in E, the safest investment, by i_t^E. The retirement system offers five accounts (A, B, C, D, E). An individual may chose to invest in one or in two accounts. The 5 different accounts where introduced in August of 2002. Before that there where 2 accounts (Account C, and Account E). Account E was introduced in May of 2000 and Account C was the only account since December of 1980 until the introduction of the new ones. When the individual did not report a fund, the legal default account, according to the individual's gender and age, was assigned.

Optional savings (s_t): Dichotomous variable that takes the value 1 if an individual reports to have any optional savings in period t and 0 otherwise.

Accumulated required assets (A_t^r): Amount of private savings accumulated in the retirement system. Computed from Administrative data from the Superintendence of Pensions, based on investing 10% of individual's wage every month, in the account of choice reported in EPS from 2002 onwards. When the individual did not report a fund, the legal default account, according to the individual's gender and age, was assigned. Between May of 2000 and August of 2002, when two accounts are available, investments are accumulated using the mean return of the two accounts. In thousand of dollars of 2009.

Work experience (E_t): Years of labor experience since 1980.

Wage (w_t): Hourly wage, measured by the reported after taxes (and legal deductions) monthly wage divided by 4 times the reported weekly hours typically worked. In 2009 dollars.

Marital status (m_t): Takes 1 if the individual reports to be married in period t and 0 otherwise.

Marital history (M_t): May include lagged marital state, number of marriages and cohabitations, and duration of most recent marriage state.

Changes in number of children (n_t): Takes 1 of 3 values which represent changes in the total number of children of 18 years-old or younger in period t (total number refers to children in and outside the household). 0 = no change in the number of children, -1 = decrease in the number of children, 1 = increase in the number of children.

Children history (N_t): May include birth last period, total number of children and ages of each child.

Number of medical visits (k_t): Reported number of medical visits of the individual in period t.

Health status (H_t): Takes 1 of 4 values, $\{1, ..., 4\}$ where 1 = very good, 2 = good, 3 = fair, 4 = poor.

Expected Duration of Life (T_t^e): Reported expected duration of life in years (reported expected age of death) at the beginning of period t.

Elicited Risk Aversion (r_t): Takes 1 of 3 values based on the answers to hypothetical gambles. 1 being the most risk averse category and 3 the least risk averse category. Individuals are classified into a category of elicited risk aversion based on their answers to three hypothetical gambles (2 questions, 2 scenarios each). At the beginning of period t.

Other characteristics (X_t):

Age: Age from administrative data.

Gender: Gender from administrative data.

Education: Education category. It takes four categories: Less than High School, High School, Technical College, and College and Some Post College.

Region of residence: Set of dummy variables based on the reported region of residence. Using the old Chilean administrative division which labels regions from

1 to 13 for 2002, 2004, and 2006. Using the new Chilean administrative division which labels region from 1 to 15 for 2009. Used for geographical classification for exclusion restrictions. When region of residence is missing, region of place of work if working is used.

Other variables:

Market characteristics (Z_t):

Z_t^E**:** It includes: Unemployment rate by region of residence.

Z_t^M**:** It includes: Number of marriages in a year per 1,000 people by region of residence, Mean college tuition in 2009 dollars by region of residence.

Z_t^N**:** It includes: Number of marriages in a year per 1,000 people by region of residence, Mean college tuition in 2009 dollars by region of residence.

Z_t^K**:** It includes: Number of beds available per 1,000 people of residence, Number of medical doctors available per 1,000 people by region of residence.

Z_t^H**:** It includes: Inches of rainfall in a year by region of residence.

Time trend: 0 in 2002, 2 in 2004, 4 in 2006, and 7 in 2009.

C Estimation Results

Table C1: Joint Significance Test for Market Level Exogenous Characteristics in Behavioral and Subjective Assessments Equations

Equation	All Market Level Exogenous Characteristics (jointly tested)	
Employment at t	***	p-value= 0.000
Occupation at t	***	p-value= 0.000
Investment in A at t	***	p-value= 0.000
Investment in B at t		p-value= 0.120
Investment in C at t	***	p-value= 0.000
Investment in D at t	*	p-value= 0.054
Investment in E at t	***	p-value= 0.000
Savings at t	***	p-value= 0.000
Duration of Life at t	***	p-value= 0.000
Elicited Risk Aversion at t	***	p-value= 0.000

* Significant at the 10 percent level.
** Significant at the 5 percent level.
*** Significant at the 1 percent level.

Table C2: Significance Test for Lagged Market Level Exogenous Characteristics in Behavioral and Subjective Assessments Equations

Behavior at t	Lagged Market Level Exogenous Characteristics (at $t-1$)					
	Unemployment Rate	Hospital Beds	Number of Doctors	Number of Marriages	Rainfall	College Tuition
Employment	**	Not Sig	***	***	*	Not Sig
Occupation	***	Not Sig	***	***	***	***
Investment in A	Not Sig	Not Sig	**	***	***	Not Sig
Investment in B	Not Sig	Not Sig	Not Sig	Not Sig	Not Sig	***
Investment in C	Not Sig	Not Sig	**	***	***	Not Sig
Investment in D	Not Sig	Not Sig	Not Sig	Not Sig	Not Sig	Not Sig
Investment in E	Not Sig	Not Sig	***	Not Sig	Not Sig	Not Sig
Savings at t	**	Not Sig	Not Sig	Not Sig	Not Sig	***
Duration of Life	**	Not Sig	Not Sig	Not Sig	Not Sig	Not Sig
Elicited Risk Aversion	**	**	***	**	Not Sig	**

* Significant at the 10 percent level.
** Significant at the 5 percent level.
*** Significant at the 1 percent level.

Table C3: Estimation Results: Multinomial Logit on Employment Status (relative to work full-time)

Variable	Part-Time		Not Working	
	Coeff.	St.Er.	Coeff.	St.Er.
Work Experience	-0.065	0.021***	-0.078	0.011***
Experience Squared	0.001	0.001	-0.001	0.000***
Lagged Investment in A	-0.164	0.340	-0.077	0.098
Lagged Investment in B	-0.089	0.293	-0.100	0.081
Lagged Investment in C	-0.093	0.311	-0.100	0.079
Lagged Investment in D	-0.043	0.325	0.051	0.094
Lagged Investment in E	0.265	0.483	-0.047	0.139
Lagged Assets	-0.042	0.006***	-0.002	0.002
Lagged Optional Savings	-0.148	0.097	-0.143	0.049***
Lagged Marital Status	-0.399	0.138***	-0.249	0.069***
Number of Children	-0.052	0.075	-0.078	0.035**
Interaction Female-Married	0.519	0.174***	0.698	0.092***
Interaction Female-Children	0.140	0.085*	0.233	0.043***
Health: Very good	-0.007	0.126	0.003	0.066
Health: Fair	0.083	0.099	0.328	0.050***
Health: Poor	0.455	0.172***	1.005	0.088***
Age	0.126	0.064**	0.162	0.029***
Age Squared	-0.044	0.033	-0.072	0.015***
Age Cubic	0.006	0.005	0.014	0.002***
Female	0.619	0.147***	0.602	0.077***
High School	-0.276	0.107***	-0.486	0.052***
Technical College	-0.221	0.168	-1.031	0.093***
College	-0.106	0.849	-1.581	0.347***
Unemployment rate	-0.017	0.025	0.033	0.012***
Number of hospital beds	0.201	0.201	-0.087	0.092
Number of doctors	1.174	0.512**	0.191	0.213
Number of marriages	0.166	0.212	0.272	0.082***
Inches of rainfall	0.010	0.004**	0.006	0.002***
College tuition	0.093	0.091	-0.063	0.045
Missing: Number of Children	0.189	0.871	-0.317	0.194
Missing: Education	-0.261	0.785	-0.176	0.317
Time trend	0.086	0.066	0.065	0.019***
Constant	-6.321	0.916***	-2.654	0.406***
Permanent Unob. Het.	-0.543	0.258**	-1.229	0.124***
Permanent Unob. Het.	0.395	0.154**	0.883	0.091***
Permanent Unob. Het.	-0.499	0.176***	-1.399	0.120***
Time-varying Unob. Het.	0.297	0.140**	0.028	0.064
Time-varying Unob. Het.	0.678	0.310**	1.637	0.409***
Time-varying Unob. Het.	0.312	0.177*	-0.146	0.095

* Significant at the 10 percent level.
** Significant at the 5 percent level.
*** Significant at the 1 percent level.

Table C4: Estimation Results: Multinomial Logit on Occupation Category (relative to Elementary occupation)

Variable	Prof and Tech		Clerical Support		Service and Sales		Agricul and Craft		Plant and Machine	
	Coeff.	St.Er.	Coeff.	St.Er.	Coeff.	St.Er.	Coeff.	St.Er.	Coeff.	St.Er.
Work Experience	-0.072	0.029**	-0.013	0.031	-0.058	0.024**	-0.003	0.029	-0.014	0.029
Experience Squared	0.001	0.001	0.000	0.001	0.001	0.001*	0.002	0.001**	0.000	0.001
Lagged Investment in A	-0.108	0.205	-0.078	0.200	0.000	0.209	-0.134	0.251	-0.161	0.191
Lagged Investment in B	-0.118	0.157	0.174	0.155	0.334	0.156**	-0.001	0.204	-0.083	0.150
Lagged Investment in C	-0.401	0.160**	-0.016	0.157	0.063	0.158	-0.347	0.206*	-0.245	0.147*
Lagged Investment in D	-0.241	0.220	-0.124	0.218	-0.149	0.215	-0.026	0.232	-0.196	0.196
Lagged Investment in E	-0.568	0.373	-0.310	0.386	0.348	0.316	-0.404	0.379	-0.237	0.275
Lagged Assets	0.051	0.004***	0.054	0.004***	0.041	0.004***	-0.004	0.006	0.028	0.004***
Lagged Optional Savings	0.317	0.085***	0.135	0.089	-0.007	0.089	0.118	0.104	-0.191	0.085**
Lagged Marital Status	0.401	0.174**	0.591	0.171***	0.137	0.177	0.068	0.120	0.192	0.133
Number of Children	-0.077	0.063	-0.162	0.068**	0.012	0.065	-0.111	0.053**	0.104	0.049**
Interaction Female-Married	0.134	0.259	-0.390	0.245	0.098	0.258	0.471	0.249*	-0.210	0.243
Interaction Female-Children	-0.030	0.086	0.083	0.089	-0.133	0.088	0.226	0.102**	-0.239	0.089***
Health: Very good	0.236	0.115**	0.042	0.119	0.121	0.119	0.077	0.135	-0.092	0.111
Health: Fair	-0.265	0.115**	-0.072	0.114	-0.078	0.110	0.079	0.102	-0.067	0.098
Health: Poor	-0.151	0.446	0.042	0.406	0.121	0.372	0.076	0.227	-0.171	0.305
Age	0.010	0.025	-0.080	0.026***	-0.054	0.023**	-0.046	0.026*	0.013	0.025
Age Squared	0.002	0.006	0.010	0.006	0.011	0.005**	0.006	0.006	-0.003	0.006
Female	-0.227	0.180	0.324	0.174*	0.752	0.184***	-1.039	0.202***	-2.275	0.175***
High School	2.656	0.115***	2.778	0.118***	1.558	0.109***	-0.503	0.121***	1.075	0.105***
Technical College	6.471	0.275***	4.494	0.291***	2.771	0.269***	-0.271	0.477	1.523	0.285***
College	8.027	0.602***	5.560	0.710***	3.578	0.732***	1.209	1.048	1.302	0.867

(continuation) Estimation Results: Multinomial Logit on Occupation Category (relative to Elementary occupation)

Variable	Prof and Tech		Clerical Support		Service and Sales		Agricul and Craft		Plant and Machine	
	Coeff.	St.Er.	Coeff.	St.Er.	Coeff.	St.Er.	Coeff.	St.Er.	Coeff.	St.Er.
Unemployment rate	0.027	0.025	0.021	0.027	-0.025	0.024	0.018	0.026	0.061	0.025**
Number of hospital beds	-0.136	0.206	-0.199	0.223	-0.275	0.202	-0.217	0.212	-0.058	0.195
Number of doctors	0.743	0.392*	0.446	0.467	1.156	0.412***	-1.558	0.536***	0.418	0.417
Number of marriages	0.063	0.173	0.423	0.183**	0.323	0.164**	-0.620	0.195***	0.253	0.161
Inches of rainfall	0.001	0.005	0.004	0.005	-0.003	0.004	0.027	0.005***	0.005	0.004
College tuition	0.204	0.089**	0.439	0.094***	0.006	0.089	-0.765	0.102***	0.164	0.090*
Missing: Number of Children	-0.084	0.308	-0.235	0.356	-0.586	0.356*	0.081	0.523	0.181	0.332
Missing: Education	4.686	0.538***	3.454	0.633***	2.151	0.613***	-11.427	1.186***	1.692	0.642***
Time trend	0.023	0.038	-0.041	0.038	-0.026	0.037	-0.006	0.048	0.038	0.035
Constant	-2.650	0.696***	-5.162	0.770***	-2.541	0.696***	4.692	0.814***	0.597	0.660
Permanent Unob. Het.	-1.440	0.193***	1.370	0.232***	-1.106	0.222***	-1.406	0.339***	-4.461	0.168***
Permanent Unob. Het.	-3.777	0.259***	-1.824	0.269***	-0.729	0.209***	0.755	0.248***	-4.240	0.144***
Permanent Unob. Het.	1.585	0.228***	1.103	0.307***	3.710	0.217***	-1.595	0.547***	-3.281	0.253***
Time-varying Unob. Het.	0.005	0.117	-0.037	0.118	-0.034	0.117	-0.004	0.131	-0.163	0.109
Time-varying Unob. Het.	1.171	0.330***	0.358	0.361	0.887	0.344***	0.453	0.501	0.311	0.327
Time-varying Unob. Het.	0.709	0.176***	0.477	0.180***	0.211	0.183	-0.294	0.227	-0.068	0.175

* Significant at the 10 percent level.
** Significant at the 5 percent level.
*** Significant at the 1 percent level.

Table C5: Estimation Results: Logit on Investment Decisions (relative to not invest in that account)

Variable	Logit 1 Account A		Logit 2 Account B		Logit 3 Account C		Logit 5 Account D		Logit 5 Account E	
	Coeff.	St.Er.	Coeff.	St.Er.	Coeff.	St.Er.	Coeff.	St.Er.	Coeff.	St.Er.
Work Experience	0.053	0.024**	0.001	0.012	-0.115	0.017***	0.068	0.014***	0.033	0.020*
Experience Squared	-0.002	0.001***	0.000	0.000	0.004	0.001***	-0.003	0.000***	-0.001	0.001
Lagged Investment in A	2.507	0.177***	0.020	0.104	-0.424	0.230**	-0.058	0.141	-0.465	0.202**
Lagged Investment in B	0.246	0.176	1.325	0.088***	-1.123	0.190***	0.103	0.117	0.013	0.150
Lagged Investment in C	0.559	0.194***	0.344	0.088***	0.889	0.175***	-0.168	0.111	0.039	0.137
Lagged Investment in D	-0.067	0.342	0.369	0.114***	-1.739	0.264***	1.210	0.130***	-0.100	0.162
Lagged Investment in E	0.672	0.481	0.570	0.158***	-0.110	0.354	-0.305	0.201	1.255	0.179***
Lagged Assets	0.015	0.003***	0.013	0.002***	0.002	0.002	-0.009	0.002***	0.007	0.003***
Lagged Optional Savings	0.365	0.112***	0.021	0.053	-0.106	0.092	-0.119	0.069*	-0.047	0.087
Lagged Marital Status	0.338	0.189*	0.068	0.074	-0.173	0.122	0.016	0.097	0.226	0.120*
Number of Children	-0.049	0.067	0.013	0.034	-0.275	0.054***	0.210	0.046***	-0.102	0.058*
Interaction Female-Married	-0.289	0.288	-0.139	0.102	0.165	0.174	0.040	0.130	-0.146	0.164
Interaction Female-Children	0.048	0.103	-0.002	0.046	0.655	0.078***	-0.426	0.063***	0.134	0.075*
Health: Very good	0.146	0.138	-0.168	0.066**	0.228	0.115*	-0.022	0.092	0.121	0.109
Health: Fair	-0.116	0.155	-0.074	0.062	-0.004	0.101	0.046	0.073	0.060	0.093
Health: Poor	0.239	0.312	-0.394	0.131***	-0.030	0.184	0.221	0.125*	-0.106	0.171
Age	0.311	0.033***	-0.347	0.013***	1.207	0.041***	-0.208	0.018	0.035	0.021*
Age Squared	-0.095	0.007***	0.053	0.003***	-0.318	0.010***	0.104	0.004	-0.006	0.005
Female	-0.314	0.238	0.062	0.084	-1.257	0.152***	1.085	0.110	0.167	0.139
High School	0.705	0.155***	0.261	0.057***	-0.239	0.096**	-0.104	0.072	0.139	0.094
Technical College	1.391	0.199***	0.562	0.086***	-0.798	0.170***	-0.402	0.116	-0.032	0.149
College	1.911	0.427***	0.717	0.210***	-1.079	0.642*	-0.647	0.362	-0.076	0.719

(continuation) Estimation Results: Logit on Investment Decisions (relative to not invest in that account)

Variable	Logit 1		Logit 2		Logit 3		Logit 5		Logit 5	
	Account A		Account B		Account C		Account D		Account E	
	Coeff.	St.Er.	Coeff.	St.Er.	Coeff.	St.Er.	Coeff.	St.Er.	Coeff.	St.Er.
Unemployment rate	0.079	0.027***	0.015	0.014	0.023	0.023	0.013	0.017	0.006	0.022
Number of hospital beds	-0.135	0.233	-0.004	0.110	0.278	0.197	-0.001	0.137	0.380	0.166**
Number of doctors	-0.052	0.496	-0.442	0.326	0.223	0.510	-0.562	0.347	-1.065	0.382***
Number of marriages	0.433	0.196**	-0.108	0.134	-0.427	0.162***	-0.111	0.133	-0.107	0.151
Inches of rainfall	0.015	0.004***	0.005	0.003*	-0.009	0.004***	-0.005	0.003	-0.002	0.004
College tuition	-0.517	0.107***	-0.107	0.054**	0.257	0.081***	-0.121	0.064	-0.421	0.078***
Missing: Number of Children	0.424	0.357	-0.132	0.155	-0.490	0.378	-0.053	0.261	-0.278	0.385
Missing: Education	0.892	0.815	-0.369	0.650	0.018	0.715	-0.872	0.538	0.354	0.711
Time trend	-0.268	0.041***	-0.217	0.023***	-0.024	0.038	-0.056	0.026	-0.116	0.034***
Constant	-7.674	0.924***	1.951	0.769**	-2.374	0.724***	-4.353	0.690	-4.342	0.703***
Permanent Unob. Het.	0.176	0.191	0.195	0.086**	-0.425	0.163***	-0.027	0.117	0.048	0.150
Permanent Unob. Het.	-0.500	0.198**	-0.258	0.081***	0.096	0.143	0.157	0.103	0.399	0.124***
Permanent Unob. Het.	0.111	0.181	-0.146	0.090	-0.198	0.162	0.126	0.114	0.068	0.151
Time-varying Unob. Het.	2.051	0.210***	2.987	0.087***	-7.760	0.290***	3.405	0.124	2.794	0.267***
Time-varying Unob. Het.	2.438	0.308***	1.872	0.175***	-5.302	0.357***	2.142	0.213	1.399	0.521***
Time-varying Unob. Het.	9.663	0.337***	1.132	0.198***	-21.710	27.740	-4.549	0.462	2.718	0.310***

* Significant at the 10 percent level.
** Significant at the 5 percent level.
*** Significant at the 1 percent level.

Table C6: Estimation Results: Logit on Savings Decision (relative to not invest in that account or relative to not hold optional savings)

Variable	Optional Savings	
	Coeff.	St.Er.
Work Experience	-0.007	0.009
Experience Squared	0.000	0.000
Lagged Investment in A	0.203	0.068***
Lagged Investment in B	0.116	0.056**
Lagged Investment in C	0.180	0.055***
Lagged Investment in D	0.138	0.071*
Lagged Investment in E	0.121	0.103
Lagged Assets	0.006	0.001***
Lagged Optional Savings	0.825	0.034***
Lagged Marital Status	0.074	0.050
Number of Children	0.001	0.023
Interaction Female-Married	-0.061	0.070
Interaction Female-Children	-0.042	0.032
Health: Very good	0.001	0.046
Health: Fair	-0.077	0.041*
Health: Poor	-0.201	0.081**
Age	-0.061	0.009***
Age Squared	0.008	0.002***
Female	0.131	0.057**
High School	0.294	0.038***
Technical College	0.529	0.057***
College	0.893	0.135***
Unemployment rate	-0.016	0.010*
Number of hospital beds	0.049	0.069
Number of doctors	0.152	0.150
Number of marriages	0.037	0.062
Inches of rainfall	0.005	0.002***
College tuition	0.043	0.034
Missing: Number of Children	-0.071	0.112
Missing: Education	0.665	0.197***
Time trend	0.008	0.014
Constant	-1.297	0.283***
Permanent Unob. Het.	-0.057	0.059
Permanent Unob. Het.	-0.356	0.052***
Permanent Unob. Het.	-0.091	0.056
Time-varying Unob. Het.	0.042	0.047
Time-varying Unob. Het.	-0.142	0.113
Time-varying Unob. Het.	0.172	0.066***

* Significant at the 10 percent level.
** Significant at the 5 percent level.
*** Significant at the 1 percent level.

Table C7: Estimation Results: Subjective Assessments

Variable	Elicited Risk Aversion (relative to Most)				Expected Duration of Life	
	Intermediate		Least			
	Coeff.	St.Er.	Coeff.	St.Er.	Coeff.	St.Er.
Work Experience	0.024	0.015*	-0.019	0.011*	0.018	0.013
Experience Squared	-0.001	0.001	0.001	0.000		
Lagged Investment in A	0.098	0.117	0.123	0.084	-0.158	0.503
Lagged Investment in B	-0.021	0.098	0.002	0.071	0.402	0.357
Lagged Investment in C	0.072	0.094	-0.028	0.072	0.338	0.361
Lagged Investment in D	0.052	0.117	-0.044	0.089	0.435	0.539
Lagged Investment in E	-0.390	0.200*	-0.026	0.124	0.284	0.685
Lagged Assets	0.001	0.002	-0.001	0.002	0.005	0.006
Lagged Optional Savings	0.029	0.060	-0.002	0.042	0.526	0.172***
Lagged Marital Status	0.058	0.080	-0.006	0.055	0.785	0.310**
Number of Children	0.001	0.038	0.016	0.026	0.145	0.108
Interaction Female-Married	0.046	0.114	0.062	0.081	-0.766	0.467
Interaction Female-Children	-0.036	0.054	-0.032	0.037	-0.195	0.151
Health: Very good	0.115	0.076	0.186	0.052***	1.253	0.220***
Health: Fair	0.024	0.067	0.046	0.048	-2.485	0.192***
Health: Poor	-0.176	0.129	-0.075	0.091	-5.987	0.402***
Age	-0.006	0.005	-0.010	0.003***	-0.120	0.042***
Age Squared					0.055	0.010***
Female	-0.090	0.096	-0.370	0.067***	-0.657	0.350*
High School	0.011	0.068	0.109	0.045**	0.513	0.191***
Technical College	0.175	0.102*	0.283	0.067***	1.662	0.353***
College	-0.111	0.613	0.267	0.185	1.735	0.693**
Unemployment rate	-0.022	0.016	-0.020	0.011*	-0.182	0.047***
Number of hospital beds	0.346	0.118***	0.202	0.091**	0.164	0.431
Number of doctors	0.519	0.295*	0.078	0.302	0.942	0.677
Number of marriages	-0.281	0.123**	-0.212	0.126*	-0.867	0.335***
Inches of rainfall	-0.015	0.003***	-0.007	0.002***	-0.030	0.009***
College tuition	0.077	0.057	0.104	0.045**	0.328	0.157**
Missing: Number of Children	-0.295	0.214	0.106	0.125	0.968	0.556*
Missing: Education	0.720	0.595	0.423	0.334	0.102	1.000
Time trend	0.045	0.024*	0.012	0.020	0.084	0.082
Constant	-2.805	0.626***	-0.895	0.741	52.038	1.014***
Permanent Unob. Het.	-0.152	0.100	-0.200	0.070***	1.337	0.437***
Permanent Unob. Het.	-0.059	0.085	-0.275	0.062***	0.060	0.367
Permanent Unob. Het.	0.081	0.096	0.154	0.064**	0.222	0.421
Time-varying Unob. Het.	0.135	0.079*	-0.049	0.054	0.135	0.223
Time-varying Unob. Het.	0.000	0.170	0.065	0.115	1.281	0.788
Time-varying Unob. Het.	0.321	0.108***	0.169	0.074**	0.276	0.474

* Significant at the 10 percent level.
** Significant at the 5 percent level.
*** Significant at the 1 percent level.

Table C8: Estimation Results: Wage equation

Variable	Wage (log)	
	Coeff.	St.Er.
Work Experience	0.006	0.003*
Experience Squared	0.000	0.000
Legislators	0.561	0.022***
Clerical	0.339	0.022***
Service and Sales	0.118	0.023***
Agricultural	-0.079	0.023***
Plant Operators	-0.042	0.021**
Health: Very good	0.060	0.013***
Health: Fair	-0.107	0.013***
Health: Poor	-0.196	0.026***
Number of Children	0.003	0.007
Lagged Marital Status	0.092	0.011***
Age	0.001	0.001
Female	-0.196	0.013***
High School	0.257	0.012***
Technical College	0.686	0.021***
College	0.875	0.040***
Missing: Occupation	0.139	0.044***
Unemployment rate	-0.003	0.003
Missing: Education	0.365	0.059***
Missing: Number of Children	0.000	0.031
Constant	0.572	0.039***
Permanent Unob. Het.	-0.263	0.028***
Permanent Unob. Het.	-0.411	0.024***
Permanent Unob. Het.	-0.314	0.029***
Time-varying Unob. Het.	0.039	0.014***
Time-varying Unob. Het.	-10.294	0.039***
Time-varying Unob. Het.	0.180	0.019***

* Significant at the 10 percent level.
** Significant at the 5 percent level.
*** Significant at the 1 percent level.

Table C9: Estimation Results: Marital Status, and Variation in Number of Children

Variable	Marital Status (relative to married)		Children variation (relative to no change)			
			Decrease		Increase	
	Coeff.	St.Er.	Coeff.	St.Er.	Coeff.	St.Er.
Duration of marriage	-0.025	0.004***	0.066	0.004***	-0.098	0.014***
Lagged Marital Status	-4.382	0.106***	-1.133	0.115***	0.798	0.195***
Number of Children	-0.258	0.035***	1.161	0.032***	0.691	0.065***
Interaction Female-Married	-0.097	0.106	-0.316	0.095***	-0.076	0.213
Interaction Female-Children	0.100	0.048**	0.177	0.041***	-0.035	0.098
Full-Time employed	-0.047	0.071	0.297	0.060***	0.554	0.194***
Part-Time employed	-0.029	0.153	0.254	0.127**	0.148	0.463
Age	0.063	0.028**	0.515	0.017***	-0.153	0.025***
Age Squared	-0.037	0.017**	-0.113	0.004***	0.006	0.009
Age Cubic	0.006	0.003**				
Female	0.357	0.090***	0.263	0.098***	0.005	0.211
High School	0.016	0.060	-0.078	0.049	0.202	0.118*
Technical College	-0.079	0.092	-0.131	0.080*	0.068	0.187
College	-0.452	0.159***	-0.075	0.127	0.037	0.583
Number of marriages	-0.317	0.085***				
College tuition			-0.001	0.039	-0.217	0.087***
Missing: Marriage Duration	-0.082	0.441	1.595	0.443***	-0.026	0.988
Missing: Number of Children	-0.641	0.158***				
Missing: Education	-0.374	0.553	0.114	0.426	0.941	0.893
Constant	3.257	0.388***	-8.618	0.261***	-2.371	0.463***
Permanent Unob. Het.	0.184	0.093**	-0.107	0.079	-0.053	0.200
Permanent Unob. Het.	0.016	0.078	0.041	0.064	-0.112	0.206
Permanent Unob. Het.	0.045	0.093	-0.099	0.076	-0.183	0.198
Time-varying Unob. Het.	0.015	0.089	-0.011	0.079	-0.199	0.212
Time-varying Unob. Het.	-1.795	0.352***	0.866	0.319***	3.972	0.439***
Time-varying Unob. Het.	-0.043	0.130	0.254	0.105**	-0.072	0.271

* Significant at the 10 percent level.
** Significant at the 5 percent level.
*** Significant at the 1 percent level.

Table C10: Estimation Results: Health status and Medical Care Consumption

Variable	Health Status (relative to very good)						Medical Consumption	
	Good		Regular		Poor			
	Coeff.	St.Er.	Coeff.	St.Er.	Coeff.	St.Er.	Coeff.	St.Er.
Health: Very good	-0.528	0.060***	-0.789	0.084***	-0.889	0.203***	-1.047	0.246***
Health: Fair	0.289	0.081***	1.526	0.084***	1.845	0.122***	4.887	0.207***
Health: Poor	0.678	0.329**	2.353	0.322***	4.108	0.333***	15.679	0.424***
Number of Medical Visits	0.010	0.003***	0.022	0.004***	0.027	0.004***		
Work Experience	0.003	0.005	-0.004	0.006	-0.005	0.008		
Legislators	-0.296	0.142**	-0.442	0.175**	-0.288	0.330		
Clerical	-0.025	0.143	0.007	0.172	0.282	0.352		
Service and Sales	0.011	0.156	-0.090	0.187	0.084	0.322		
Agricultural	-0.165	0.178	-0.244	0.204	-0.191	0.342		
Plant Operators	0.062	0.141	-0.018	0.163	0.208	0.264		
Age	0.034	0.014**	0.084	0.017***	0.163	0.032***	-0.048	0.040
Age Squared	-0.004	0.003	-0.009	0.004**	-0.021	0.007***	0.019	0.009**
Female	0.170	0.064***	0.379	0.075***	0.618	0.115***	4.149	0.177***
High School	-0.098	0.066	-0.537	0.077***	-0.693	0.121***	1.370	0.198***
Technical College	-0.214	0.105**	-0.924	0.139***	-1.301	0.274***	2.881	0.378***
College	-0.489	0.253*	-1.445	0.520***	-1.873	0.826**	3.974	0.943***
Inches of rainfall	0.001	0.002	0.006	0.002**	0.003	0.004		
Number of hospital beds							-0.038	0.299
Number of doctors							0.550	0.671
Missing: Occupation	-0.096	0.327	-0.341	0.438	-0.405	0.691		
Missing: Education	-0.201	0.492	-0.657	0.712	-0.766	0.922	2.248	1.000**
Not employed	0.123	0.333	0.254	0.448	0.713	0.686		
Constant	0.869	0.200***	-0.946	0.244***	-4.435	0.508***	1.537	0.882*
Permanent Unob. Het.	-0.079	0.139	-0.130	0.168	-0.220	0.294	-0.302	0.413
Permanent Unob. Het.	0.072	0.118	0.409	0.136***	0.749	0.206***	-0.201	0.480
Permanent Unob. Het.	0.075	0.137	0.093	0.169	0.296	0.288	-0.657	0.434
Time-varying Unob. Het.	-0.068	0.075	-0.055	0.090	0.009	0.150	0.215	0.340
Time-varying Unob. Het.	1.084	1.442	1.105	1.442	1.624	1.670	-1.633	0.699**
Time-varying Unob. Het.	-0.095	0.103	-0.273	0.126**	-0.325	0.210	0.947	0.598

* Significant at the 10 percent level.
** Significant at the 5 percent level.
*** Significant at the 1 percent level.

Table C11: Pearson's Correlation Coefficient of Unobserved Heterogeneity Between Subjective Assessments and Outcomes

Outcome	Risk Aversion				Expected Duration of Life	
	Intermediate		Least			
	Perm.	Time-Var.	Perm.	Time-Var.	Perm.	Time-Var.
Employment (relative to full-time worker)						
Part-Time Worker	-0.021	0.681	-0.558	-0.014	-0.689	0.765
Not Working	-0.092	-0.236	-0.597	0.027	-0.643	0.867
Occupation (relative to elementary occupation)						
Legis., Prof., Tech., other	0.626	0.435	0.967	0.794	0.022	0.815
Clerical support workers	0.058	0.527	0.623	0.948	0.626	0.543
Service and sales workers	0.842	0.081	0.829	0.587	-0.244	0.903
Agricultural, craft and trade	-0.069	-0.638	-0.558	-0.505	-0.664	0.425
Operators and assemblers	0.506	-0.589	0.612	0.479	-0.474	0.339
Investment Decision						
Account A (Riskier)	0.114	0.917	0.682	0.680	0.526	0.407
Account B	-0.389	0.610	0.225	-0.465	0.728	0.321
Account C	0.343	-0.984	-0.210	-0.465	-0.909	-0.399
Account D	0.269	-0.067	-0.285	-0.912	-0.492	0.069
Account E (Safest)	-0.238	0.838	-0.749	-0.169	-0.279	0.351
Saving Outcomes						
Optional Savings	0.222	0.884	0.726	0.432	0.255	-0.151
Elicited Risk Aversion (relative to most risk averse)						
Intermediate Risk Averse	1.000	1.000	0.804	0.342	-0.699	0.268
Least Risk Averse	0.804	0.342	1.000	1.000	-0.213	0.300
Marital status						
Married	-0.675	0.134	-0.209	-0.254	0.997	-0.915
Variation in Number of Children (relative to no change)						
Decrease	0.038	0.177	-0.467	0.609	-0.740	0.920
Increase	-0.263	-0.240	0.012	0.268	0.041	0.859
Health Status (relative to very good)						
Good	0.587	-0.336	0.013	0.188	-0.762	0.812
Regular	0.071	-0.478	-0.529	-0.064	-0.564	0.713
Poor	0.139	-0.369	-0.459	-0.111	-0.561	0.776
Expected Duration of Life	-0.699	0.268	-0.213	0.300	1.000	1.000
Log Wage	0.270	0.179	0.573	-0.181	-0.146	-0.899
Medical Consumption	-0.236	0.729	-0.277	0.278	-0.314	-0.440

Note: (a) Permanent unobserved heterogeneity also enters the initial condition equations.

D Alternative Specifications of the Model

Table D1: System of Equations Estimated for each Model and Unobserved Heterogeneity Allowed

Equation	Model									
	1	2	3	4	5*	6	7	8	9	10
Employment (e_t)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Occupation (o_t)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Savings (s_t)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Investment in A (i_t^A)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Investment in B (i_t^B)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Investment in C (i_t^C)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Investment in D (i_t^D)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Investment in E (i_t^E)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Expected Duration (T_t^E)	✓	x	x	✓	✓	x	x	x	✓	✓
Elicited Risk Aversion (r_t)	✓	x	x	✓	✓	x	x	x	✓	✓
Log Wage (w_t)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Marital status (m_{t+1})	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Change in # children (n_{t+1})	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Medical consumption (k_t)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Health status (H_{t+1})	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Initial conditions										
Employment	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Work experience	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Occupation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Savings	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Marital status	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Number of children	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Health status	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Elicited risk aversion	x	x	x	x	x	x	x	x	✓	✓
Expected duration	x	x	x	x	x	x	x	x	✓	✓
Correlated Unobserved Heterogeneity										
Permanent	NO	YES	YES	YES	YES	NO	YES	YES	YES	YES
(mass points)	–	(5)	(3)	(6)	(4)	–	(6)	(2)	(3)	(4)
Time-Varying	NO	NO	YES	NO	YES	NO	NO	YES	NO	YES
(mass points)	–	–	(3)	–	(4)	–	–	(3)	–	(3)

Note: (a) Model 5* corresponds to the preferred model developed in Section 5. (b) A check-mark (✓) means that the equation is included in the system estimated, a cross (x) that it does not. (c) When neither components of unobserved heterogeneity are allowed, each equation is estimated independently of the rest (no correlation). (d) Initial conditions equations are correlated solely through permanent unobserved heterogeneity, when corresponds. (e) The number of mass points are selected according to the sufficient number of points for capturing the distribution of permanent and time-varying individual heterogeneity.

Table D2: Endogenous and Predetermined Explanatory Variables in each estimated model

Equation	Model 1-3		Model 4-5		Model 6-8		Model 9-10	
	Predetermined	Exogenous	Predetermined	Exogenous	Predetermined	Exogenous	Predetermined	Exogenous
Wealth-related decisions								
at period t								
Employment (e_t)	$\tilde{\Omega}_t$	X_t, Z_t	$\tilde{\Omega}_t$	X_t, Z_t	$\tilde{\Omega}_t$	X_t, Z_t, r_t, T^e_t	$\tilde{\Omega}_t$, r_{t-1}, T^e_{t-1}	X_t, Z_t
Occupation (o_t)	$\tilde{\Omega}_t$	X_t, Z_t	$\tilde{\Omega}_t$	X_t, Z_t	$\tilde{\Omega}_t$	X_t, Z_t, r_t, T^e_t	$\tilde{\Omega}_t$, r_{t-1}, T^e_{t-1}	X_t, Z_t
Savings (s_t)	$\tilde{\Omega}_t$	X_t, Z_t	$\tilde{\Omega}_t$	X_t, Z_t	$\tilde{\Omega}_t$	X_t, Z_t, r_t, T^e_t	$\tilde{\Omega}_t$, r_{t-1}, T^e_{t-1}	X_t, Z_t
Investment in A (i^A_t)	$\tilde{\Omega}_t$	X_t, Z_t	$\tilde{\Omega}_t$	X_t, Z_t	$\tilde{\Omega}_t$	X_t, Z_t, r_t, T^e_t	$\tilde{\Omega}_t$, r_{t-1}, T^e_{t-1}	X_t, Z_t
Investment in B (i^B_t)	$\tilde{\Omega}_t$	X_t, Z_t	$\tilde{\Omega}_t$	X_t, Z_t	$\tilde{\Omega}_t$	X_t, Z_t, r_t, T^e_t	$\tilde{\Omega}_t$, r_{t-1}, T^e_{t-1}	X_t, Z_t
Investment in C (i^C_t)	$\tilde{\Omega}_t$	X_t, Z_t	$\tilde{\Omega}_t$	X_t, Z_t	$\tilde{\Omega}_t$	X_t, Z_t, r_t, T^e_t	$\tilde{\Omega}_t$, r_{t-1}, T^e_{t-1}	X_t, Z_t
Investment in D (i^D_t)	$\tilde{\Omega}_t$	X_t, Z_t	$\tilde{\Omega}_t$	X_t, Z_t	$\tilde{\Omega}_t$	X_t, Z_t, r_t, T^e_t	$\tilde{\Omega}_t$, r_{t-1}, T^e_{t-1}	X_t, Z_t
Investment in E (i^E_t)	$\tilde{\Omega}_t$	X_t, Z_t	$\tilde{\Omega}_t$	X_t, Z_t	$\tilde{\Omega}_t$	X_t, Z_t, r_t, T^e_t	$\tilde{\Omega}_t$, r_{t-1}, T^e_{t-1}	X_t, Z_t
Subjective assessments								
at period t								
Expected Duration (T^E_t)	–	–	$\tilde{\Omega}_t$	X_t, Z_t	–	–	$\tilde{\Omega}_t$, r_{t-1}, T^e_{t-1}	X_t, Z_t
Elicited Risk Aversion (r_t)	–	–	$\tilde{\Omega}_t$	X_t, Z_t	–	–	$\tilde{\Omega}_t$, r_{t-1}, T^e_{t-1}	X_t, Z_t
Stochastic outcomes								
at period t								
Log Wage ($w_t \vert o_t, e_t$)	E_t, H_t	X_t, Z^E_t	E_t, ot, H_t	X_t, Z^E_t	E_t, ot, H_t	X_t, Z^E_t	E_t, ot, H_t	X_t, Z^E_t
Medical consumption (k_t)	H_t	X_t, Z^K_t	H_t	X_t, Z^K_t	H_t	X_t, Z^K_t, r_t, T^e_t	H_t, r_{t-1}, T^e_{t-1}	X_t, Z^K_t
Stochastic outcomes								
at the end of period t								
Marital status (m_{t+1})	e_t, M_t, N_t	X_t, Z^M_t	e_t, M_t, N_t	X_t, Z^M_t	e_t, M_t, N_t	X_t, Z^M_t, r_t, T^e_t	e_t, M_t, N_t	X_t, Z^M_t
Change in # children (n_{t+1})	e_t, M_t, N_t	X_t, Z^N_t	e_t, M_t, N_t	X_t, Z^N_t	e_t, M_t, N_t	X_t, Z^N_t, r_t, T^e_t	e_t, M_t, N_t	X_t, Z^N_t
Health status (H_{t+1})	e_t, o_t, k_t, E_t, H_t	X_t, Z^H_t	e_t, o_t, k_t, E_t, H_t	X_t, Z^H_t	e_t, o_t, k_t, E_t, H_t	X_t, Z^H_t, r_t, T^e_t	e_t, o_t, k_t, E_t, H_t	X_t, Z^H_t
Initial conditions								
(at period $t = 1$)								
Employment	–	X_1, Z_1	–	X_1, Z_1	–	X_1, Z_1	–	X_1, Z_1
Work experience	–	X_1, Z_1	–	X_1, Z_1	–	X_1, Z_1	–	X_1, Z_1
Occupation	–	X_1, Z_1	–	X_1, Z_1	–	X_1, Z_1	–	X_1, Z_1
Savings	–	X_1, Z_1	–	X_1, Z_1	–	X_1, Z_1	–	X_1, Z_1
Marital status	–	X_1, Z^M_1	–	X_1, Z^M_1	–	X_1, Z^M_1	–	X_1, Z^M_1
Number of children	–	X_1, Z^N_1	–	X_1, Z^N_1	–	X_1, Z^N_1	–	X_1, Z^N_1
Health status	–	X_1, Z^K_1, Z^H_1	–	X_1, Z^K_1, Z^H_1	–	X_1, Z^K_1, Z^H_1	–	X_1, Z^K_1, Z^H_1
Elicited risk aversion	–	–	–	–	–	–	–	X_1, Z_1
Expected duration	–	–	–	–	–	–	–	X_1, Z_1

Note: (a) Model 5 corresponds to the preferred model developed in Section 5. (b) Unobserved heterogeneity is not specified in this table. (c) Models 9 and 10 include the measure of elicited risk aversion from the first wave of EPS (2002) for modeling the initial condition equation and as explanatory variables for the first-period behaviors. (d) The vector $\tilde{\Omega}_t = (i_{t-1},\ s_{t-1},\ A^r_t,\ E_t,\ M_t,\ N_t,\ H_t)$. (e) The vector $Z_t = (Z^E_t, Z^M_t, Z^N_t, Z^K_t, Z^H_t)$.

Table D3: Unobserved Heterogeneity Support Points and Probability Weights

Model	Permanent CUH		Time-Variant CUH	
	Points of Support	Probability Weights	Points of Support	Probability Weights
Model 1	–	–	–	–
Model 2	1	0.1280	–	–
	2	0.2077	–	–
	3	0.1883	–	–
	4	0.2791	–	–
	5	0.1970	–	–
Model 3	1	0.4854	1	0.0239
	2	0.4392	2	0.4738
	3	0.0754	3	0.5023
Model 4	1	0.0686	–	–
	2	0.4253	–	–
	3	0.0000	–	–
	4	0.3026	–	–
	5	0.1707	–	–
	6	0.0328	–	–
Model 5	1	0.3210	1	0.4218
	2	0.1809	2	0.4741
	3	0.3472	3	0.0249
	4	0.1509	4	0.0793
Model 6	–	–	–	–
Model 7	1	0.1453	–	–
	2	0.3081	–	–
	3	0.0297	–	–
	4	0.1491	–	–
	5	0.0320	–	–
	6	0.3358	–	–
Model 8	1	0.5158	1	0.4819
	2	0.4842	2	0.4440
	–	–	3	0.0742
Model 9	1	0.4735	–	–
	2	0.4899	–	–
	3	0.0366	–	–
Model 10	1	0.4474	1	0.0173
	2	0.1811	2	0.4055
	3	0.3360	3	0.5772
	4	0.0355	–	–

Note: (a) Model 5 corresponds to the preferred model.

Table D4: Comparison of Contemporaneous Marginal Effects of Lagged Investment decisions under Different Models (%) (continues)

	Model 1	Model 2	Model 3	Model 4	Model 5*	Model 6	Model 7	Model 8	Model 9	Model 10
Lagged Investments in Account A										
Investment in A	19.40^{*a}	16.20^{***a}	17.05^{***a}	17.35^{***a}	13.82	19.46^{*a}	19.72^{**a}	14.02^{**a}	18.63^{***a}	18.66^{*a}
Investment in B	0.03^{a}	-1.32^{a}	-0.99^{a}	-0.32^{a}	0.20	0.04^{a}	0.12^{a}	-0.12^{a}	-0.04^{a}	0.02^{a}
Investment in C	-6.85^{***a}	-3.14^{**a}	-4.03^{***a}	-5.94^{***a}	-3.07***	-6.85^{a}	-6.72^{***a}	-3.02^{***a}	-6.41^{***a}	-6.42^{***a}
Investment in D	-1.03^{a}	-1.93^{a}	-1.72^{a}	-0.98^{a}	-0.38	-1.02^{a}	-1.03^{a}	-0.83^{a}	-1.00^{a}	-0.96^{a}
Investment in E	-1.18^{a}	-1.38	-1.51^{a}	-1.15^{a}	-1.38	-1.15^{a}	-1.10^{a}	-1.35	-1.20^{a}	-1.19^{a}
Savings	4.22^{a}	4.00^{**a}	4.10^{***a}	4.10^{***a}	3.79**	4.30^{a}	4.32^{**a}	4.08^{***a}	4.03^{***a}	3.94^{***a}
Lagged Investments in Account B										
Investment in A	1.51^{a}	0.58^{a}	1.55^{a}	1.28^{a}	0.76	1.56^{a}	1.65^{a}	-0.01^{a}	1.35^{a}	1.42^{a}
Investment in B	14.28^{*a}	12.15^{***a}	14.89^{***a}	14.09^{***a}	15.84***	14.32^{**a}	14.06^{**a}	15.58^{***a}	14.23^{***a}	14.24^{***a}
Investment in C	-4.75^{**a}	-0.67^{a}	-7.06^{***a}	-4.46^{***a}	-7.98***	-4.78^{a}	-4.75^{***a}	-6.53^{***a}	-4.50^{***a}	-4.52^{***a}
Investment in D	-0.37^{a}	-1.40^{a}	-0.46^{a}	-0.34^{a}	0.72	-0.40^{a}	-0.37^{a}	0.06^{a}	-0.32 ^{a}	-0.32^{a}
Investment in E	0.10^{a}	-0.30^{a}	-0.24^{a}	0.09^{a}	0.05	0.09	0.05	-0.13^{a}	0.05	0.04
Savings	2.33^{a}	2.36^{*a}	2.27^{*a}	2.36^{a}	2.12	2.36^{a}	2.49^{**a}	2.29^{*a}	2.22^{*a}	2.29^{a}
Lagged Investments in Account C										
Investment in A	2.94^{a}	4.70^{*a}	3.22^{a}	3.10^{*a}	1.77	3.06^{a}	3.23^{a}	1.61^{a}	2.89^{a}	2.86^{a}
Investment in B	2.11^{a}	4.63^{**a}	2.95^{a}	2.16^{a}	3.59*	2.16^{a}	2.21^{a}	3.56^{**c}	2.09^{a}	2.07^{a}
Investment in C	7.37^{***a}	1.81^{a}	10.06^{***a}	7.20^{***a}	6.62***	7.27^{a}	7.15^{**a}	9.13^{***a}	7.50^{***a}	7.59^{***a}
Investment in D	-1.94^{a}	-0.24^{a}	-2.29^{*a}	-1.99^{a}	-1.13	-2.00^{a}	-2.02^{a}	-1.67^{*a}	-1.95^{a}	-1.92^{a}
Investment in E	0.18^{a}	0.74^{a}	0.01^{a}	0.18^{a}	0.14	0.22^{a}	0.21^{a}	0.18^{b}	0.13	0.11
Savings	3.28	3.41^{*a}	3.36^{*a}	3.34^{*a}	3.28**	3.49^{a}	3.57^{**a}	3.49^{**a}	3.22^{*a}	3.29
Lagged Investments in Account D										
Investment in A	0.81^{a}	0.02^{a}	1.62^{a}	0.83^{a}	-0.19	0.99^{a}	1.06^{a}	-4.09^{a}	0.81^{a}	0.80^{a}
Investment in B	1.90^{a}	0.60^{a}	3.00^{a}	1.90^{a}	3.97	1.97 ^{a}	2.13 ^{a}	4.75^{**a}	1.85^{a}	1.85^{a}
Investment in C	-7.05^{***a}	-3.12^{a}	-9.40^{***a}	-6.98^{***a}	-11.84***	-7.20^{a}	-7.26^{**a}	-11.33^{***a}	-6.90^{***a}	-6.90^{***a}
Investment in D	5.75^{*a}	4.06^{a}	7.83^{***a}	5.71^{**a}	10.06***	5.69^{a}	5.63^{a}	11.18^{***a}	5.73^{**a}	5.72^{**a}
Investment in E	-0.54^{a}	-0.85^{a}	-0.41^{a}	-0.54^{a}	-0.34	-0.49^{a}	-0.45^{a}	-0.14^{a}	-0.59^{a}	-0.58^{a}
Savings	2.51	2.59^{c}	2.58	2.56	2.55	2.75^{a}	2.81^{*a}	2.74^{a}	2.46^{a}	2.49^{a}
Lagged Investments in Account E										
Investment in A	4.42^{a}	3.45^{a}	4.90^{*a}	4.59^{*a}	2.37	4.57^{a}	4.73^{a}	2.45^{a}	4.24^{a}	4.38^{a}
Investment in B	5.02^{a}	3.49^{a}	5.46^{*a}	5.07^{a}	6.35*	5.10^{a}	5.01^{**a}	6.11^{**a}	4.96^{**a}	4.92^{a}
Investment in C	1.02^{a}	3.65^{*a}	0.61^{a}	0.88^{a}	-0.80	0.91^{a}	0.93^{a}	0.03^{a}	1.21^{a}	1.15^{a}
Investment in D	-3.50^{a}	-4.30^{*a}	-4.16^{**a}	-3.53^{*a}	-1.97	-3.54^{a}	-3.55^{a}	-2.65^{*a}	-3.49^{*a}	-3.44^{a}
Investment in E	7.33^{a}	6.24^{a}	6.97^{a}	7.23	7.14	7.46^{a}	6.97^{b}	7.54^{a}	7.28^{c}	7.21
Savings	1.87^{a}	2.09^{a}	2.01^{a}	2.01^{a}	2.25	2.04^{a}	2.23**	2.00^{a}	1.75^{a}	1.95^{a}

(continuation) Comparison of Contemporaneous Marginal Effects of Lagged Investment decisions under Different Models (%)

	Model 1	Model 2	Model 3	Model 4	Model 5*	Model 6	Model 7	Model 8	Model 9	Model 10
Lagged Savings										
Investment in A	1.44^{a}	1.26^{*a}	1.20^{a}	1.18^{a}	1.09	1.35^{a}	1.29^{a}	0.98^{a}	1.36^{**a}	1.23^{a}
Investment in B	0.36^{a}	0.47^{a}	0.10^{a}	0.31^{a}	0.22	0.35^{a}	0.32^{a}	0.53^{a}	0.32^{a}	0.35^{a}
Investment in C	-0.48^{a}	-0.73^{a}	-0.01^{a}	-0.29^{a}	-0.76***	-0.41^{a}	-0.33^{a}	-0.56^{a}	-0.44^{a}	-0.33^{a}
Investment in D	-0.86^{a}	-0.52^{a}	-0.90^{*a}	-0.86^{a}	-0.80*	-0.87^{a}	-0.87^{a}	-0.92^{**a}	-0.86^{a}	-0.82^{b}
Investment in E	-0.24^{a}	-0.15	-0.32^{a}	-0.22^{a}	-0.16	-0.26^{a}	-0.23^{a}	-0.31^{a}	-0.23^{a}	-0.21^{a}
Savings	16.79^{***a}	16.50^{***a}	16.68^{***a}	16.61^{***a}	16.24***	16.65^{***a}	16.76^{***a}	16.63^{***a}	16.65^{***a}	16.55^{***a}
Work Experience										
Investment in A	-0.46^{a}	-0.56^{**a}	-0.35^{**a}	-0.43^{a}	-0.31	-0.47^{a}	-0.49^{a}	-0.43^{a}	-0.46^{**a}	-0.44^{a}
Investment in B	0.21^{a}	0.11^{a}	0.34^{a}	0.20^{a}	0.10	0.21^{a}	0.19^{a}	0.22^{a}	0.20^{a}	0.20^{*a}
Investment in C	1.31^{***a}	1.59^{***a}	1.46^{***a}	1.34^{***a}	1.44***	1.32^{**a}	1.34^{***a}	1.47^{***a}	1.32^{***a}	1.32^{***a}
Investment in D	-0.47^{**a}	-0.61^{**a}	-0.67^{***a}	-0.48^{***a}	-0.86***	-0.49^{aa}	-0.50^{**a}	-0.79^{***a}	-0.49^{**a}	-0.48^{***a}
Investment in E	-0.01	-0.05^{a}	-0.02	-0.01	-0.02	-0.01^{b}	-0.01^{a}	-0.02^{a}	-0.02	-0.01
Savings	0.44^{a}	0.42^{b}	0.44^{*a}	0.45^{***a}	0.41	0.45^{a}	0.46^{**a}	0.45^{*a}	0.45^{a}	0.45^{a}
Age										
Investment in A	-0.29^{a}	-0.27^{**a}	-0.17^{a}	-0.24^{a}	-0.10	-0.29^{a}	-0.28^{a}	0.01^{a}	-0.26^{**a}	-0.27^{a}
Investment in B	-2.05^{***a}	-2.07^{***a}	-1.82^{***a}	-2.04^{***a}	-1.72***	-2.04^{***a}	-1.93^{***a}	-1.81^{***a}	-2.06^{***a}	-2.04^{***a}
Investment in C	0.07^{a}	0.07^{a}	-0.19^{a}	0.04^{a}	-0.48***	0.05^{a}	0.02^{a}	-0.39^{***a}	0.05^{a}	0.05^{a}
Investment in D	2.11^{***a}	2.15^{***a}	2.03^{***a}	2.11^{***a}	2.02***	2.10^{***a}	2.10^{***a}	1.97^{***a}	2.11^{***a}	2.11^{***a}
Investment in E	0.04^{a}	0.03^{a}	0.03^{a}	0.04^{a}	0.03	0.04^{a}	0.05^{a}	0.04^{a}	0.03^{a}	0.04^{a}
Savings	-0.60^{***a}	-0.58^{***a}	-0.56^{***a}	-0.60^{***a}	-0.53***	-0.59^{***a}	-0.62^{***a}	-0.57^{***a}	-0.60^{***a}	-0.61^{***a}
Accumulated Assets										
Investment in A	0.11^{a}	0.11^{**a}	0.09^{**a}	0.10^{*a}	0.04	0.10^{a}	0.11^{a}	0.04^{a}	0.11^{***a}	0.10^{a}
Investment in B	0.14^{**a}	0.15^{***a}	0.11^{***a}	0.14^{***a}	0.14***	0.14^{**a}	0.14^{**a}	0.13^{***a}	0.14^{***a}	0.14^{***a}
Investment in C	-0.04^{a}	-0.07^{***a}	0.04^{**a}	-0.03^{a}	0.02	-0.03^{***a}	-0.03^{a}	0.03^{a}	-0.04^{a}	-0.03^{**a}
Investment in D	-0.09^{**a}	-0.07^{**a}	-0.09^{***a}	-0.10^{***a}	-0.06***	-0.09^{a}	-0.09^{**a}	-0.07^{***a}	-0.10^{***a}	-0.09^{***a}
Investment in E	0.02^{a}	0.03	0.02^{a}	0.02^{a}	0.03	0.02^{a}	0.02^{a}	0.02^{a}	0.02^{a}	0.02^{a}
Savings	0.12^{***a}	0.13^{***a}	0.11^{***a}	0.12^{***a}	0.10***	0.12^{***a}	0.12^{**a}	0.12^{***a}	0.12^{***a}	0.11^{***a}

Note: (a) Marginal effects computed at the observed values. (b) Model with no updating of current endogenous behaviors in response to past behaviors and outcomes. (c) Simulated with 100 repetitions. (d) Bootstrapped standard errors are in parentheses using with 100 draws. (e) Model 5 corresponds to the preferred model.

* Significant at the 10 percent level. ** Significant at the 5 percent level. *** Significant at the 1 percent level.

^{a,b,c} Difference in means test with respect to model 5, significant at the 1, 5, and 10 percent level, respectively.

E Policy Simulations: Auxiliary Tables

Table E5: Effect of Investment Path Through the Life-Cycle: Percentage Change in Accumulated Assets at the End of Seven Years under Simulated Life-cycle Investment Paths.

	Investment Paths				
	Predicted by Model	Riskier Default	Riskier Gender-Equated	All C	All E
	(1)	(2)	(3)	(4)	(5)
Mean	0.02	8.07***	8.39***	1.10***	-12.76***
	(2.40)	(0.52)	(0.57)	(0.29)	(1.35)
Percentile					
1%	-0.30	8.32	9.41*	4.27	-4.87
	(3.41)	(6.55)	(5.44)	(6.08)	(13.94)
5%	-0.95	7.48*	8.66**	2.60	-8.84
	(2.57)	(3.92)	(3.37)	(3.46)	(7.87)
10%	-1.05	6.82**	8.03***	1.61	-9.66
	(2.26)	(2.99)	(2.57)	(2.28)	(5.89)
25%	-1.16	6.34***	7.16***	0.26	-10.79***
	(1.94)	(1.68)	(1.41)	(1.03)	(3.79)
50%	-1.19	7.61***	8.27***	-0.67	-12.88***
	(2.14)	(0.87)	(0.83)	(0.51)	(2.42)
75%	-0.25	8.24***	9.29***	0.13	-13.27***
	(2.43)	(0.56)	(0.70)	(0.24)	(1.54)
90%	0.16	8.40***	8.82***	1.42***	-13.18***
	(2.50)	(0.38)	(0.52)	(0.18)	(0.91)
95%	0.50	8.16***	8.38***	2.24***	-12.84***
	(2.60)	(0.35)	(0.48)	(0.20)	(0.72)
99%	1.24	8.18***	6.90***	3.12***	-12.23***
	(2.70)	(0.43)	(0.49)	(0.31)	(0.57)

Note: (a) Percentage change in accumulated assets with respect to default investment path. (b) Bootstrapped standard errors are in parentheses using with 100 draws.

* Significant at the 10 percent level; ** 5 percent level; *** 1 percent level.

Table E6: Share of Individuals that Stay in the Default at the End of Each Period when Individuals Observed to be in the Default in Period $t = 2$ are Treated (%)

Period	Baseline			Default + 1			Riskier Default		
	Total	Women	Men	Total	Women	Men	Total	Women	Men
Treatment									
2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Response									
3	63.58	61.77	65.30	36.72	35.81	37.58	34.94	32.42	37.32
	(5.73)	(5.71)	(5.81)	(8.68)	(8.17)	(9.18)	(12.55)	(12.58)	(12.60)
4	62.64	59.80	65.31	26.56	26.76	26.38	24.12	21.85	26.26
	(5.74)	(5.65)	(5.91)	(8.97)	(8.32)	(9.60)	(11.69)	(11.51)	(11.92)
5	60.39	56.38	64.18	22.69	23.68	21.76	20.43	18.38	22.37
	(5.47)	(5.31)	(5.73)	(8.47)	(7.82)	(9.09)	(10.26)	(10.04)	(10.52)
6	59.61	54.83	64.13	20.48	22.59	18.48	19.01	17.23	20.69
	(5.41)	(5.23)	(5.73)	(8.03)	(7.39)	(8.63)	(9.08)	(8.84)	(9.35)
7	59.41	54.18	64.36	17.89	20.78	15.16	18.63	17.55	19.66
	(5.43)	(5.22)	(5.80)	(7.62)	(7.08)	(8.14)	(8.00)	(7.73)	(8.29)
8	60.66	55.12	65.91	17.21	20.50	14.11	18.38	17.14	19.56
	(5.53)	(5.38)	(5.89)	(7.13)	(6.67)	(7.58)	(6.85)	(6.55)	(7.16)

Note: (a) Individuals start period $t = 1$ with their observed initial conditions. Individuals treated are those individuals who are observed to be in the default in period $t = 2$. After the treatment, the simulated outcomes are used to update next periods endogenous explanatory variables. (b) Baseline simulation correspond to the evolution of the model without policy intervention. (c) Bootstrapped standard errors in parentheses using with 100 draws.

Table E7: Share of Individuals that Stay in the Default at the End of Each Period when All Individuals in the System in Period $t = 2$ are Treated (%)

Period	Baseline			Default + 1			Riskier Default		
	Total	Women	Men	Total	Women	Men	Total	Women	Men
Treatment									
2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Response									
3	72.99	72.02	73.84	37.33	37.24	37.42	35.15	32.83	37.18
	(6.02)	(6.00)	(6.07)	(8.96)	(8.67)	(9.28)	(13.24)	(13.12)	(13.45)
4	66.72	65.24	68.01	27.64	28.21	27.15	24.90	22.55	26.95
	(5.87)	(5.75)	(6.06)	(9.38)	(8.80)	(9.98)	(12.18)	(11.90)	(12.55)
5	63.86	61.90	65.59	23.86	24.79	23.05	21.55	19.38	23.44
	(5.66)	(5.42)	(6.02)	(8.92)	(8.27)	(9.59)	(10.68)	(10.36)	(11.07)
6	63.15	60.89	65.13	21.67	23.17	20.36	20.53	18.54	22.28
	(5.63)	(5.31)	(6.14)	(8.50)	(7.77)	(9.24)	(9.43)	(9.10)	(9.81)
7	63.09	60.57	65.31	19.31	21.11	17.73	20.37	18.61	21.92
	(5.63)	(5.30)	(6.26)	(8.05)	(7.40)	(8.73)	(8.30)	(7.96)	(8.68)
8	64.86	62.03	67.34	18.00	20.27	16.01	20.42	18.57	22.04
	(5.68)	(5.47)	(6.25)	(7.44)	(6.86)	(8.06)	(7.04)	(6.69)	(7.43)

Note: (a) Individuals start period $t = 1$ with their observed initial conditions. Individuals treated are all individuals in the system in period $t = 2$. After the treatment, the simulated outcomes are used to update next periods endogenous explanatory variables. (b) Baseline simulation correspond to the evolution of the model without policy intervention. (c) Bootstrapped standard errors in parentheses using with 100 draws.

Table E8: Effect of Contribution Rate: Percentage Change in Accumulated Assets at the End of Seven Years under Different Mandatory Contribution Schedules.

	Mandatory Contribution Schedule			
	$\alpha = 11\%$	$\alpha = 13\%$	$\alpha = 15\%$	$\alpha = 20\%$
	(1)	(2)	(3)	(4)
Mean	3.21***	9.64***	16.09***	32.25***
	(0.46)	(1.38)	(2.31)	(4.64)
Percentile				
1%	7.82***	23.05*	37.86***	69.17***
	(2.41)	(7.40)	(12.62)	(26.14)
5%	7.60***	22.19***	36.57***	70.34***
	(0.97)	(3.09)	(5.42)	(11.72)
10%	7.83***	22.93***	37.75***	72.83***
	(0.81)	(2.56)	(4.43)	(9.53)
25%	7.51***	22.21***	36.56***	71.48***
	(0.50)	(1.57)	(2.72)	(5.89)
50%	5.52***	16.33***	26.96***	53.31***
	(0.48)	(1.42)	(2.36)	(4.72)
75%	3.65***	10.97***	18.32***	36.57***
	(0.54)	(1.59)	(2.61)	(5.07)
90%	2.09***	6.42***	10.96***	23.11***
	(0.43)	(1.31)	(2.24)	(4.69)
95%	1.65***	4.99***	8.42***	17.43***
	(0.34)	(1.05)	(1.80)	(3.82)
99%	1.06***	3.33***	5.61***	11.66***
	(0.25)	(0.76)	(1.28)	(2.66)

Note: (a) Percentage change in accumulated assets with respect to the baseline simulation ($\alpha = 10\%$). (b) Bootstrapped standard errors are in parentheses using with 100 draws.
* Significant at the 10 percent level; ** 5 percent level; *** 1 percent level.

Table E9: Crowd-out Effect Per Year Of Increasing Mandatory Contribution Schedules: Percentage Change in Participation (continues)

Period	Investment					Savings	Employment		
	A	B	C	D	E		Full-Time	Part-Time	Not Emp
Contribution rate = 11%									
$t=3$	0.03***	0.03***	0.00	-0.01**	0.02	0.02**	0.01	-0.19***	0.00
	(0.01)	(0.01)	(0.00)	(0.01)	(0.02)	(0.01)	(0.03)	(0.07)	(0.02)
$t=4$	0.07***	0.06***	0.00	-0.03***	0.06*	0.04**	0.01	-0.30*	0.00
	(0.02)	(0.02)	(0.00)	(0.01)	(0.03)	(0.02)	(0.05)	(0.15)	(0.04)
$t=5$	0.13***	0.11***	0.00	-0.06***	0.10**	0.08***	0.02	-0.52***	0.00
	(0.04)	(0.03)	(0.01)	(0.01)	(0.05)	(0.03)	(0.09)	(0.20)	(0.07)
$t=6$	0.16***	0.17***	0.00	-0.06***	0.16**	0.11***	0.03	-0.74***	0.00
	(0.05)	(0.06)	(0.01)	(0.01)	(0.07)	(0.04)	(0.12)	(0.25)	(0.10)
$t=7$	0.19***	0.24***	0.01	-0.06***	0.19**	0.14***	0.04	-0.87***	0.00
	(0.07)	(0.08)	(0.01)	(0.02)	(0.09)	(0.05)	(0.17)	(0.30)	(0.13)
$t=8$	0.21**	0.35***	0.01	-0.09***	0.30***	0.17***	0.05	-1.14***	0.01
	(0.09)	(0.10)	(0.01)	(0.02)	(0.11)	(0.06)	(0.21)	(0.37)	(0.15)
Contribution rate = 13%									
$t=3$	0.11***	0.07***	0.00	-0.04***	0.05	0.06**	0.02	-0.54***	0.01
	(0.03)	(0.02)	(0.01)	(0.01)	(0.04)	(0.02)	(0.07)	(0.17)	(0.06)
$t=4$	0.23***	0.17***	0.00	-0.08***	0.19**	0.14***	0.03	-0.91**	0.01
	(0.07)	(0.06)	(0.01)	(0.02)	(0.08)	(0.05)	(0.16)	(0.37)	(0.12)
$t=5$	0.36***	0.34***	0.00	-0.14***	0.30**	0.22***	0.06	-1.55***	0.01
	(0.11)	(0.10)	(0.02)	(0.03)	(0.13)	(0.08)	(0.26)	(0.57)	(0.19)
$t=6$	0.50***	0.47***	0.00	-0.16***	0.46**	0.33***	0.10	-2.12***	0.00
	(0.16)	(0.16)	(0.03)	(0.04)	(0.19)	(0.11)	(0.37)	(0.63)	(0.28)
$t=7$	0.60***	0.72***	0.01	-0.19***	0.58**	0.44***	0.12	-2.62***	0.01
	(0.21)	(0.24)	(0.04)	(0.05)	(0.25)	(0.14)	(0.50)	(0.82)	(0.37)
$t=8$	0.71***	1.06***	0.01	-0.23***	0.87***	0.56***	0.14	-3.29***	0.02
	(0.27)	(0.32)	(0.04)	(0.06)	(0.31)	(0.18)	(0.62)	(1.08)	(0.45)

Note: (a) Percentage change in accumulated assets with respect to the baseline simulation (Contribution Rate= 10%)
(b) Individuals start period $t = 1$ with their observed initial conditions. All individuals are treated in period $t = 2$.
(c) Bootstrapped standard errors are in parentheses using with 100 draws.
* Significant at the 10 percent level; ** 5 percent level; *** 1 percent level.

(continuation) Crowd-out Effect Per Year Of Increasing Mandatory Contribution Schedules: Percentage Change in Participation

Period	Investment					Savings	Employment		
	A	B	C	D	E		Full-Time	Part-Time	Not Emp
Contribution rate = 15%									
$t = 3$	0.18***	0.11***	0.01	-0.06***	0.10	0.10***	0.03	-0.89***	0.00
	(0.05)	(0.04)	(0.01)	(0.02)	(0.07)	(0.04)	(0.12)	(0.25)	(0.09)
$t = 4$	0.38***	0.28***	0.01	-0.14***	0.32**	0.23***	0.06	-1.58***	0.00
	(0.11)	(0.10)	(0.02)	(0.04)	(0.14)	(0.08)	(0.27)	(0.57)	(0.20)
$t = 5$	0.60***	0.56***	0.01	-0.22***	0.50**	0.38***	0.10	-2.46***	0.01
	(0.18)	(0.17)	(0.03)	(0.06)	(0.21)	(0.13)	(0.43)	(0.82)	(0.33)
$t = 6$	0.82***	0.80***	0.00	-0.27***	0.74**	0.54***	0.15	-3.38***	0.00
	(0.26)	(0.27)	(0.05)	(0.07)	(0.31)	(0.18)	(0.62)	(1.03)	(0.46)
$t = 7$	1.08***	1.27***	0.02	-0.32***	0.99**	0.73***	0.20	-4.28***	0.01
	(0.35)	(0.40)	(0.06)	(0.09)	(0.41)	(0.24)	(0.84)	(1.37)	(0.61)
$t = 8$	1.25***	1.78***	0.02	-0.38***	1.37**	0.93***	0.24	-5.29***	0.01
	(0.44)	(0.53)	(0.07)	(0.10)	(0.52)	(0.30)	(1.04)	(1.76)	(0.76)
Contribution rate = 20%									
$t = 3$	0.35***	0.23***	0.02	-0.13***	0.21	0.20***	0.07	-1.72***	0.00
	(0.09)	(0.08)	(0.02)	(0.04)	(0.13)	(0.07)	(0.25)	(0.46)	(0.19)
$t = 4$	0.78***	0.57***	0.02	-0.27***	0.68**	0.49***	0.12	-3.10***	0.00
	(0.22)	(0.19)	(0.04)	(0.07)	(0.27)	(0.16)	(0.53)	(1.01)	(0.40)
$t = 5$	1.20***	1.08***	0.01	-0.41***	0.96**	0.75***	0.20	-4.89***	0.02
	(0.37)	(0.34)	(0.07)	(0.11)	(0.44)	(0.26)	(0.86)	(1.46)	(0.65)
$t = 6$	1.66***	1.69***	0.02	-0.52***	1.36**	1.09	0.30	-6.49	-0.01
	(0.53)	(0.55)	(0.09)	(0.14)	(0.65)	(0.36)	(1.25)	(1.97)	(0.92)
$t = 7$	2.19***	2.56***	0.04	-0.66***	1.96**	1.46***	0.41	-8.39***	0.01
	(0.72)	(0.80)	(0.12)	(0.17)	(0.83)	(0.48)	(1.68)	(2.48)	(1.22)
$t = 8$	2.50***	3.58***	0.04	-0.81***	2.65**	1.85***	0.47	-10.27***	0.01
	(0.91)	(1.09)	(0.15)	(0.19)	(1.06)	(0.62)	(2.07)	(3.20)	(1.54)

Note: (a) Percentage change in accumulated assets with respect to the baseline simulation (Contribution Rate= 10%)
(b) Individuals start period $t = 1$ with their observed initial conditions. All individuals are treated in period $t = 2$.
(c) Bootstrapped standard errors are in parentheses using with 100 draws.
* Significant at the 10 percent level; ** 5 percent level; *** 1 percent level.

Table E10: Percentage change in accumulated assets at the end of seven years fixing not-employed women with children to be part-time workers, with respect to the updated evolution of the model with no policy changes

	Fixing Mothers to Work Part-Time when Not-employed			
	Total	All Women	Women in treatment	Men
Mean	1.02*	3.33	9.54***	–
	(0.56)	(2.05)	(3.48)	
Percentile				
1%	56.08	62.86	333.29	–
	(41.08)	(73.94)	(435.83)	
5%	32.56	58.33	120.82	–
	(23.50)	(44.36)	(96.77)	
10%	16.78	38.73	70.80	–
	(14.21)	(32.00)	(48.99)	
25%	5.23	16.18	31.24*	–
	(4.13)	(13.71)	(18.44)	
50%	1.45	6.61	15.32**	–
	(0.89)	(4.75)	(7.01)	
75%	0.38 *	2.43	7.82***	–
	(0.22)	(1.72)	(2.84)	
90%	0.15	0.69	4.55***	–
	(0.09)	(0.57)	(1.44)	
95%	0.05	0.39	2.72***	–
	(0.07)	(0.31)	(0.92)	
99%	-0.04	0.08	1.97***	–
	(0.07)	(0.12)	(0.65)	

Note: (a) Percentage change in accumulated assets with respect to the baseline simulation. (b) Bootstrapped standard errors are in parentheses using with 100 draws.
* Significant at the 10 percent level; ** 5 percent level; *** 1 percent level.

Table E11: Effect of Family Characteristics: Percentage Change in Accumulated Assets at the End of Seven Years

	Marital Status		Number of Children
	Married at $t = 1$	Permanently Married	Additional Children at $t = 1$
	(1)	(2)	(3)
Mean	0.64***	2.66***	-0.12
	(0.16)	(0.61)	(0.16)
Percentile			
1%	-4.14*	-14.94**	-5.43**
	(2.21)	(7.25)	(2.31)
5%	-2.30	-7.06	-3.41**
	(1.55)	(4.87)	(1.33)
10%	-0.57	-1.23	-2.10**
	(1.13)	(3.65)	(0.93)
25%	1.33**	4.61***	-0.60
	(0.53)	(1.73)	(0.49)
50%	1.41***	4.62***	-0.18
	(0.30)	(0.93)	(0.31)
75%	0.82***	3.48***	-0.04
	(0.16)	(0.69)	(0.18)
90%	0.34***	2.02***	-0.02
	(0.09)	(0.51)	(0.10)
95%	0.27***	1.71***	0.02
	(0.08)	(0.43)	(0.08)
99%	0.10*	1.46***	0.01
	(0.06)	(0.34)	(0.08)

Note: (a) For column 1 and 3 percentage change in accumulated assets with respect to the baseline simulation. For column 2 percentage change in accumulated assets of being permanently married versus being permanently single. (b) Permanently married starting at year 2. (c) Bootstrapped standard errors are in parentheses using with 100 draws.

* Significant at the 10 percent level; ** 5 percent level; *** 1 percent level.

Table E12: Effect of Health Characteristics: Percentage Change in Accumulated Assets at the End of Seven Years

	Initial Improvement in Health Status (1)	Permanent Improvement in Health Status (2)
Mean	0.48***	2.57***
	(0.12)	(0.78)
Percentile		
1%	3.18***	4.56
	(0.70)	(3.58)
5%	2.77***	5.90*
	(0.44)	(3.30)
10%	2.26***	6.79**
	(0.36)	(2.95)
25%	1.52***	6.67***
	(0.28)	(2.00)
50%	0.81***	4.26***
	(0.19)	(1.25)
75%	0.43***	2.73***
	(0.13)	(0.84)
90%	0.28***	1.77***
	(0.10)	(0.57)
95%	0.22**	1.34***
	(0.09)	(0.49)
99%	0.06	0.81**
	(0.06)	(0.36)

Note: (a) Percentage change in accumulated assets with respect to the baseline simulation. (b) Bootstrapped standard errors are in parentheses using with 100 draws.

* Significant at the 10 percent level; ** 5 percent level; *** 1 percent level.

Table E13: Model 1 without subjective assessments nor correlated unobserved heterogeneity. Effect of Investment Path Through the Life Cycle: Percentage Change in Accumulated Assets at the End of Seven Years under Simulated Life-cycle Investment Paths.

	Investment Paths				
	Predicted by Model	Riskier Default	Riskier Gender-Equated	All C	All E
	(1)	(2)	(3)	(4)	(5)
Mean	-2.05	7.92***	8.60***	0.82	-12.71***
	(7.17)	(2.25)	(2.27)	(0.81)	(3.21)
Percentile					
1%	-0.90	13.66	16.60	4.54	-8.87
	(12.05)	(13.09)	(13.58)	(10.16)	(23.25)
5%	-2.74	10.32	12.32	1.99	-12.29
	(8.68)	(8.25)	(9.11)	(5.39)	(12.71)
10%	-2.97	8.94	10.93	1.13	-12.45
	(7.36)	(6.59)	(7.20)	(4.02)	(9.33)
25%	-3.20	7.70*	9.20*	-0.08	-12.79**
	(6.80)	(4.52)	(4.72)	(2.45)	(6.22)
50%	-3.23	7.85**	9.27***	-0.57	-13.37***
	(7.13)	(3.15)	(3.20)	(1.47)	(4.48)
75%	-2.84	7.97***	9.24***	0.04	-13.19***
	(7.11	(2.57)	(2.81)	(0.89)	(3.57)
90%	-2.21	7.89***	8.49***	1.17	-12.60***
	(7.14	(2.16)	(2.30)	(0.72)	(3.02)
95%	-2.25	7.77***	7.68***	1.83**	-12.29***
	(7.48	(2.02)	(2.07)	(0.88)	(2.80)
99%	-0.11	7.65***	7.23***	2.83**	-11.62***
	(7.89	(2.09)	(1.86)	(1.25)	(2.71)

Note: (a) Percentage change in accumulated assets with respect to default investment path. (b) Bootstrapped standard errors are in parentheses using with 100 draws.
* Significant at the 10 percent level; ** 5 percent level; *** 1 percent level.

Table E14: Model 1 without subjective assessments nor correlated unobserved heterogeneity. Effect of Contribution Rate: Percentage Change in Accumulated Assets at the End of Seven Years under Different Mandatory Contribution Schedules.

	Mandatory Contribution Schedule			
	$\alpha = 11\%$	$\alpha = 13\%$	$\alpha = 15\%$	$\alpha = 20\%$
	(1)	(2)	(3)	(4)
Mean	4.54	13.63	22.76	45.77
	(2.87)	(8.66)	(14.52)	(29.36)
Percentile				
1%	6.17**	18.07**	29.50**	54.38**
	(2.46)	(7.56)	(12.78)	(26.31)
5%	7.23***	20.73***	33.43***	63.93***
	(1.78)	(5.49)	(9.35)	(19.79)
10%	7.48***	21.93***	35.98***	69.68***
	(1.46)	(4.56)	(7.89)	(16.91)
25%	7.04***	20.95***	34.41***	67.20***
	(1.50)	(4.65)	(8.01)	(17.24)
50%	5.83**	17.28**	28.45**	55.77**
	(2.36)	(7.15)	(12.05)	(24.69)
75%	4.71*	14.18*	23.56*	46.72*
	(2.77)	(8.33)	(13.97)	(28.32)
90%	3.99	12.23	20.55	41.58
	(3.03)	(9.15)	(15.33)	(30.94)
95%	3.58	10.71	18.11	37.65
	(3.16)	(9.54)	(15.99)	(32.31)
99%	3.29	9.80	16.67	35.89
	(3.39)	(10.27)	(17.24)	(34.85)

Note: (a) Percentage change in accumulated assets with respect to the baseline simulation ($\alpha = 10\%$). (b) Bootstrapped standard errors are in parentheses using with 100 draws.
* Significant at the 10 percent level; ** 5 percent level; *** 1 percent level.

Table E15: Model 6: Model with subjective assessments as exogenous explanatory variables and no correlated unobserved heterogeneity. Effect of Investment Path Through the Life Cycle: Percentage Change in Accumulated Assets at the End of Seven Years under Simulated Life-cycle Investment Paths.

	Investment Paths				
	Predicted by Model	Riskier Default	Riskier Gender-Equated	All C	All E
	(1)	(2)	(3)	(4)	(5)
Mean	-2.10	8.04**	8.72***	0.85	-12.81*
	(7.19)	(3.17)	(3.10)	(1.31)	(7.40)
Percentile					
1%	-2.46	11.89	13.73	4.28	-9.61
	(18.09)	(17.65)	(16.02)	(14.25)	(38.60)
5%	-2.77	11.07	13.62	2.18	-12.08
	(12.67)	(12.55)	(12.14)	(7.89)	(25.09)
10%	-2.93	9.37	11.27	1.35	-12.42
	(10.28)	(9.74)	(9.47)	(5.61)	(19.49)
25%	-3.29	7.95	9.53	-0.14	-12.91
	(8.08)	(6.30)	(6.37)	(3.62)	(13.92)
50%	-3.32	7.99*	9.50**	-0.57	-13.46
	(7.40)	(4.39)	(4.75)	(2.29)	(10.63)
75%	-2.83	8.09**	9.36**	0.10	-13.25
	(7.36)	(3.54)	(3.75)	(1.44)	(8.69)
90%	-2.39	7.97**	8.69***	1.11	-12.80*
	(7.42)	(3.11)	(3.03)	(1.06)	(7.41)
95%	-2.10	7.89***	7.88***	1.93**	-12.37*
	(7.51)	(2.91)	(2.72)	(0.98)	(6.54)
99%	-0.20	8.04***	7.18***	3.03**	-11.70**
	(7.44)	(2.56)	(2.30)	(1.24)	(5.13)

Note: (a) Percentage change in accumulated assets with respect to default investment path. (b) Bootstrapped standard errors are in parentheses using with 100 draws.
* Significant at the 10 percent level; ** 5 percent level; *** 1 percent level.

Table E16: Model 6: Model with subjective assessments as exogenous explanatory variables and no correlated unobserved heterogeneity. Effect of Contribution Rate: Percentage Change in Accumulated Assets at the End of Seven Years under Different Mandatory Contribution Schedules.

	Mandatory Contribution Schedule			
	$\alpha = 11\%$	$\alpha = 13\%$	$\alpha = 15\%$	$\alpha = 20\%$
	(1)	(2)	(3)	(4)
Mean	4.32*	13.00*	21.71*	43.64*
	(2.34)	(7.09)	(11.94)	(24.49)
Percentile				
1%	5.06*	15.32*	25.43*	46.02
	(2.95)	(8.97)	(15.09)	(30.57)
5%	6.45***	19.06***	31.07**	58.56 **
	(2.37)	(7.23)	(12.18)	(24.93)
10%	7.06***	20.65***	33.70***	64.96***
	(2.07)	(6.27)	(10.64)	(21.99)
25%	6.97***	20.43***	33.47***	64.86***
	(1.63)	(4.93)	(8.29)	(16.97)
50%	5.67***	16.69***	27.58***	53.83***
	(1.63)	(4.91)	(8.20)	(16.52)
75%	4.62**	13.75**	22.83**	45.25**
	(1.98)	(5.97)	(10.02)	(20.41)
90%	3.83	11.74	19.69	39.81
	(2.47)	(7.48)	(12.66)	(26.22)
95%	3.32	10.22	17.34	36.10
	(2.73)	(8.36)	(14.16)	(29.45)
99%	2.77	8.70	14.90	32.71
	(3.13)	(9.55)	(16.10)	(33.08)

Note: (a) Percentage change in accumulated assets with respect to the baseline simulation ($\alpha = 10\%$). (b) Bootstrapped standard errors are in parentheses using with 100 draws.
* Significant at the 10 percent level; ** 5 percent level; *** 1 percent level.