An Empirical Investigation of Risk Aversion, Transaction Costs and Portfolio Choice

Monica Paiella

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Abstract

The thesis focuses on household portfolio choice and looks at the role that transaction costs and individual risk aversion have in explaining observed behaviour. The first chapter focuses on the issue of heterogeneous financial market participation and determines a lower bound on the level of transaction costs that are required to reconcile observed portfolio choices with asset returns within an isoelastic utility framework. The bound is determined from the set of conditions that ensure the optimality of consumption behaviour by financial market non-participants. The evidence found using the US Consumer Expenditure Survey suggests that reasonably low costs can justify observed behaviour for degrees of risk aversion held as realistic by the literature. In the second chapter I explore a dimension of heterogeneity which can help explain why some households, but not others enter the stock market. Using the Bank of Italy Survey of Household Income and Wealth, I construct a direct measure of absolute risk aversion and relate it to consumers' endowment and attributes and to measures of exposure to background risk. The purpose of the analysis is to gather evidence on the amount of heterogeneity characterising individual attitudes towards risk and on its observability, on how the environment affects risk aversion and on how an index of risk aversion can help predict household decisions involving the undertaking of some risk, such as portfolio and occupation choice, the demand for insurance and moving decisions and also the propensity to change job and the health status. The last chapter completes the thesis with a study of the saving behaviour of US households. Using micro data from the Consumer Expenditure Survey, I employ cross sectional and synthetic cohort techniques to characterise the life cycle profile of saving rates and other variables of interest. In particular, I pay attention to the distinction between mandatory saving and discretionary saving and to their composition, relating also the evidence to the recent policy debate on saving incentives and their usefulness.

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Declaration

No part of this thesis has previously been presented to any college or university for any degree.

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Introduction

The past ten years have been characterised by major changes both in financial markets and in the related academic research. Financial markets have experienced a dramatic broadening of participants base, mainly due to the growth of mutual and private pension funds, to the increasing popularity of retirement accounts, such as the 401(k) accounts, and to the growth in stock prices. The combination of growing investment in equity and rising stock prices has been associated with a significant increase in the share of households owning publicly traded stock, either directly or through mutual funds, retirement accounts or other managed assets. For households overall, the shift towards equity has gone together with an increase in the importance of financial assets as a share of total assets. These changes in portfolio behaviour have spurred a new stream of research focussing on households' portfolio decisions and not just on their saving behaviour, which has been traditionally subject to a considerable amount of research. The relative neglect for household portfolio choices in the established literature has been due to several factors. First of all, traditionally, households have held very simple portfolios consisting of just few types of financial assets. Then, on the one hand, the standard models of portfolio choice have appeared to be unable to explain household unwillingness to hold risky assets at some stages of the life cycle or at all. On the other, the leading asset pricing models have been incapable of accounting for the observed household portfolio incompleteness. Finally, detailed information on household portfolio composition has become available only recently, starting from the early eighties. Yet, household portfolio behaviour deserves systematic investigation. In fact, portfolio decisions have important implications for the pace of wealth accumulation and, as a consequence, for the adequacy of savings to finance retirement and to provide for unforeseen events. They also determine how fiscal policy and changes in macro variables affect household expenditure and savings. Finally, understanding households' portfolio decisions may provide important insights for the theories of consumption and saving behaviour.

Some evidence on portfolio choice

In simple portfolio models, rational households can invest in a wide range of assets characterised by different returns and different degrees of risk. Yet, as mentioned before, the evidence available suggests that, despite the fact that the US financial environment is relatively liberal, households exhibit very limited portfolio diversification. Bertaut and Starr-McCluer (2000) find that, of the thirteen main categories of financial assets, also in the 1995 wave of the US Survey of Consumer Finances, the average number of assets per-household was 3, with 26 percent of households holding at most one asset - most commonly a checking account. Yet, with respect to the early eighties, in the late nineties there has been a shift in the composition of financial assets with the relative importance of time and savings deposits declining and that of pension and mutual funds and corporate equity rising. Despite this, according also to the most recent evidence based on micro data, more than one-quarter of all households still invests in safe assets only. Another interesting piece of evidence is the clear correlation between wealth and the structure of household portfolios, with ownership of almost all types of assets increasing in wealth. The variation in portfolio composition across the wealth distribution, together with the concentration in wealth ownership leads to important differences in the concentration across assets, which in turn implies large differences in the riskiness of household portfolios. A further interesting issue of portfolio analysis concerns the relationship between risk and age, with the share of households holding risky assets being highest among the prime aged, although for virtually all age groups, the share of risky asset holders has risen over time.

According to the evidence available across the wealth distribution and over the life cycle most of the action concerns the asset ownership decisions and not as much the management of the portfolio shares. In fact, in Guiso et al. (forthcoming) it is well documented that the positive correlation between wealth and the shares of risky assets conditional on holding them is lower than the correlation between wealth and the probability of risky asset holding. Similarly, while the age profile of risky asset ownership appears to be hump-shaped, that of the share of risky assets is relatively flat. This suggests that the theoretical and empirical research should devote considerable attention particularly to the ownership decision.

Previous and current research on portfolio choice

Most of the evidence concerning household portfolio behaviour finds little support in the classical portfolio models of Merton (1969) and Samuelson (1969), which can hardly rationalise the choice of holding only very few of the assets available, the choice of holding no equity at all and the existence of age profiles in the ownership of risky assets. Of course, such models abstract from important aspects of the decision problem, such as the presence of information and transaction costs, of background risk and borrowing constraints and of heterogeneity in household preferences. Indeed, there are several indication in the literature that information and transaction costs could help rationalise the phenomena of limited financial market participation and of lack of portfolio diversification. For example, King and Leape (1998) find a positive correlation between age and the probability of holding a financial asset, which is consistent with a model where the information on the investment opportunities arrives stochastically over time. Information costs appear to be a crucial deterrent of investment in stock also in Haliassos and Bertaut (1995). The issue of transaction costs, their nature and how they affect the choice of holding stock is addressed extensively in the first chapter of this thesis where I propose a way to bound the costs needed to reconcile observed financial market participation and return premia. Another empirical paper studying the interaction between frictions and household portfolio choice is Vissing-Jorgensen (1999), whose methodology builds on Mulligan and Sala-i-Martin (1996) and differs substantially from my type of analysis. In fact, as I will discuss extensively in Chapter One, the objective of my analysis is that of determining the minimal costs rationalising the choice of holding no equity despite the premium and I find that relatively small costs can indeed justify such behaviour. Instead, Vissing-Jorgensen (1999) uses a dynamic sample selection model to gather evidence of state dependency in financial market participation - which is symptomatic of entry and transaction costs - and a censored regression model to determine the distribution of the per-period participation costs. She estimates the median of this cost to be around $200, which is a figure much higher than the ones I obtain, but is still consistent with my results.

As to the role of background risk in explaining observed participation behaviour, recent research by Guiso et al. (1996), Gollier and Zeckhauser (1997), Coco et al. (1998) and Heaton and Lucas (2000) supports the view that households in risky environment should limit their exposure to portfolio risk. Furthermore, insofar as it evolves with age, background risk may help explain the life cycle of asset holdings. As to the role of credit market imperfection, Gollier (1999) shows that the possibility of being liquidity constrained in the future reduces the willingness to bear risk presently.

Another issue relevant for any analysis of portfolio choice is that of heterogeneity of households' preferences and in particular of individual attitudes towards risk. The classical theory predicts that the higher the degree of risk aversion, the lower should be the share invested in risky assets. Thus, risk aversion might be an important omitted variable in the portfolio problem, biasing the empirical results. In addition, Gollier and Zeckhauser (1997) show that the life cycle profile of the portfolio share invested in risky assets is affected by the curvature of absolute risk tolerance. Moreover, if risk tolerance is concave, wealth inequality can help elucidate the equity premium puzzle (Gollier, 1999). In the second chapter of the thesis, I address these issues empirically and find indeed that the attitude to bear risk has considerable predictive power for those choices involving the undertaking of risk by the household, such as investing in equity. Also, the rather unique evidence presented is consistent with the fact that the share invested in risky assets varies over the life cycle and it is also consistent with the predictions of the theories of attitudes towards risk in the presence of uninsurable risk that I have mentioned above.

Outline of the thesis

The rest of the thesis consists of three chapters. The first chapter focuses on the issue of limited financial market participation and determines a lower bound on the level of fixed transaction costs that are required to reconcile observed portfolio choices with asset returns within an isoelastic utility framework. The bound is determined from the set of conditions that ensure the optimality of consumption behaviour by financial market non-participants. It represents the lowest possible cost rationalising observed non-participation choices by providing a measure of the utility gains from participation for observed non-participants. Such gains are related both to the size of financial market returns and to the opportunity of smoothing consumption, with the benefits of the former decreasing in the degree of relative risk aversion and those of the latter increasing in it. Using the US Consumer Expenditure Survey, I find that a yearly cost of at least $40 is needed to rationalise non-participation for a consumer with log utility and who can trade in the S&P500 CI. This lower bound declines rapidly in risk aversion for levels of risk aversion up to two/three; for higher values, it levels off. A yearly cost of at least $18 is needed to rationalise non-participation for a consumer with log utility and who can trade in US Treasury Bills. This lower bound rises steadily in risk aversion.

In the second chapter I explore a dimension of household heterogeneity which can help explain why some households, but not others enter the stock market. Using the Bank of Italy Survey of Household Income and Wealth, I construct a direct measure of absolute risk aversion based on the maximum price a consumer is willing to pay to enter a lottery. I then relate this measure to consumers' endowment and attributes and to measures of exposure to background uncertainty. I find that risk aversion is a decreasing function of endowment - thus rejecting CARA preferences - but that the elasticity to consumption is far below the unitary value predicted by CRRA utility. Thus, absolute risk tolerance is a concave function of consumer endowment. I also find that households' attributes are of little help in predicting their degree of risk aversion, which is characterised by massive unexplained heterogeneity. Yet, the consumers' environment affects risk aversion, with individuals more likely to face income uncertainty exhibiting a higher degree of absolute risk aversion. This is consistent with recent theories of attitudes towards risk in the presence of uninsurable risks. Finally, I find that risk attitudes have considerable predictive power on several household decisions, including portfolio and occupation choice, the demand for insurance, moving decisions, propensity to change job and health status.

The last chapter completes the thesis with an analysis of the saving behaviour of US households. Using micro data from the Consumer Expenditure Survey, I employ cross sectional and synthetic cohort techniques to characterise the life cycle profile of saving rates and of other variables of interest. In particular, I pay attention to the distinction between mandatory saving and discretionary saving and to their composition, relating also the evidence to the recent policy debate on saving incentives and their usefulness.

Chapter One

Limited Financial Market Participation: A Transaction Cost-based Explanation

A large number of studies has suggested that observed asset returns are inconsistent with consumption choices as predicted by the standard neo-classical model for consumption. The testable implications of this model have, in fact, repeatedly been proven to be at odds with empirical evidence and have given rise to the equity premium and other asset pricing puzzles[1]. Such empirical inconsistency has generally been rationalized by the literature either assuming that agents are highly averse to consumption risk or conjecturing that trading stock is much more costly than trading bonds. Recently, it has also been shown that accounting for limited stock market participation might be important for explaining the puzzles, since allowing for differences in the consumption patterns of asset holders and non-holders tends to lower the risk aversion implied by the model[2]. However, no attempt has been made to rationalize non-participation. Non-participation to financial markets is the main issue this chapter wants to address and does so by verifying whether it can be rationalized on the ground of transaction costs that are small enough to be *realistic*. The second issue the chapter deals with is that of the differences in the costs of trading distinct assets. In the literature, cost differentials generally result from calibration exercises, whereas here I identify the bounds to the costs directly and look for evidence that trading risky assets is costlier than trading riskless ones.

The approach I adopt to identify the transaction costs is based on the observation that the standard way of examining the consistency of a model with empirical evidence is to test a set of first-order conditions against the data. The rejection of such conditions suggests that there are gains the consumer could

[1] See Kocherlakota (1996) for a thorough review of the literature.

make by modifying her consumption. However, if such gains are not too large, a possible interpretation of the sub-optimal behavior is that the consumer faces small transaction costs every time she approaches financial markets and the costs of modifying consumption are higher than the utility gains. By measuring such gains it is possible to determine a set of bounds on the level of transaction costs that help rationalize non-participation and, ultimately, can reconcile asset returns and consumption choices.

For the estimation of such cost bounds, I extend Luttmer (1999) and determine the lower bounds to the trading costs as the minimal costs that rationalize non-participation, i.e. as those costs exactly equal to the utility gains from trade. However, unlike Luttmer, whose work is based on aggregate information, I use individual level data, which allow distinguishing between actual participants and non-participants to financial markets, instead of simply characterizing traders and non-traders in the time period under scrutiny. As a consequence, the nature of the costs I focus upon is substantially different from the nature of the costs in Luttmer's analysis. In fact, the frictions he considers are the costs that the representative agent must pay to trade and modify her consumption in the current period and in one or at most few subsequent periods. Instead, by distinguishing between participants and non-participants, this chapter focuses on the costs any individual faces in order to actually participate to financial markets. In addition, because of the use of aggregate data, the validity of Luttmer's results is limited and his analysis applies strictly only to an agent who happens to consume US per-capita consumption because, in the presence of fixed costs, the conditions upon which aggregation results are based do not hold. For this reason, the use of micro data is particularly desirable in a framework where fixed costs play a role. The use of individual-level data brings about several other advantages. First, it allows to verify whether there are important cost differences when trading different portfolios, - at least to the extent that the data permit to distinguish between different assets. Second, it allows to take into account the

[2] See Attanasio, Banks and Tanner (1996) for a study based on the UK Family Expenditure Survey and Paiella (1999) and Vissing-Jørgensen (1999) for two analyses based on the US Consumer Expenditure Survey.

effects that individual specific factors have on utility reducing the scope for unobserved heterogeneity and, consequently, the potential for bias. Last, given the availability of some panel dimension in the data I use, it is possible to account for differences in the covariance between individual consumption growth and asset returns. Another empirical work studying the interaction between market frictions and household portfolio choice, using micro data, is Vissing-Jorgensen (1999). Vissing-Jorgensen (1999) is built on the methodology of Mulligan and Sala-i-Martin (1996) and differs substantially from my type of analysis. In fact, as I have mentioned and as I will discuss more extensively in the rest of the chapter, the objective of my work is that of determining the minimal costs rationalizing the choice of holding no equity despite the premium and I find that relatively small costs can indeed justify such behavior. Instead, Vissing-Jorgensen (1999) uses a dynamic sample selection model to gather evidence of state dependency in financial market participation - which is symptomatic of entry and transaction costs -, and a censored regression model to determine the distribution of the per-period participation costs. She estimates the median of this cost to be around $200, which is a figure slightly higher than the ones I obtain, but is still consistent with my results

The costs I consider are fixed per-period participation costs that must be paid at the time of investment and in each subsequent period as long as the agent stays in the market. Since I estimate the bounds by measuring the utility gain in case of participation, the costs I set limits upon can include both cash outlays and "figurative" charges, such as brokerage fees and other commissions, bid-ask spreads, money/time spent understanding financial markets and determining the optimal portfolio, money/time spent setting up and managing the accounts, value of time spent trading and any other kind of opportunity cost of investors' time in processing information.

The rest of the chapter is organized as follows. In Section 1, I discuss the model for the gains from financial market participation and relate such gains to the trading costs. In Section 2, I examine the econometric issues arising from the estimation of the model and present the estimation procedure. In Section 3, I describe the data and analyze the empirical results. Section 4 concludes.

1. Measuring Transaction Costs

Consider an environment where households have access to several means to substitute consumption over time. In particular, they can accumulate real assets, currency and/or financial securities. The securities can be traded after the payment of a fixed cost that can vary between the market for risky assets and the market for riskless ones. Households have additively separable preferences over consumption and the per-period utility function is strictly increasing and concave. Let $\{c^h\}_t, t = 1,2,...$ be household *h* observed sequence of consumption choices. These choices are the result of some complicated, unobservable set of decisions involving labour supply, saving and portfolio composition. On the basis of portfolio composition, it is possible to distinguish among three types of households: those who hold both risky and riskless assets (type 1); those who hold only riskless assets (type 2); and those who have chosen not to participate to any financial market (type 3). Households are utility maximizers. As a consequence, since at time *t* they could have chosen any other sequence of consumption bundles, their time *t* expected gain from deviating from $\{c^h\}_t$ must be negative. In particular, for those households who have chosen not to participate to some or both financial markets, time *t* expected utility gain, $y^*_{h,t}$, from adopting an alternative saving/consumption strategy, involving participation must be non-positive, i.e.

(1) $$y^*_{h,t} = E[v^i_{h,t+1}(x,\delta,u) \mid I_{h,t}] \leq 0, \qquad i = 2,3; \qquad \forall t$$

where, under the assumption of additively separable preferences, (equation (2))

$$v^i_{h,t+1}(.) = \{U(\tilde{c}^i_{h,t}(x,\delta)) - U(c_{h,t})\}\exp(u_{h,t}) + \beta\{U(\tilde{c}^i_{h,t+1}(x,\delta)) - U(c_{h,t+1})\}\exp(u_{h,t+1})$$

$v^i_{h,t+1}(.)$ is the utility gain that type *i* household *h* can obtain by deviating from $\{c^h\}_t$. $U(c_{h,t})$ is the utility from the level of consumption that has been chosen. $U(\tilde{c}^i_{h,t}(x,\delta))$ is the utility in case of optimal participation to the financial market(s) that type *i* household *h* has chosen to stay out of. Participation implies paying the fixed cost δ and holding the optimally determined portfolio x of securities. β is a positive subjective discount rate and $u_{h,t}$ is an unobservable random taste shifter which captures individual heterogeneity. $u_{h,t}$ represents all the unobservable and unaccounted for factors that affect individual portfolio choices and that I do not explicitly model or control for. Specifically, within the framework defined by (1) and (2), it captures all those unobservable features of individual preferences that influence the financial market participation choice and therefore determine the size of the loss from deviating from $\{c^h\}_t$. $E[.\,|\,I_{h,t}]$ is household h expectation conditional on the information available at time t. (1) and (2) imply that, at time t, given the information available, financial market non-participants should not be able to pay the fixed cost, participate optimally to the market(s) they have chosen to stay out of and obtain a higher level of utility. Inequalities like (1) must hold for any t and $t+s$, $s\geq 1$[3].

The inequality in (1) does not allow identifying the fixed cost parameters that would reconcile observed consumption choices with the assumption that agents are rational and choose optimally. However, under the assumption of non-satiation of preferences, $v^{i}_{h,t+1}(x,\delta,u)$ is strictly decreasing in δ. Then, I can replace δ with $d\leq\delta$ and the inequalities in (1) with equalities and look for lower bounds to the costs. Such lower bound coincides with the level of participation costs that would make the utility in case of participation exactly equal to the utility in case of non-participation. In other words, it coincides with the levels of costs offsetting exactly the gain from participation.

Two issues are worth discussing at this stage. The first relates to the benchmark I use to quantify the gain/loss from participation. As I have mentioned in the Introduction, the model is motivated by the desire of rationalizing observed behavior as optimal, despite the empirical inconsistency of the neo-classical model for consumption noted by Hansen and Singleton (1983),

[3] Focusing the analysis on two adjacent periods is not restrictive, as long as the per-period costs of participating to the market for one-period securities and to n-period securities are the same. In this instance, by an arbitrage argument, the one-period returns on the two assets must be the same.

Mehra and Prescott (1985) and Hansen and Jagannathan (1991)[4], among others. The fixed cost bounds are essentially measures of the benefit from participation and their interpretation is straightforward: the lower the bounds, the smaller the expected utility gain from participation and, consequently, the lower the transaction costs needed to make participation disadvantageous and, therefore, non-participation *rational*. Thus, for this exercise to be interesting, I must determine the individual optimal investment in those assets that households do not hold and compare the utility associated to such portfolio with the utility associated to the choice made, *ceteris paribus*. Then, for those who hold only riskless assets, let $\tilde{c}^2_{h,t} = c_{h,t} - \delta_2 - x_{2,h,t}q_2$ and $\tilde{c}^2_{t+1} = c_{h,t+1} + x_{2,h,t}R_{2,t,t+1}$; for those who have chosen not to hold any financial assets, let $\tilde{c}^3_{h,t} = c_{h,t} - \delta_{12} - x_{1,h,t}q_1 - x_{2,h,t}q_2$ and $\tilde{c}^3_{h,t+1} = c_{h,t+1} + x_{1,h,t}R_{1,t,t+1} + x_{2,h,t}R_{2,t,t+1}$[5]. δ_2 is the fixed cost for the market for risky assets. δ_{12} is the joint cost of participating to both financial markets[6]. Given the participation cost, x_1 and x_2 are the individual optimal holdings of riskless and risky assets with time t prices q_1 and q_2 and time $t+1$ payoffs $R_{1,t,t+1}$ and $R_{2,t,t+1}$, respectively. As it will be shown in the next section, the optimal portfolios are determined by exploiting the fact that asset returns are to some extent predictable using a pricing kernel based on investors' utility. The specification adopted for $\tilde{c}^i_{h,t}$ and $\tilde{c}^i_{h,t+1}$ is a simplification and implies that the resources to be invested in the market subject to a cost are obtained by reallocating expenditure over time without modifying saving, whatever form it takes. Yet, since financial assets involving higher costs carry on average also higher returns, it is reasonable to expect that after paying the cost and investing in the higher return asset, the investor moves into this asset some of her

[4] The three studies mentioned above characterize the inconsistency of the theory with the data in different ways. Hansen and Singleton (1983) reject the overidentifying restrictions of the model. Mehra and Prescott (1985) point out an *equity premium puzzle*. Hansen and Jagannathan (1991) determine a set of bounds on the first two moments of a generic stochastic asset-pricing factor and find that the moments of the marginal rate of substitution are inconsistent with such bounds.
[5] For estimation purposes I assume that half of the per-period cost must be paid at t and half at $t+1$.
[6] Given the nature of the costs, (1) and (2) for type 3 households do not allow to identify the participation cost to each individual market separately, but only a single cost that pertains to both markets jointly.

wealth accumulated in other lower return assets[7]. Alternatively, the income effect from higher returns might induce her to increase her consumption at t, reducing overall savings. The specification that I have adopted has the advantage of not requiring the computation of household cash-in-hand, which is not directly available from the data I use. However, the inability to use individual cash-in-hand can be expected to bias downward the estimates, especially in the case where some asset is not subject to transaction costs. However, as it will be shown, information available on household after-tax income allows to quantify the importance of this bias.

The second issue worth mentioning relates to the nature of the costs of financial market participation *vis á vis* the fact that the analysis focuses explicitly only on two time periods and neglects any continuation payoff. The focus on only two time periods can be justified by assuming that households are at an optimum conditional on the presence of transaction costs. The counterfactual implies switching consumption between the two periods under scrutiny, leaving everything else unchanged (at the optimum) and consequently I do not need to keep into account any other date. For this to hold, costs must be fixed and per-period. In principle, financial market participation involves three types of costs: an entry cost, a transaction/trading cost and a per-period participation cost. Entry costs consist in the time and money spent determining the household optimal portfolio and, to most extent, are likely to be fixed. Trading costs are likely to have a fixed component, consisting in commissions and in the value of time spent trading, and a variable one, proportional to the amount traded, related

[7] Consider for simplicity a household that holds its savings in a zero return costless asset. The budget constraints for time t and $t+1$ can be written as: $\begin{matrix} c_t = y_t + s_{t-1} - s_t \\ c_{t+1} = y_{t+1} + s_t - s_{t+1} \end{matrix}$, where c_t, y_t and s_t are time t consumption, income and saving, respectively. If households were allowed to reshuffle their savings when participating hypothetically to financial markets, then $\tilde{c}_t$ and $\tilde{c}_{t+1}$ could be defined as: $\begin{matrix} \tilde{c}_t = c_t + s_t - x_t - \delta \\ \tilde{c}_{t+1} = c_{t+1} - s_t + x_t R_{t,t+1} \end{matrix}$, where $\tilde{c}_t$ is consumption in case of financial market participation; $c_t + s_t$ is time t cash-in-hand, i.e. it is the amount of resources available for either consumption or investment at time t; x_t is the optimal portfolio of costly assets with return $R_{t,t+1}$ and δ is the per-period participation cost. The "simpler" specification I have adopted is

to bid-ask spreads and to commissions variable components. Finally, the per-period participation costs represent all the portfolio management monetary and opportunity costs. The different types of costs are likely to affect participation choices in different ways. In particular, when entry costs are present, the number of periods that households expect to stay in the market becomes crucial in determining investment choices. Similarly, when trading costs exist, the length of the investment is a crucial factor. Finally, in the presence of per-period costs, the length of the investment and/or of participation is irrelevant only if asset returns are assumed to be exogenous and, therefore, independent on the number of financial market participants, which in turn depends on the costs. Reasonably, all three types of costs can be expected to exist. The assumption of fixed per-period participation costs together with the focus on one period participation and investment can cause the actual costs to be somewhat underestimated if the entry and the trading costs are the most significant cost component and/or household investments are very long term. In fact, in this instance the actual gains from participation would be larger than the one estimated with the model in (1) and (2). The empirical evidence on the nature of the costs and on households movements in and out of financial markets is rather scarce. Yet, as to the first issue, the wide availability of low cost mutual funds is believed to have reduced effectively the costs of buying and trading a well-diversified portfolio. As to the second, using portfolio choice data from the 1984, 1989 and 1994 waves of the Panel Study of Income Dynamics, Vissing-Jørgensen (1999) finds widespread movements in and out of financial markets, with many households participating in one year but not the others. Such observed behavior suggests that household investments are rather short term and is consistent with the view that entry and trading costs are limited. Thus, the main cost components of financial market participation are likely to be portfolio management costs, related both to the time and money spent determining the optimal asset portfolio and to the time and money spent following financial markets, in order to form expectations on future returns and change the investment accordingly. If this is the case, although the former of

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primarily dictated by data limitations. In fact, it does not require the computation of s_t, which is these costs are likely to be somewhat higher for first-time investor (but not necessarily for new entrants), the assumption of fixed per-period participation costs should not cause the bound underestimation to be serious.

2. Estimation Issues

2.1 Econometric Issues

As explained in Section 1, after replacing the inequality in (1) with an equality, the model

(3) $$E_t[v^i_{h,t+1}(x,d,u)] = 0 \qquad i = 2,3; \quad \forall t$$

allows to identify and measure a bound to the cost of financial markets participation. Such measure is provided by the value of d equalizing the utility from observable consumption to the utility from consumption in case of participation to some additional financial market, whose participation costs want to be quantified. One way of interpreting d is in terms of Hicks compensating variation for a change in prices from the set of (unobservable) prices implicit in the individual preferences to observable market prices. As a consequence, the fixed cost bounds are in principle heterogeneous. Because of the lack of a long panel dimension in the data used, it is not possible to estimate consistently the bounds at the household level. However, I can compute an average individual household expected gain that will yield an estimate of the lower bound to the transaction costs for a consumer with a mean expected gain. Such estimate will differ from the mean of the individual lower bounds for a Jensen inequality term due to the fact that the utility gain function is strictly decreasing and concave in the cost. The issue can be illustrated in the following way. Assume that there are just two kinds of households. For the first, the expected gain from financial market participation is set to zero by a cost equal to d_1. For the second, the expected gain is set to zero by a cost d_2, with $d_2 > d_1$. The mean of the expected gains (and consequently the mean of the costs), $\bar{d}$, is simply the average of d_1 and d_2. Due to the inability of identifying the individual expected gains, I cannot

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not directly available from the data.

determine $\bar{d}$, but I can look for the bound to the cost for a consumer whose expected utility gain coincides with the households mean expected utility gain. This estimate will differ from $\bar{d}$ by a Jensen inequality term because of the non-linearity of the function, as shown in Figure 1.

Another issue worth mentioning relates to the omission of the information on financial market participants, which brings in the estimation a potential source of bias due to the censoring of the expected utility gain, $y^*_{h,t}$. If $y^*_{h,t}$ sample mean differs from the population mean simply because the composition of the sample is different, the estimates of the fixed cost bounds based only on data on non-participants will be biased. The issue can be addressed by identifying the selection rule and correcting for the possibility of selection bias by means of an equation explaining *initial* participation such as a latent variable model predicting asset holdings when the portfolio decision takes place[8]. Thus, let r^* be an underlying latent variable denoting the level of indirect utility associated to the portfolio choice of interest:

$$r^*_{h,t} = V_{h,t} + \eta_{h,t} = z_{h,t}'\pi + \eta_{h,t}$$

where z is a *kx1* vector of household specific observable variables. For $r^*_{h,t} > 0$, participation occurs, in which case a dichotomous variable, $D_{h,t}$, is equal to one; otherwise, it is zero. Then, if $\eta_{h,t}$ and the individual random taste shifter, $u_{h,t}$, are distributed jointly as standard normal random variables and $E_{(h)}\{\exp(u_{ht}) \mid D_{h,t} \neq 1\} = E_{(h)}\{\exp(u_{ht+1}) \mid D_{h,t} \neq 1\}$[9], the mean value of the expected utility gain in the sub-sample excluding participants can be written as (omitting the superscript *i*):

$$
\begin{aligned}
E_{(h)}\{y_{h,t} \mid D_{h,t} \neq 1\} &= E_{(h)}\{E_t[\tilde{v}_{h,t+1}(x,\delta)] \cdot \exp(u_{h,t}) \mid D_{h,t} \neq 1\} \\
&= E_t[\tilde{v}_{h,t+1}(x,\delta)] \cdot E_{(h)}\{\exp(u_{h,t}) \mid D_{h,t} \neq 1\} \qquad (4) \\
&= E_t[\tilde{v}_{h,t+1}(x,\delta)] \cdot s_{h,t}(V, \rho_{u\eta})
\end{aligned}
$$

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[8] It is worth pointing out that the expected utility gain equation in (1) does not determine the household type. It simply ensures the non-participants are happy to hold on to their choices.

[9] This implies assuming that $\exp(u_{h,t})$ is a random walk in the sub-sample considered.

where $E_{(h)}\{\ \}$ is the mean taken across households, whereas $E_t[\ ]$ is household conditional expectation,

(5) $\quad \tilde{v}_{h,t+1}(x,\delta) = U(\tilde{c}_{h,t}(x,\delta)) - U(c_{h,t}) + \beta[U(\tilde{c}_{h,t+1}(x,\delta)) - U(c_{h,t+1})]$

and[10]

(6) $\quad s_{h,t}(V,\rho_{u\eta}) = e^{1/2}\dfrac{1-\Phi(V_{h,t}+\rho_{u\eta})}{1-\Phi(V_{h,t})}$

where $\rho_{u\eta}$ is the correlation between $u_{h,t}$ and $\eta_{h,t}$. Thus, the model corrected to account for sample selection can be written as:

(7) $\quad y_{h,t} = E[w_{h,t}\tilde{v}_{h,t+1}(x,\delta)]\cdot s_{h,t}(V,\rho_{u\eta}) + \xi_{h,t}$

where $\xi_{h,t}$ is an error, such that $E_h\{\xi_{h,t} \mid D_{h,t} \neq 1\} = 0$. In practice, when bounding the cost associated to the market for risky assets, the sample selection correction term will account for the exclusion of risky asset holders; when bounding the costs associated to the market for riskless assets, it will account for the exclusion of those who hold such assets.

2.2 Estimation Procedure

The estimation of the parameters of interest takes two steps. In the first step, I evaluate the sample selection correction term, $s_{h,t}(V,\rho_{u\eta})$. Then, after substituting it in (7), in the second step, I estimate the household optimal portfolio and the transaction cost bound using a method of moment estimator. The sample selection correction term entails the identification of two sets of parameters, the parameters in $V_{h,t}$ and $\rho_{u\eta}$. The first set in $V_{h,t}$ can be obtained by maximum likelihood estimation of the bivariate probit associated to the latent variable model for portfolio choice. The unobservable correlation between $u_{h,t}$ and $\eta_{h,t}$ can hardly be identified and distinguished from the unknown parameters that enter the expected utility gain function, given the multiplicative structure of the model in (7). However, since $\rho_{u\eta} \in [-1,+1]$, I can proceed and determine the range of values that the cost bounds can take on depending on the value of $\rho_{u\eta}$. Under the assumption of isoelastic utility, another parameter that cannot be identified within the model is the coefficient of relative risk aversion characterizing household preferences. As I do with $\rho_{u\eta}$, I assign relative risk aversion a range of values and verify how sensitive my estimates are to such parameter.

2.2.1 The Optimal Portfolio

In order to identify the potential gains from financial market participation and measure the transaction cost bounds, the household optimal portfolio, x, must be determined. Let $x_{h,t}(g) = f(z_{h,t}, g) \cdot c_{h,t}$, where z is an $mx1$ vector of instruments that have been shown useful in predicting market returns; z varies over time and can be household specific. $f(.)$ is a logit transformation of an $mx1$ vector g of parameters[11]. The household optimal portfolio is simply the investment ensuring the maximum return in terms of utility, given the per-period participation costs. Thus, it can be estimated by maximizing households utility in case of participation with respect to the vector of unknown parameters, g, given the fixed transaction cost, i.e. by solving the following problem:

$$\max_{g} E\left[U(\tilde{c}^{i}_{h,t}(x(g),\delta)) \cdot s_{h,t}(V,\rho_{u\eta}) + \beta \cdot U(\tilde{c}^{i}_{h,t+1}(x(g),\delta)) \cdot s_{h,t}(V,\rho_{u\eta})\right]$$

As I have mentioned before, the optimal portfolio is determined by exploiting the fact that asset returns are to some extent predictable. Since, in practice, the vector of instruments z that I use does not vary across households, but varies only over time, optimal holdings cannot be estimated by exploiting across household variability, but only the variability over time. Thus, I can compute x by solving:

$$\text{(8)} \qquad \max_{g} E\left[\overline{U(\tilde{c}^{i}_{h,t}(x(g),\delta)) \cdot s_{h,t}(V,\rho_{u\eta})} + \beta \cdot \overline{U(\tilde{c}^{i}_{h,t+1}(x(g),\delta)) \cdot s_{h,t}(V,\rho_{u\eta})}\right]$$

where

$$\overline{U(\tilde{c}^{i}_{h,t}(x(g),\delta)) \cdot s_{h,t}(V,\rho_{u\eta})} = H_{t}^{i^{-1}} \sum_{h_t} U(\tilde{c}^{i}_{h,t}(x(g),\delta)) \cdot s_{h,t}(V,\rho_{u\eta})$$

is time t mean household utility. H^{i}_{t} is the number of households of type i who had their first interview in the t^{th} time period. If the maximand is sufficiently

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10 See the Appendix for the derivation of this result.

11 Specifically: $f(z,g) = (1 + \exp(z'g))^{-1}$. This specification is dictated primarily by computational considerations.

smooth and an optimal portfolio, $x(g)^*$, associated to the fixed cost exist, then, in terms of first-order conditions, the optimal g must be such that (equation (9))

$$(T-1)^{-1}\sum_{t=1}^{T-1}\left[D_g\overline{U(\tilde{c}^i_{h,t}(x(g),\delta))\cdot s_{h,t}(V,\rho_{u\eta})}+\beta\cdot D_g\overline{U(\tilde{c}^i_{h,t+1}(x(g),\delta))\cdot s_{h,t}(V,\rho_{u\eta})}\right]=0$$

where D_g is the derivative with respect to g.

The idea behind the optimal portfolio estimation procedure is that of capturing the unexploited investment opportunities for non-participants using their own mean utility as pricing kernel. Thus, by solving the set of equations[12] in (9) and focussing on those who do not hold risky assets, I can determine their optimal investment in such securities (given the costs) in case of participation to the market. Similarly, by focussing on those who do not hold riskless bills, I can determine their optimal investment is such assets. Notice that, in practice, the actual transaction costs are not observed, nor estimated and only the cost bounds are identified. Therefore, the optimal portfolios of risky and riskless assets are determined as a function of a level of costs equal to the estimated bounds, which is consistent with the rest of the analysis.

2.2.2 The Transaction Cost Bounds

The estimation of the cost bounds is based on the conditional moments in (3), which, after correcting for sample selection, can be written as:

(10) $$E[\tilde{v}^i_{h,t+1}(x,d)\mid I_{h,t}]\cdot s^i_{h,t}(V,\rho_{u\eta})+\xi_{h,t}=0 \qquad i=2,3;\quad \forall t$$

where $I_{h,t}$ is household h information set at time t. Let $W_{h,t}$ be a collection of non-negative[13] variables in $I_{h,t}$ observable to the econometrician. Taking any $w_{h,t}$ in $W_{h,t}$, it follows from (10) that

(11) $$E[w_{h,t}\tilde{v}^i_{h,t+1}(x,d)]\cdot s^i_{h,t}(V,\rho_{u\eta})+\xi_{h,t}=0 \qquad i=2,3;\quad \forall t$$

As mentioned in the previous section, the lack of a longer panel dimension in the data set precludes estimating the individual d. However, by aggregating properly

[12] The first-order conditions are necessary, but not sufficient for a maximum, unless the function being maximized is strictly concave in the parameters, which needs not be the case in the problem considered here. Thus, the second-order condition must be checked as well.

across households, we can identify the bound to the costs for a consumer whose expected utility gain equals the mean expected gain. Then, the relevant moment conditions are:

(12) $E\left[E_{(h)}\left\{w_{h,t}\widetilde{v}^{i}_{h,t+1}(x,d)\cdot s^{i}_{h,t}(V,\rho_{u\eta})\right\}\right]=0 \qquad i=2,3$

which yield a consistent estimator of the bounds if the trading rules as a function of the parameters are well behaved and if $w_{h,t}\widetilde{v}^{i}_{h,t+1}(.)$ is time stationary and has finite mean, so that some law of large numbers can be applied. By means of (12), it is possible to estimate consistently $d \leq \delta$ as a function of $\rho_{u\eta}$ and of the coefficient of relative risk aversion.

3. Empirical Analysis

3.1 Data

The data used to estimate the fixed cost bounds are taken from the US Consumer Expenditure Survey (CEX), which is a representative sample of the US population, run by the US Bureau of Labor Statistics. The survey is a rotating panel in which each consumer unit is interviewed every three months over a twelve months period, apart from attrition. The data used for the analysis cover the period 1982-1995 and the sample consists of 24,643 households. Each quarterly interview collects household monthly expenditure data on a variety of goods and services for the three months preceding the one when the interview takes place. In the final interview, an annual supplement is used to obtain a financial profile of the household providing information as to the amounts held in checking, brokerage and other accounts, in saving accounts, in US saving bonds and as to the market value of all stocks, bonds, mutual funds and other securities. The changes occurred in such stocks over the previous twelve months are also reported.

[13] The non-negativity assumption is not strictly needed. However, in order to ensure that the inequality implied by (1) has the same sign across households, it is necessary that the variables in W_h have the same sign across households.

The consumption measure I use is deseasonalized, real monthly per-adult equivalent[14] expenditure on non-durable goods and services. Given the timing of the data on asset holdings, for each household only two consumption observations are used: the one for the month preceding the first interview and the one for the month preceding the last, implying a nine-month gap. It follows that for each household only a single observation on the expected utility gain, $E_t[v_{h,t+1}(.)]$, can be defined. t is the month of the first observation on consumption and $t+1$ that of the second. Since the interviews take place throughout the year, in the sample used, t runs from 1981:12 to 1985:5 and from 1986:1 to 1994:12, for a total of 150 periods[15].

The household type is determined on the basis of asset holdings twelve months before the last interview, which can be computed by subtracting the changes occurred over that period to the stocks held at the time of the last interview. The variables "stocks, bonds, mutual funds and other securities" and "US saving bonds" are added together and those households who report a non-null amount of such variable are defined as risky asset holders. As a measure of riskless asset holdings, I take the amounts held in checking and saving accounts. Table 1 reports the sample composition in each of the years considered on the ground of household asset portfolios. The first column of the Table contains the share of households holding a positive amount of both risky and riskless assets. They represent about 30.5% of the sample. The second column reports the share holding only riskless assets (51% of the sample). The third column indicates how many households do not hold either asset (18.5% of the sample). In the sample used, no household holds only risky assets. The evidence reported in the Table suggests that the share of households owning stocks and bonds has increased substantially over the years covered by the survey. This is consistent with the evidence found by Poterba and Samwick (1997) using the Survey of Consumer

[14] Household per-adult equivalent consumption is obtained from total household consumption using the following adult equivalent scale: the household head is weighted 1, the other adults in the households are weighted 0.8 and the children are weighted 0.4.
[15] See the Appendix for an explanation of the discontinuity and for further details on the data, on household selection and exclusions and on variable definition.

Finance, which suggests that equity ownership has increased over time especially through mutual funds and tax-deferred accounts. Also, they find a sharp rise in the fraction of households owning both tax-exempt and taxable bonds.

Table 2 reports some descriptive statistics for the sample as a whole and for the three types of households. Type 1 households, who participate to both markets, are more likely to be headed by a man, the household head is more educated than the average, slightly older and more often married. Their after-tax monthly family income is higher, as well as their per-capita consumption. Those who hold neither risky nor riskless assets tend to be the least educated and to have the lowest income and consumption and in 41 percent of the cases are headed by a woman.

Asset returns are summarized in Table 3. As risky return I take the total return (capital gains plus dividends) on the S&P500 Composite Share Index. As riskless return I take the return on US Treasury bills. The data in the Table are returns over the nine-month period that runs between the two consumption observations used in the analysis. The mean equity premium over the sample period considered is about seven percent.

3.2 *Estimation Results*

3.2.1 The Sample Selection Correction Term

Before estimating the fixed cost bounds, the sample selection term, $s_{h,t}(V, \rho_{uv})$, must be determined to account for the censoring of the expected utility gain. Such objective can be achieved by means of a bivariate probit model for participation at time *t*. The variables included as determinants of the probability of asset holding are a polynomial in age, a set of education dummies, the education dummies interacted with age, a dummy for the presence of children, a dummy for single person households and a dummy for the region where the household resides. Fourteen year dummies are also included. The first column of Table 4 reports the estimation results for the probability of participating to both financial markets. Such probability appears to increase non-linearly with age and with education; it is higher among male-headed households and is lower among single person households. These estimates allow to construct the sample selection correction term for the case when the analysis is based on those households who do not hold risky securities to bound the costs of participating to the market for such assets. The second column of the Table reports the estimation results for the probability of holding either both assets or no assets at all, which corresponds to one minus the probability of holding only riskless securities. These figures allow to correct for sample selection when computing the risky asset market cost bound using only the information on those households who do not hold risky assets, but do hold some riskless ones. Given the apparent disparities between those who participate to both markets (type 1) and those who do not participate to any (type 3), the results from the estimation are not as clear-cut as those reported in the first column and their interpretation is not as straightforward. The last column of the Table shows the results for the probability of holding either both assets or only some riskless assets and allows to correct for sample selection when the analysis is based on those who do not hold any financial securities. The outcome is very similar to that reported in the first column, both from a qualitative and a quantitative point of view, with households having an older, more educated and male head more likely to participate to financial markets.

In order to compute the sample selection correction term, as defined in (6), a value must be assigned to the unobservable and non-identifiable correlation between $u_{h,t}$ and $\eta_{h,t}$, which, in the tables below, is set equal to +0.5 and -0.5 to assess the effect of a positive correlation in the first case and of a negative one in the second.

3.2.2 The Optimal Portfolio and The Transaction Cost Bounds

Three sets of results are presented in this section. The first set refers to the costs of participating to the market for risky assets; the second looks at the possible costs of participating to the market for riskless ones and the third set focuses on the two markets considered jointly. Once determined the appropriate sample selection correction term, moment conditions (9) and (12) can be used to estimate jointly the optimal portfolio and the lower bound to the per-period cost of participating to the market of interest. For identification purposes, two sets of instruments are needed. The first set (z), identifying the parameters defining the optimal investment at time *t*, includes the returns on the S&P500 CI and on Treasury bills, the rate of growth of GDP and the rate of inflation. All variables are lagged one period and refer to the time interval from *t-1* to *t*. The second set (*w*), consisting of good predictors of the utility gains in case of participation, includes household monthly consumption and income at time *t*, the household head age, two education dummies for household head with high school diploma and university degree and all the instruments in *z* (plus a constant). Thus, the estimation relies on 15 equations to determine 5 parameters, which provide the basis for an overidentifying restriction test of the model.

The Tables 5 to 9, reporting the estimates of the parameters of interest, have the following structure. The results in panel (a) are obtained by setting $\rho_{u\eta}=0.5$, those in panel (b) by setting $\rho_{u\eta}=-0.5$. Each column is computed assuming isoelastic preferences for different levels of risk aversion. The first row of each table reports the estimates of the bound to the fixed per-period participation costs. These are annualized figures obtained by multiplying by twelve the method of moments estimates that are based on monthly consumption data and, therefore, are an average of the mean monthly utility gain over the sample period considered. The reason for multiplying these estimates by twelve is to relate the gains from financial market participation to annual expenditure. The next set of rows in the tables contains the estimates of the parameters of the optimal asset portfolio, which implies investing in the financial market the share of time *t* consumption reported in the row before the last. The shares reported are average values; in fact, the portfolio parameters are determined using time-varying instruments and consequently the optimal shares to invest vary over time. Standard errors are reported in parenthesis[16]. The Sargan test of overidentifying restrictions is reported in the last row. The rate of discount over the nine-month period of investment, β, is set equal to 0.98, which implies an annual rate of approximately 0.97. A nine-month rate of 0.99 implies slightly higher bound estimates, but the overall conclusions do not change in any significant way.

[16] The standard errors have been corrected to account for the MA(9) structure of the error due to the overlapping of the observations on the expected utility gain, which follows from the monthly

3.2.2.1 The optimal portfolio

Table 5 and 6 focus on the market for risky assets. The results in Table 5 are obtained by focussing on all households who do not report holdings of risky assets; those in Table 6 are obtained using only the information on those who do not hold risky assets, but still hold some riskless securities. The figures reported in the two tables are very similar. Notice also that there are almost no differences between the two panels of the tables, suggesting little sensitivity to the value assigned to $\rho_{u\eta}$, which is chosen arbitrarily. According to the estimates in the first column of the tables, a household with a relative risk aversion of 0.5 could benefit from participating to the risky asset market and optimal behavior would involve investing around 12.5% of current consumption. The literature on portfolio choice predicts that as risk aversion increases households should reduce their risky asset investments. This is unequivocally supported by the evidence displayed in the Tables, according to which as the coefficient of risk aversion increases, the optimal portfolio as a share of consumption falls rapidly. If risk aversion is 3.5, the optimal portfolio of risky asset should correspond to just around 5% of consumption. The standard errors of the portfolio parameters reported in the Tables suggest that the coefficients associated to the instruments are generally statistically significant.

Table 7 reports the results of an exercise aimed at quantifying the downward bias in the transaction cost estimates reported in Table 5. As mentioned in Section 2, the gains from participation are likely to be under-estimated because of the unavailability of a measure of cash-in-hand. Given the information on total after-tax family income, it is possible to make an assumption as to the wealth held in liquid lower-return assets, that is likely to be invested in the higher return risky asset, once paid the participation cost[17]. The estimates reported in the Table result from the assumption that households can reallocate one percent of monthly income and that the savings they reallocate are initially invested in a zero return asset. The one percent income figure is low; yet, it seems

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frequency of interviews. The issue of non-positive definite variance covariance matrix in finite samples has been taken care of by using a set of weights like in Newey and West (1987).

reasonable since total after-tax income does not account for mortgage payments, health insurance, retirement contributions, etc. which limit considerably the amount of liquid wealth immediately available for reinvestment. Also, one percent of income corresponds to approximately 4.5 percent of the monthly consumption figures used in the analysis.

The Table reports the optimal portfolio as a share of "estimated" cash-in-hand: a household with a relative risk aversion of 0.5 should invest in the risky asset market around 16 percent of its cash-in-hand; one with a risk aversion of 3.5 should invest around 10 percent. Compared to the figures in Table 5, those in Table 7 suggest that, if households can invest in the risky asset market also part of their accumulated wealth, they will reduce their consumption slightly less if they are little averse to risk and relatively more if they are more risk averse. Yet, overall, the differences in terms of reallocation of current consumption between the two sets of Tables are rather small - less than one percentage point – and are the result of the complex interaction of the investment riskiness with the fact that transaction costs are fixed and more resources are now available for investment.

To get some sense of the differences in the costs of participating to different financial markets, I have used the model for the expected utility gain to determine the benefit that those households who hold neither risky nor riskless portfolios would reap by investing in riskless assets. The set of results, shown in Table 8, is obtained by focussing on these agents and using moment conditions (9) and (12) to estimate jointly the optimal portfolio and the lower bound to the costs of participating to such market. The portfolio parameters estimates suggest that a household with a risk aversion of 0.5 could increase its utility by investing in the riskless asset market around 8 percent of its consumption. As before, as risk aversion increases, the utility maximizing investment decreases, but the rate of decrease is much lower than in the case of a risky asset portfolio. The standard errors of the coefficients associated to lagged returns are generally statistically significant, whereas the evidence on the coefficients of GDP and inflation is

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[17] See footnote 7 in Section 1.

mixed, suggesting that the latter have little additional predictive power over lagged asset returns.

Finally, I have considered the case where households holding neither risky nor riskless portfolios are allowed to invest in both (or either) assets after paying a fixed cost unrelated to the specificity of the investment. As instruments to determine the optimal share of consumption to invest in financial assets, I use lagged returns on T-bills and on the S&P500 CI and lagged GDP growth and inflation. To compute the optimal portfolio share of risky assets, I use the equity premium lagged one period[18].

Table 9 reports the results of the estimation. As before, as risk aversion increases, the total optimal investment in risky and riskless assets as a share of consumption decreases. Yet, the portfolio parameter estimates exhibit an interesting feature: in fact, they suggest that if the costs were low enough, households would choose to participate to financial markets by holding an optimal portfolio consisting almost exclusively of risky assets. Only, for a coefficient of risk aversion equal to 2.5 or higher, riskless asset holdings become non-negligible. This result suggests that, if they can choose between risky and riskless assets, households clearly prefer the former. This could be expected given the assumption of single fixed participation cost *vis á vis* the considerable risk premium. Yet, as risk aversion increases, the high volatility of risky returns makes these securities less desirable and households rapidly reduce their risky asset holding. At the same time, they start investing (although very infinitesimally) in riskless assets which provide a convenient means of smoothing consumption at a very low risk. As it will be discussed more thoroughly later, the benefits related to consumption smoothing can be expected to be rather important for this group of households, whose expenditure at time $t+1$ is lower than that at t by 10% on average.

Before turning to the results concerning the lower bounds to the costs of participating to financial markets, it is worth addressing the issue of the sensitivity

[18] For computational reason, both the overall investment as a share of consumption and the share invested in risky assets are determined by means of logit transformations of the coefficients of the instruments (see footnote 11).

of all the estimation results to the value[19] taken on by $\rho_{u\eta}$ in the sample selection correction term. Under self-selection, those individuals who have a "comparative disadvantage" with financial market participation will not hold financial assets because their gain is lower than that of a randomly selected sample of individuals with the same characteristics. Thus, the need to control for the exclusion of asset holders when estimating the participation gain. The lack of sensitivity to the value taken on by the correlation between the unobservable of the model for the utility gain from participation and the unobservable affecting the likelihood of participating can be interpreted as evidence of very limited self-selection.

3.2.2.2 *The transaction cost bounds*

The discussion in the previous section on optimal portfolios showed that those who have chosen not to hold one or more of the available securities could increase their utility by participating optimally to the relevant markets. Yet, if participation costs are high enough, any gain would be eliminated and non-participation becomes optimal.

Table 5 and 6 report the estimates of the lower bound to the costs rationalizing non-participation to the risky asset market. According to the figures in Table 5, panel (a), a household with relative risk aversion of 0.5 would not net any positive gain from participating optimally to the risky asset market if the annual costs involved were greater than \$52. As risk aversion increases, the estimated bounds decrease at a falling rate and tend to level off for coefficients of risk aversion above 2.5/3. This trend in the estimates results from the fact that the lower bound is a measure of the gains from participation and, when the investment is risky, such gains are lower the more concave the utility function. The standard errors reported in parenthesis imply that the bounds are estimated with acceptable precision, which increases considerably as the concavity of the utility function increases. In fact, the 95% confidence intervals range from approximately \$25 to \$79 for a risk aversion of 0.5 and from \$30 to \$46 for a risk aversion of 3. Finally, the Sargan test, whose p-value is reported in parenthesis in

[19] In addition to ±0.5, other values (not reported for brevity) have been tried. No important difference in either the portfolio parameters or the bounds has been recorded.

the last row of the Table, never rejects the overidentifying restrictions to the model, providing evidence in favor of the hypothesis of correct specification. Notice that, like with portfolio parameters, there are negligible differences between Table 5 and 6 and also between the two panels of each Table.

As pointed out earlier, these figures are obtained without accounting for household cash-in-hand and for the possibility of reinvesting accumulated savings. As a consequence, they can be expected to be somewhat downwardly biased. Table 7 addresses the issue of the severity of the problem. According to it, a household with a risk aversion of 0.5 that can reinvest one percent of its after-tax income, in addition to reallocating its consumption expenditure, will not net a positive gain from optimal risky asset holding if the annual participation costs are higher than approximately \$85. The set of estimates of the gains from participation in Table 7 is to some extent higher than those seen before, as it could be expected given the fixed nature of the costs *vis-á-vis* the fact that now households have more resources to invest. Yet, they remain reasonably low to be thought to bound actual market frictions. Also, they can be expected to fall rapidly when assuming that the accumulated saving that are to be moved into the costly security were invested in a positive return asset and not in a zero return one, like I have assumed here. According to the figures in Table 7 as risk aversion increases the estimated bound does not change significantly.

Next, to address the issue of the differences in the costs of different financial portfolios, I have estimated the gains from participating to the riskless asset market, using the information on those households who hold no financial securities. The point estimates of the bounds, reported in Table 8, are always strongly significant, suggesting that investing in riskless assets is also somewhat costly. According to the Table, for a household with a risk aversion of 0.5, it is optimal not to participate to the riskless asset market, if participation involves costs that are higher than around \$14. These figures suggest that the gains from holding riskless assets are quite small and, as expected, they are significantly smaller than those recorded for risky asset market participation, at least for low levels of risk aversion. Yet, they tend to increase rapidly as risk aversion increases: in fact, for a household with a risk aversion of 3.5 the bound estimate is above

$36, which is of the same order as the bound for non-participants to the risky asset market with similar risk aversion (see Table 6). As to the precision of the bound estimates as measured by the width of the confidence intervals, like in the previous tables it appears to be negatively correlated to the size of the bound. However, in the case of riskless asset markets, it appears to be slightly larger, with somewhat narrower confidence intervals. Finally, as before, a Sargan test of the over-identifying restrictions never rejects the null of correct specification of the analysis.

The positive relationship between the bound estimates and the degree of risk aversion is due to the specific nature of the gains from having access to riskless securities. In fact, the main benefit in terms of utility from investing in such assets comes from the possibility of smoothing consumption over time, without increasing significantly consumption risk, although life-time consumption does not rise significantly because of the limited size of the returns. The more risk averse the agent, the greater the utility gain from smoothing consumption, the higher the bound to the cost rationalizing non-participation. As I have mentioned before, in the sample I use those who do not hold riskless assets exhibit falling consumption, on average. Such behavior can hardly be rationalized within the standard neo-classical model for consumption, according to which these households would undoubtedly benefit from smoothing consumption by investing in a riskless asset. Yet, if the costs involved in shifting consumption over time are higher than the estimated bound, their choices can be fully rationalized.

The last type of analysis I have carried out aims at determining the gain from having access to a market where both risky and riskless securities can be traded. The gains represent the lower bound to the single fixed cost rationalizing the behavior of those households in the sample that have chosen not to hold any financial asset. Table 9 reports the results of the estimation: for a household with 0.5 relative risk aversion, the point estimate of the bound is approximately $35. As risk aversion increases, the lower bound at first does not change or decreases somewhat, but then increases as well and for a risk aversion coefficient of 3.5, it is around $45. Overall, the results in Table 9 are consistent with those in the previous tables and shed further light on the nature of the gains, and therefore on the lower bound to the costs, of financial market participation. In fact, the trend in the bound estimates, together with those in the portfolio parameters suggest that the nature of the gain is different at different levels of risk aversion. As discussed in the previous section, if the participation cost is unrelated to the investment and households can choose between risky and riskless assets, they appear to prefer the former, which could be expected given the considerable risk premium. Yet, as risk aversion increases, the utility benefit from holding a risky portfolio for its high expected return falls rapidly and households tend to reduce their investment because of risky returns high volatility. Besides rising expected life-time consumption, risky assets can also provide a means of smoothing consumption, which is particularly valuable for the sample of households considered here and this helps explain the increase in the bound that can be recorded for values of risk aversion above 2/2.5. Also, at these levels of risk aversion, which is when consumption-smoothing considerations become important, households do not just reduce their overall investment, but also switch to riskless assets, which provide a convenient means of smoothing consumption at a very low risk. Finally, notice that for levels of risk aversion above 2, the bound estimates in Table 9 are directly comparable to those in Table 8, which refer to the market for riskless assets, although they are somewhat higher, probably as a result of the higher return of the means available to smooth consumption. For lower levels of risk aversion they are of the same order as those reported in Table 5 and 6, which focus on the risky asset market, although they are somewhat lower reflecting the great heterogeneity of households across types.

4. Conclusions

This chapter focuses on the issue of limited financial market participation and determines a lower bound on the level of fixed participation costs that is required to reconcile observed consumption choices with asset returns within an isoelastic utility framework. The bound is obtained from the set of conditions that ensure the optimality of observed behavior for financial market non-participants. The evidence found suggests that reasonably low costs can justify observed behavior for degrees of risk aversion held as realistic by the literature. In fact, under the assumption of log utility, conservative estimates corresponding to the upper extreme of 95 percent confidence intervals imply a lower bound to the annual fixed costs that rationalize non-participation to risky assets markets in the range of 55-100 dollars, which amounts to less than 0.4-0.7% of household annual consumption. To justify non-participation to riskless asset markets, even smaller frictions are sufficient.

An interesting point that has emerged from the analysis is that for many households most of the gains from financial market participation are not as much related to the size of the returns, as to the benefits from smoothing consumption. However, overall, for the sample of non-participants considered in the analysis, the gains from participating to financial markets do not appear to be large enough to justify the investment *vis-á-vis* the costs. The results based on a "guess" of household cash-in-hand suggest that this might be due to the fact that the resources available for investment are limited. Yet, the differences in terms of wealth between participants and non-participants do not seem wide enough to justify such different asset holding behavior. A more reasonable explanation can instead be found in the amount of household heterogeneity, both observable and unobservable, which appears to explain the differences in the consumption patterns across household types. In fact, households are likely to differ in terms of taste for risk, individual ability, faculty of modifying labor supply, etc. Differences in all these factors can be expected to have an effect both on the gains from asset holdings and on the costs of financial market participation. Expectedly, the kind and the size of the benefits of observed financial market participants are very different and much larger than those recorded for non-participants, whereas the level of costs, especially of figurative charges, can be expected to be much smaller.

Appendix

A1. The US CEX

The data used to estimate the fixed cost bounds are taken from the US Consumer Expenditure Survey (CEX), which is a representative sample of the US population, run by the US Bureau of Labor Statistics. The survey is a rotating panel in which interviews take place throughout the year and each consumer unit is interviewed every three months over a twelve months period, apart from attrition. New households are introduced into the panel on a regular basis as old ones complete their participation. As a whole, about 4500 households are interviewed each quarter, more or less evenly spread over the three months: 80% are re-interviewed after three months, whereas the remaining 20% is dropped and a new group is added. Thus, each month approximately one fifth of the units that are interviewed are new to the survey. This rotating procedure is designed to improve the overall efficiency of the survey and to reduce the problems of attrition.

Each quarterly interview collects household monthly expenditure data on a variety of goods and services for the three months preceding the one when the interview takes place. During the first interview, information on demographic and family characteristics is collected. In the first and the last interviews income and employment information on each household member are also acquired. In addition, in the final interview, an annual supplement is used to obtain a financial profile of the household providing information as to the amounts held in checking, brokerage and other accounts, in saving accounts, in US saving bonds and as to the market value of all stocks, bonds, mutual funds and other securities. The changes occurred in such stocks over the previous twelve months are also reported.

The data used for the analysis cover the period 1982-1995. I exclude from the sample those households with incomplete income responses and those living in rural areas or in university housing. In addition, I exclude those whose head was less than twenty-five or older than sixty-five (about 10,000 households), those who do not participate to all interviews (about 33% of the initial sample), the top 0.1 percent and the bottom 1.7 percent of the income distribution. The reason for this latter selection is to exclude about 500 households who report a total after-tax income below $2,000 and who are likely to consume all their income and have no resources to invest in financial markets. Finally, I select out those households with average monthly per-adult equivalent consumption[20] lower than $150 (about 1,000 households corresponding to 3.6% of the sample) and those who report a change in per-adult equivalent consumption over the nine months period, $\Delta c_{h,t}$, greater than $1,000 in absolute value (about 500 households). For several households the financial supplement contains many invalid blanks either in the stocks of assets or in the changes occurred with respect to the previous year. Since I am interested in the asset holding choice, - and not in the actual amounts held -, I keep not only those households who report both a "valid stock" and a "valid change", but also those who report only one of the two amounts of interest[21]. Overall, the sample used consists of 24,643 households.

The consumption measure I use is deseasonalized, real[22] monthly per-adult equivalent expenditure on non-durable goods and services. The exclusion of durable consumption is grounded in the assumption of separability of preferences between durables and non-durables/services. Given the timing of the data on asset holdings, for each household only two consumption observations are used: the one for the month preceding the first interview and the one for the month preceding the last, implying a nine-month gap. It follows that for each household only a single observation for the expected utility gain, $E_t[v_{h,t+1}(.)]$, can be defined. t is the month of the first observation on consumption and $t+1$ that of the second. Because of this matching of households forward in time, a problem arises around 1985-86 when the sample design and the household

[20] See footnote 14 in Section 3.

[21] About 3,000 households report invalid information in either the flows or stocks of financial assets.

[22] Nominal consumption is deflated by means of household specific indices based on the Consumer Price Index provided by the Bureau of Labor Statistics. The individual indices are determined as geometric averages of elementary regional price indices, weighted by the shares of household expenditure on individual goods. See Attanasio and Weber (1995) for a more extensive discussion of these indices.

identification numbers were changed. As a consequence, it is not possible to match forward those households who have their first interview in the third and fourth quarter of 1985 and they are excluded from the sample. Thus, the sample used consists of households who have their first interview between 1982:1 and 1985:6[23] and between 1986:1 and 1995:1, which implies that t, the month of the first observation on consumption, runs from 1981:12 to 1985:5 and from 1986:1 to 1994:12, for a total of 150 periods.

The household type is determined on the basis of asset holdings twelve months before the final interview, which can be determined by subtracting the changes occurred over that period to the stocks held at the time of the last interview[24]. The variables "stocks, bonds, mutual funds and other securities" and "US saving bonds" are added together and those households who report a non-null amount of such variable are defined as risky asset holders. As a measure of riskless assets, I take the amounts held in checking and saving accounts. Less than 0.4% of the households reports only holdings of risky assets: these households are dropped from the sample.

A2. Derivation of the Sample Selection Correction Term

By assumption $(u_{h,t}\ \eta_{h,t})$ is a joint normal random variable: namely

$$\text{(A1)}\qquad \begin{pmatrix} u_{h,t} \\ \eta_{h,t} \end{pmatrix} \sim \mathrm{N}\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \sigma_{u\eta} \\ \sigma_{u\eta} & 1 \end{pmatrix}\right)$$

Normality implies that

$$\text{(A2)}\qquad u_{h,t} = \sigma_{u\eta}\eta_{h,t} + \zeta_{h,t}$$

In order to determine the sample selection correction term, $s_{h,t}(V, \rho_{u\eta})$, I must compute the (across household) conditional expectation $E_{(h)}\{\exp(u_{h,t}) \mid D_{h,t} \neq 1\}$,

[23] For the first quarter of 1986, the Bureau of Labor Statistics created two files: one based on the original sample design and one based on the new design. After the first quarter, no track is kept of the households in the old sample. Thus, I can match forward only those households in the original sample who had their first interview up to June 1985.

[24] When either of the two variables is missing, I define the household as asset holder either if they hold a positive amount of the asset at the time of the fifth interview or if they report a non-null change with respect to the previous twelve months.

where $D_{h,t} \neq 1$ if $\eta_{h,t} \leq -V_{h,t}$. Using (A2) and the fact that $\zeta_{h,t}$ is independent of $\eta_{h,t}$, I can rewrite such conditional expectation as follows

$$\text{(A3)}\quad \begin{aligned} E_{(h)}\{\exp(u_{h,t}) \mid D_{h,t} \neq 1\} &= E_{(h)}\{\exp(\sigma_{u\eta}\eta_{h,t} + \zeta_{h,t}) \mid D_{h,t} \neq 1\} \\ &= E_{(h)}\{\exp(\sigma_{u\eta}\eta_{h,t}) \cdot \exp(\zeta_{h,t}) \mid D_{h,t} \neq 1\} \\ &= E_{(h)}\{\exp(\sigma_{u\eta}\eta_{h,t}) \mid D_{h,t} \neq 1\} \cdot E_{(h)}\{\exp(\zeta_{h,t})\} \end{aligned}$$

The last term of (A3) is simply

$$\text{(A4)}\quad \begin{aligned} E_{(h)}\{\exp(\zeta_{h,t})\} &= \exp\left(\frac{\sigma_{\zeta}^2}{2}\right) \\ &= \exp\left(\frac{1-\sigma_{u\eta}^2}{2}\right) \end{aligned}$$

where the second equality follows from (A2). The other term of (A3) can be developed as

$$\text{(A5)}\quad \begin{aligned} E_{(h)}\{\exp(\sigma_{u\eta}\eta_{h,t}) \mid D_{h,t} \neq 1\} &= \int_{-\infty}^{+\infty} \exp(\sigma_{u\eta}\eta_{h,t}) \cdot \phi(\eta_{h,t} \mid D_{h,t} \neq 1) d\eta_{h,t} \\ &= \frac{\int_{-\infty}^{-V_{h,t}} \exp(\sigma_{u\eta}\eta_{h,t}) \cdot \phi(\eta_{h,t}) d\eta_{h,t}}{1-\Phi(V_{h,t})} \end{aligned}$$

which follows from the fact that $D_{h,t} \neq 1$ if $\eta_{h,t} \leq -V_{h,t}$. The integral at the numerator can be rewritten as (equation (A6)):

$$\begin{aligned} \int_{-\infty}^{-V_{h,t}} \exp(\sigma_{u\eta}\eta_{h,t}) \cdot \phi(\eta_{h,t}) d\eta_{h,t} &= \int_{-\infty}^{-V_{h,t}} \exp(\sigma_{u\eta}\eta_{h,t}) \cdot (2\pi)^{-0.5} \exp\left(-\frac{\eta_{h,t}^2}{2}\right) d\eta_{h,t} \\ &= \int_{-\infty}^{-V_{h,t}} (2\pi)^{-0.5} \exp\left(\sigma_{u\eta}\eta_{h,t} - \frac{\eta_{h,t}^2}{2}\right) d\eta_{h,t} \end{aligned}$$

Completing the square of the term in the exponent,

$$\text{(A7)}\quad \begin{aligned} \sigma_{u\eta} v_{h,t} - \frac{\eta_{h,t}^{\ 2}}{2} &= -\frac{1}{2}\left(\eta_{h,t}^{\ 2} - 2\sigma_{u\eta}\eta_{h,t}\right) \\ &= -\frac{1}{2}\left(\eta_{h,t} - \sigma_{u\eta}\right)^2 + \frac{\sigma_{u\eta}^2}{2} \end{aligned}$$

which implies that (A6) can be written as (equation (A8))

$$\int_{\infty}^{-V_{h,t}} \exp(\sigma_{u\eta}\eta_{h,t})\cdot\phi(\sigma_{u\eta}\eta_{h,t})d\eta_{h,t} = \exp\left(\frac{\sigma_{u\eta}^2}{2}\right)\cdot\int_{\infty}^{-V_{h,t}}(2\pi)^{-0.5}\exp\left(-\frac{1}{2}(\eta_{h,t}-\sigma_{u\eta})^2\right)d\eta_{h,t}$$

$$= \exp\left(\frac{\sigma_{u\eta}^2}{2}\right)\cdot\int_{\infty}^{-V_{h,t}-\sigma_{u\eta}}(2\pi)^{-0.5}\exp\left(-\frac{1}{2}\eta_{h,t}^{2\,*}\right)d\eta_{h,t}^{*}$$

$$= \exp\left(\frac{\sigma_{u\eta}^2}{2}\right)\cdot\Phi(-V_{h,t}-\sigma_{u\eta})$$

$$= \exp\left(\frac{\sigma_{u\eta}^2}{2}\right)\cdot\left[1-\Phi(V_{h,t}+\sigma_{u\eta})\right]$$

Substituting (A8) in (A5) and (A4) and (A5) in (A3), I obtain

(A9)
$$E_{(h)}\{\exp(u_{h,t})\,|\,D_{h,t}\neq 1\} = \frac{\exp\left(\frac{\sigma_{u\eta}^2}{2}\right)\left[1-\Phi(V_{h,t}+\sigma_{u\eta})\right]}{1-\Phi(V_{h,t})}\cdot\exp\left(\frac{1-\sigma_{u\eta}^2}{2}\right)$$

$$= \frac{1-\Phi(V_{h,t}+\sigma_{u\eta})}{1-\Phi(V_{h,t})}\cdot\exp\left(\frac{1}{2}\right)$$

Since both $u_{h,t}$, and $\eta_{h,t}$ have unit variance, I can rewrite (A9) in terms of correlation between $u_{h,t}$ and $\eta_{h,t}$, instead of covariance, and obtain the sample selection term used in Section 1:

(A10)
$$E_{(h)}\{\exp(u_{h,t})\,|\,D_{h,t}\neq 1\} = s_{h,t}(V,\rho_{u\eta})$$

$$= \exp\left(\frac{1}{2}\right)\cdot\frac{1-\Phi(V_{h,t}+\rho_{u\eta})}{1-\Phi(V_{h,t})}\,.$$

Tables and Figures

Table 1: Sample Composition

Year	Type 1 (%)	Type 2 (%)	Type 3 (%)	Total households
1982	26.6	55.3	18.1	1957
1983	27.1	54.9	18.0	2004
1984	27.6	54.9	17.5	1987
1985	25.4	54.5	20.1	967[25]
1986	30.2	52.6	17.2	1935
1987	31.2	51.3	17.5	1940
1988	30.8	50.3	18.9	2003
1989	30.3	50.9	18.8	2001
1990	29.3	52.1	18.6	1978
1991	34.3	45.9	19.8	2027
1992	34.7	46.5	18.8	1841
1993	32.8	47.9	19.3	1910
1994	33.7	47.4	17.9	1939
1995	38.3	40.9	20.8	154
Total	30.5	51.0	18.5	24643

Table 2: Descriptive statistics for the total sample and for the three types of households

	Type 1	Type 2	Type 3	Whole Sample
Age (mean)	43.88	42.32	43.65	43.04
Less than high school (%)	5.79	14.84	32.21	15.29
High school diploma (%)	51.30	59.30	53.41	55.76
College degree (%)	42.91	25.86	14.38	28.95
Male (%)	77.81	69.24	58.96	69.958
Single person (%)	14.31	20.20	18.02	18.00
Married (%)	76.70	63.75	53.56	65.82
Children (%)	49.30	47.89	53.52	49.36
North-East (%)	21.26	18.16	28.09	20.94
Mid-West (%)	27.45	26.12	24.67	26.26
South (%)	26.69	28.36	29.80	28.12
West (%)	24.60	27.35	17.45	24.68
After tax monthly income	$3,142.34	$2,260.90	$1,764.62	$2,438.28
c_1 (mean)	$529.07	$442.45	$398.23	$455.17
c_2 (mean)	$529.81	$435.88	$360.40	$450.60
No. of Observations	7,527	12,555	4,561	24,643

[25] The relatively small number of households in 1985 is due to the fact that in 1986 the sample design and the household identification numbers were changed. Those households who entered the survey in 1985 are followed only through the first quarter of 1986. Those who had their first interview after June 1986 were dropped (or had their identifier changed) before reaching the last interview.

Table 3: Average Nine-Month Returns (1981:12-1995:09)

	Mean	Standard Deviation	Min	Max
S&P500CI	0.1208	0.1277	-0.1839	0.5932
T-Bills	0.0488	0.0167	0.0217	0.0886

Table 4: Results of Probit Estimation

	Probability of holding risky assets	Probability of holding either risky and riskless assets or no assets	Probability of holding some asset (risky or riskless)
Age	6.05	1.74	3.67
	(1.82)	(1.66)	(1.96)
Age^2	-4.41	-1.85	-2.39
	(1.76)	(1.61)	(1.90)
Age^3	1.20	0.61	0.53
	(0.55)	(0.50)	(0.59)
High School Diploma	1.23	-0.56	1.22
	(0.14)	(0.10)	(0.10)
College Degree	1.78	-0.57	2.10
	(0.15)	(0.11)	(0.13)
Sex	0.27	0.01	0.31
	(0.02)	(0.02)	(0.02)
Single	-0.22	-0.14	-0.08
	(0.03)	(0.02)	(0.03)
North East	0.04	0.31	-0.45
	(0.03)	(0.02)	(0.03)
Mid-West	0.09	0.16	-0.16
	(0.02)	(0.02)	(0.03)
South	-0.01	0.13	-0.23
	(0.02)	(0.02)	(0.03)
Children	-0.02	0.10	-0.17
	(0.02)	(0.02)	(0.03)
Age*High School Diploma	-0.46	0.42	-0.50
	(0.12)	(0.08)	(0.09)
Age*College Degree	-0.55	0.68	-1.01
	(0.12)	(0.10)	(0.11)
Constant	-4.26	-0.57	-1.50
	(0.62)	(0.55)	(0.65)
p-value Year Dummies	0.0000	0.0000	0.0000
No. of Observations	24,643	24,643	24,643
Pseudo R^2	0.0715	0.0206	0.0851

Table 5: Estimates of the Lower Bounds to the Transaction Costs for the Market for the Risky Asset and of the Corresponding Optimal Portfolios (17,116 households)

Pand (a): ($\rho_{u\eta}$=0.5)

		γ=0.5	γ=1	γ=1.5	γ=2	γ=2.5	γ=3	γ=3.5
Transaction costs bound		51.93	40.57	37.55	36.57	36.74	38.02	40.55
		(13.39)	(7.53)	(5.36)	(4.24)	(3.76)	(4.02)	(5.34)
Portfolio parameters	$R_{t-1,t}$	1.57	1.08	0.85	0.70	0.59	0.48	0.39
		(0.82)	(0.52)	(0.42)	(0.39)	(0.40)	(0.43)	(0.50)
	$R^f_{t-1,t}$	0.89	1.62	1.95	2.15	2.28	2.40	2.46
		(0.81)	(0.52)	(0.42)	(0.40)	(0.42)	(0.47)	(0.54)
	$g_{t-1,t}$	-0.09	-0.06	-0.04	-0.03	-0.02	-0.01	-0.00
		(0.03)	(0.02)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
	$\pi_{t-1,t}$	-0.14	-0.10	-0.08	-0.07	-0.05	-0.04	-0.03
		(0.04)	(0.03)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
Optimal portf. as % of Consumption		12.55	8.43	6.94	6.13	5.62	5.27	5.03
Sargan test (*dof* = *10*)		13.15	12.78	12.35	11.37	10.07	11.47	11.21
		(0.22)	(0.24)	(0.26)	(0.33)	(0.43)	(0.32)	(0.34)

Pand (a): ($\rho_{u\eta}$=-0.5)

		γ=0.5	γ=1	γ=1.5	γ=2	γ=2.5	γ=3	γ=3.5
Transaction costs bound		50.94	39.93	36.97	36.00	36.21	37.60	40.55
		(12.84)	(7.28)	(5.22)	(4.16)	(3.71)	(3.92)	(5.08)
Portfolio parameters	$R_{t-1,t}$	1.57	1.08	0.85	0.71	0.59	0.48	0.40
		(0.82)	(0.53)	(0.43)	(0.39)	(0.39)	(0.42)	(0.48)
	$R^f_{t-1,t}$	0.90	1.63	1.95	2.15	2.29	2.40	2.47
		(0.82)	(0.53)	(0.43)	(0.39)	(0.41)	(0.45)	(0.51)
	$g_{t-1,t}$	-0.09	-0.06	-0.04	-0.03	-0.02	-0.01	-0.00
		(0.03)	(0.02)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
	$\pi_{t-1,t}$	-0.14	-0.10	-0.08	-0.07	-0.05	-0.04	-0.03
		(0.04)	(0.03)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
Optimal portf. as % of Consumption		12.47	8.35	6.86	6.06	5.55	5.21	4.99
Sargan test (*dof* = *10*)		13.24	12.87	12.54	11.63	9.98	11.68	11.63
		(0.21)	(0.23)	(0.25)	(0.31)	(0.44)	(0.31)	(0.31)

Note: The transaction cost bounds are measured per-year and are in 1982-84 dollars.

Table 6: Estimates of the Lower Bounds to the Transaction Costs for the Market for the Risky Asset and of the Corresponding Optimal Portfolios (12,555 households)

Panel (a): ($\rho_{u\eta}$=0.5)

		γ=0.5	γ=1	γ=1.5	γ=2	γ=2.5	γ=3	γ=3.5
Transaction costs bound		54.70 (14.86)	42.01 (8.68)	38.07 (6.40)	36.10 (5.20)	35.03 (4.55)	34.81 (4.30)	35.21 (4.51)
Portfolio parameters	$R_{t-1,t}$	1.50 (0.84)	0.96 (0.53)	0.70 (0.42)	0.55 (0.37)	0.42 (0.35)	0.31 (0.36)	0.20 (0.40)
	$R^f_{t-1,t}$	1.05 (0.82)	1.87 (0.52)	2.26 (0.40)	2.50 (0.36)	2.69 (0.36)	2.86 (0.40)	3.02 (0.47)
	$g_{t-1,t}$	-0.10 (0.03)	-0.07 (0.02)	-0.06 (0.02)	-0.05 (0.01)	-0.04 (0.02)	-0.04 (0.02)	-0.03 (0.03)
	$\pi_{t-1,t}$	-0.15 (0.05)	-0.12 (0.03)	-0.11 (0.03)	-0.10 (0.02)	-0.09 (0.02)	-0.09 (0.03)	-0.09 (0.03)
Optimal portf. as % of Consumption		12.42	8.24	6.71	5.86	5.31	4.92	4.64
Sargan test (*dof = 10*)		12.48 (0.25)	12.66 (0.24)	13.06 (0.22)	13.01 (0.22)	12.48 (0.25)	11.91 (0.29)	11.30 (0.33)

Panel (b): ($\rho_{u\eta}$=-0.5)

		γ=0.5	γ=1	γ=1.5	γ=2	γ=2.5	γ=3	γ=3.5
Transaction costs bound		52.52 (13.86)	40.64 (8.13)	37.02 (6.02)	35.25 (4.91)	34.33 (4.32)	34.06 (4.14)	34.41 (4.44)
Portfolio parameters	$R_{t-1,t}$	1.52 (0.82)	0.97 (0.52)	0.71 (0.41)	0.55 (0.36)	0.41 (0.35)	0.29 (0.37)	0.17 (0.42)
	$R^f_{t-1,t}$	1.01 (0.81)	1.85 (0.51)	2.25 (0.40)	2.46 (0.36)	2.70 (0.37)	2.88 (0.41)	3.05 (0.49)
	$g_{t-1,t}$	-0.10 (0.03)	-0.07 (0.02)	-0.06 (0.02)	-0.05 (0.01)	-0.04 (0.02)	-0.04 (0.02)	-0.03 (0.02)
	$\pi_{t-1,t}$	-0.15 (0.05)	-0.12 (0.03)	-0.11 (0.03)	-0.10 (0.02)	-0.09 (0.02)	-0.09 (0.03)	-0.09 (0.03)
Optimal portf. as % of consumption		12.37	8.21	6.68	5.84	5.30	4.91	4.63
Sargan test (*dof = 10*)		12.68 (0.24)	12.70 (0.24)	12.91 (0.23)	12.81 (0.23)	12.36 (0.26)	11.92 (0.29)	11.31 (0.33)

Note: The transaction cost bounds are measured per-year and are in 1982-84 dollars.

Table 7: "Cash-in-Hand" Based Estimates of the Lower Bounds to the Transaction Costs for the Market for the Risky Asset and of the Corresponding Optimal Portfolios ($\rho_{u\eta}$=0.5). (17,116 households)

Panel (a): ($\rho_{u\eta}$=0.5)

		γ=0.5	γ=1	γ=1.5	γ=2	γ=2.5	γ=3	γ=3.5
Transaction costs bound		84.72	78.74	80.10	82.70	85.65	88.81	91.55
		(17.56)	(11.45)	(8.99)	(7.57)	(6.80)	(6.98)	(8.81)
Portfolio parameters	$R_{t-1,t}$	1.18	0.69	0.48	0.36	0.33	0.22	0.29
		(0.57)	(0.31)	(0.22)	(0.19)	(0.20)	(0.25)	(0.32)
	$R^f_{t-1,t}$	0.85	1.45	1.68	1.80	1.81	1.88	1.72
		(0.58)	(0.31)	(0.23)	(0.21)	(0.24)	(0.33)	(0.44)
	$g_{t-1,t}$	-0.06	-0.04	-0.02	-0.01	-0.01	0.00	0.01
		(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
	$\pi_{t-1,t}$	-0.11	-0.07	-0.05	-0.04	-0.02	-0.01	0.01
		(0.04)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.04)
Optimal portf. as % of Consumption		16.27	12.53	11.21	10.57	10.20	10.00	9.91
Sargan test (*dof* = *10*)		13.18	12.96	12.67	12.71	12.78	11.57	10.40
		(0.21)	(0.23)	(0.24)	(0.24)	(0.24)	(0.31)	(0.41)

Panel (b): ($\rho_{u\eta}$=-0.5)

		γ=0.5	γ=1	γ=1.5	γ=2	γ=2.5	γ=3	γ=3.5
Transaction costs bound		85.09	79.66	82.22	83.88	86.99	90.34	93.68
		(17.11)	(11.29)	(8.94)	(7.55)	(6.77)	(6.81)	(8.35)
Portfolio parameters	$R_{t-1,t}$	1.18	0.68	0.47	0.35	0.33	0.22	0.27
		(0.57)	(0.31)	(0.22)	(0.19)	(0.19)	(0.23)	(0.29)
	$R^f_{t-1,t}$	0.84	1.44	1.68	1.80	1.80	1.88	1.76
		(0.58)	(0.31)	(0.22)	(0.20)	(0.22)	(0.30)	(0.40)
	$g_{t-1,t}$	-0.06	-0.04	-0.02	-0.01	-0.01	0.00	0.01
		(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
	$\pi_{t-1,t}$	-0.11	-0.07	-0.05	-0.04	-0.02	-0.01	0.01
		(0.04)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	(0.03)
Optimal portf. as % of consumption		16.31	12.58	11.26	10.63	10.26	10.06	9.97
Sargan test (*dof* = *10*)		13.23	12.99	12.75	12.82	12.77	11.20	9.84
		(0.21)	(0.22)	(0.24)	(0.23)	(0.24)	(0.34)	(0.45)

Note: The transaction cost bounds are measured per-year and are in 1982-84 dollars.

Table 8: Estimates of the Lower Bounds to the Transaction Costs for the Market for the Riskless Asset and of the Corresponding Optimal Portfolios (4,561 households)

Panel (a): ($\rho_{u\eta}$=0.5)

		γ=0.5	γ=1	γ=1.5	γ=2	γ=2.5	γ=3	γ=3.5
Transaction costs bound		13.84 (1.93)	17.71 (2.60)	21.14 (3.27)	24.35 (4.03)	27.74 (5.20)	31.64 (7.31)	36.21 (11.22)
Portfolio parameters	$R_{t-1,t}$	0.56 (0.33)	0.47 (0.40)	0.49 (0.44)	0.46 (0.49)	0.42 (0.55)	0.38 (0.65)	0.36 (0.79)
	$R^f_{t-1,t}$	1.75 (0.42)	1.96 (0.49)	1.98 (0.54)	2.03 (0.58)	2.07 (0.65)	2.09 (0.74)	2.05 (0.88)
	$g_{t-1,t}$	0.01 (0.02)	0.01 (0.02)	0.02 (0.02)	0.03 (0.03)	0.03 (0.03)	0.04 (0.03)	0.05 (0.04)
	$\pi_{t-1,t}$	-0.00 (0.04)	0.02 (0.05)	0.03 (0.05)	0.04 (0.06)	0.05 (0.06)	0.07 (0.07)	0.09 (0.08)
Optimal portf. as % of consumption		7.79	6.43	5.87	5.52	5.27	5.08	4.92
Sargan test (*dof* = *10*)		13.70 (0.19)	14.40 (0.16)	14.46 (0.15)	14.40 (0.16)	14.24 (0.16)	14.01 (0.17)	13.74 (0.19)

Panel (b): ($\rho_{u\eta}$=-0.5)

		γ=0.5	γ=1	γ=1.5	γ=2	γ=2.5	γ=3	γ=3.5
Transaction costs bound		14.36 (1.95)	18.44 (2.59)	22.22 (3.25)	25.92 (4.01)	30.02 (5.10)	34.99 (6.95)	41.11 (10.23)
Portfolio parameters	$R_{t-1,t}$	0.29 (0.30)	0.40 (0.37)	0.41 (0.41)	0.35 (0.44)	0.26 (0.49)	0.17 (0.56)	0.28 (0.67)
	$R^f_{t-1,t}$	2.06 (0.39)	2.02 (0.45)	2.05 (0.49)	2.14 (0.53)	2.23 (0.58)	2.31 (0.65)	2.31 (0.76)
	$g_{t-1,t}$	0.01 (0.02)	0.02 (0.02)	0.03 (0.02)	0.03 (0.03)	0.04 (0.03)	0.05 (0.03)	0.06 (0.04)
	$\pi_{t-1,t}$	-0.01 (0.04)	0.02 (0.04)	0.03 (0.05)	0.03 (0.05)	0.04 (0.05)	0.05 (0.06)	0.07 (0.06)
Optimal portf. as % of consumption		7.76	6.43	5.90	5.59	5.38	5.23	5.11
Sargan test (*dof* = *10*)		13.22 (0.21)	14.45 (0.15)	14.45 (0.15)	14.33 (0.16)	14.08 (0.17)	13.71 (0.19)	13.37 (0.20)

Note: The transaction cost bounds are measured per-year and are in 1982-84 dollars.

Table 9: Estimates of the Lower Bounds to the Transaction Costs for a Portfolio of Risky and Riskless Assets (4,561 households)

Panel (a): ($\rho_{u\eta}$=0.5)

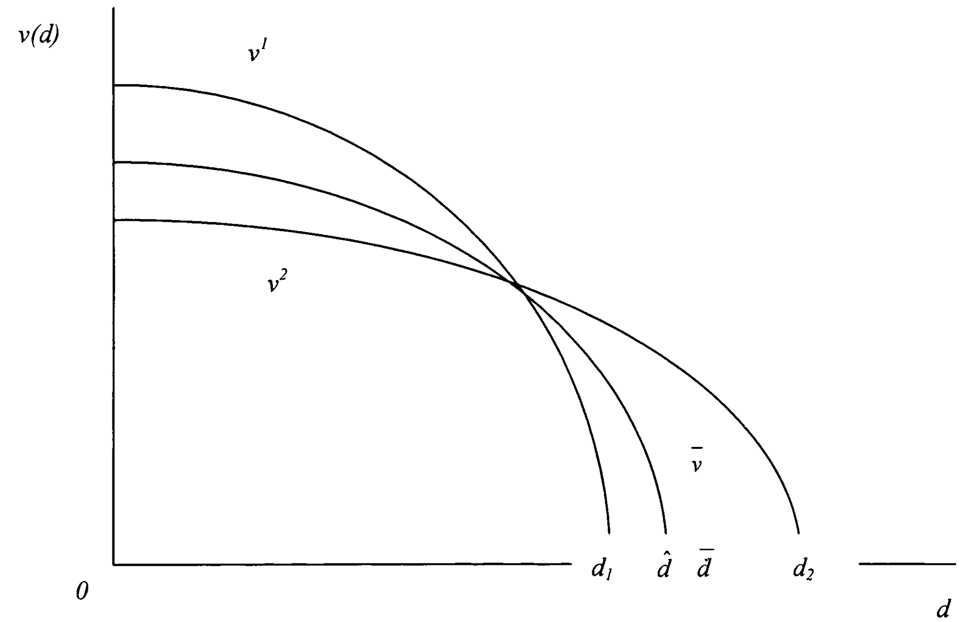
	γ=0.5	γ=1	γ=1.5	γ=2	γ=2.5	γ=3	γ=3.5
Transaction costs bound	34.61 (11.90)	31.35 (8.55)	32.04 (8.35)	33.66 (8.54)	35.94 (9.69)	38.93 (12.11)	42.65 (16.86)
Risky assets (% of Consumption)	12.78	8.73	7.27	6.48	5.96	5.59	5.30
Riskless assets (% of Consumption)	0.00	0.00	0.00	0.00	0.01	0.01	0.01
Sargan test (*dof* = *10*)	12.61 (0.25)	12.82 (0.23)	13.12 (0.22)	13.34 (0.21)	12.76 (0.24)	13.93 (0.18)	13.88 (0.18)

Panel (a): ($\rho_{u\eta}$=-0.5)

	γ=0.5	γ=1	γ=1.5	γ=2	γ=2.5	γ=3	γ=3.5
Transaction costs bound	36.24 (12.82)	32.79 (9.20)	33.64 (8.69)	35.55 (9.56)	38.33 (3.97)	42.20 (11.83)	47.29 (16.20)
Risky assets (% of Consumption)	12.72	8.71	7.30	6.53	6.06	5.73	5.48
Riskless assets (% of Consumption)	0.00	0.00	0.00	0.00	0.01	0.01	0.01
Sargan test (*dof* = *10*)	12.52 (0.25)	12.78 (0.24)	13.21 (0.21)	13.46 (0.20)	12.76 (0.24)	13.62 (0.19)	13.52 (0.20)

Note: The transaction cost bounds are measured per-year and are in 1982-84 dollars.

Figure 1: Expected Utility and Cost Bounds



v^h is household h expected utility gain; d_h is the minimal cost which equalises household h expected gain to zero; $\bar{d}$ is the mean household cost bound; $\bar{v}$ is the mean expected gain, which $\hat{d}$ equalizes to zero.

Chapter Two

Risk Aversion, Wealth and Background Risk[1]

The relationship between a consumer's attitude towards risk, as indicated for instance by the degree of absolute risk aversion or of absolute risk tolerance, and wealth is central to many fields of economics. As it was argued by Kenneth Arrow (1970) as long as 35 years ago "the behavior of these measures as wealth varies is of the greatest importance for prediction of economic reactions in the presence of uncertainty".

Most of the inference on the nature of this relation is based on common sense, introspection, casual observation of behavioral differences between the rich and the poor and a priori reasoning and concerns the sign of the relation, whereas no evidence at all, even indirect, is available on its curvature. The consensus view is that absolute risk aversion should decline with wealth.[2] Furthermore, if one agrees that preferences are characterized by constant relative risk aversion - a property of one of the most commonly used utility functions, the isoelastic - then absolute risk aversion is decreasing and convex in wealth, while risk tolerance is increasing and linear. The curvature of absolute risk tolerance has been shown to be relevant in a number of contexts. For instance, Gollier and Zeckhauser (1997) show that it determines whether the portfolio share invested in risky assets increases or decreases over the consumer life cycle, an issue that is receiving increasing attention. Moreover, if risk tolerance is concave, wealth inequality can help elucidate the risk premium puzzle (Gollier, 1999). Furthermore, the curvature of risk tolerance and the nature of risk aversion may explain why the marginal propensity to consume out of current resources, rather than being constant, declines as the level of resources increases (Carroll and Kimball (1996), Gollier (1999)).

[1] This chapter is part of a research project joint with Luigi Guiso.

[2] It is on these grounds that quadratic and exponential utility, though often analytically convenient, are regarded as misleading representations of preferences.

The aim of our analysis is to provide empirical evidence on the nature of the relationship between risk aversion and wealth. Using data from the Bank of Italy Survey of Household Income and Wealth (SHIW), we employ the information on household willingness to pay for a lottery to recover a measure of the Arrow-Pratt index of absolute risk aversion and relate it to indicators of consumers' endowment, as well as to a set of demographic characteristics to control for individual preference heterogeneity.

The usual definition of risk aversion and tolerance developed by Arrow (1970) and Pratt (1964) is based on the assumption that initial wealth is non-random. It is also constructed in a static setting or in settings where full access to the credit market is assumed. Recently it has been shown that attitudes towards risk can be affected by the prospect of being liquidity-constrained and by the presence of additional uninsurable, non-diversifiable risks. Gollier (1999) shows that the possibility that consumers will be subject to a liquidity constraint in the future makes them less willing to bear risk presently, i.e. increases their risk aversion. Pratt and Zeckhauser (1987), Kimball (1993) and Eekhoudt, Gollier and Schlesinger (1996) establish a set of conditions on preferences that define classes of utility functions whose common feature is that the presence of background risk makes the individual behave in a more risk-averse manner. They call these classes of utility functions "proper", "standard" and "risk vulnerable", respectively.[3] The main implication is that even if risks are independent, individuals will react to background risk by reducing their exposure to avoidable risks. One important consequence is that individuals facing high exogenous labor income risk - which is normally uninsurable - will be more risk-averse and thus avoid exposure to

[3] Pratt and Zeckhauser (1987) define as "proper" the class of utility functions that ensure that introducing an additional independent undesirable risk when another undesirable one is already present makes the consumer less willing to accept the extra risk. Kimball defines as "standard" the class of utility functions that guarantee that an additional independent undesirable risk increases the sensitivity to other loss-aggravating ones. Starting from initial wealth w, a risk $\tilde{x}$ is undesirable if and only if it satisfies $Eu(w-\tilde{x}) \leq u(w)$ where $u(w)$ is an increasing and concave utility function. A risk $\tilde{x}$ is loss-aggravating if and only if it satisfies $Eu'(w+\tilde{x}) \geq u'(w)$. When absolute risk aversion is decreasing, every undesirable risk is loss-aggravating, but not every loss-aggravating risk is undesirable. See Kimball (1993) and Gollier and Pratt (1996). Finally, Eeckhoudt, Gollier and Schlesinger (1996)'s risk vulnerability implies that adding a zero-mean background risk makes consumers more risk averse.

portfolio risk by holding less or no risky assets. Similarly, they should tend to buy more insurance against the risks that are insurable (Eekhoudt and Kimball (1992)).[4] Furthermore, insofar as income risk evolves with age, under standardness, background risk may help explain the life cycle of asset holdings. Several papers have cited background risk and risk vulnerability (or standardness) to explain the portfolio puzzles.[5] In all these studies, standardness or risk vulnerability is just assumed, but it is not tested because of lack of evidence on individual risk aversion.

The evidence presented in this chapter sheds light also on the empirical relevance of these concepts. In particular, the availability of information on the subjective probability distribution of future earnings and on the volatility of GDP allows us to relate our index of risk aversion to indicators of background risk.

Our findings show that absolute risk tolerance is an increasing and concave function of consumers' resources: thus, we reject both CARA and CRRA preferences. Furthermore, we find that, when income risk is proxied by the variance of shocks to GDP in the province where consumers live, risk aversion is positively affected by background risk. Our estimates, however, show that, even after controlling for individual characteristics, there remains a large amount of unexplained variation in attitudes towards risk reflecting partly genuine differences in tastes. Finally, we find that our measure of attitude towards risk has considerable explanatory power on a number of household decisions including occupation and moving/staying choices, the demand for risky financial assets, insurance and health status.

The rest of the chapter is organized as follows. Section 1 describes our measure of risk aversion when wealth is non-random and when there is background risk. Section 2 presents descriptive evidence on absolute risk aversion in our cross-section of households. In Section 3 we discuss the empirical

[4] Guiso, Jappelli and Terlizzese (1996) find that households facing greater earnings risk buy less risky assets; Guiso and Jappelli (1998) show that households buy more liability insurance in response to earnings risk.

[5] See Weil (1992), Gollier and Zeckhauser (1997), Gollier (1999), Coco et al. (1998), Heaton and Lucas (2000).

specification we use to relate absolute risk aversion to the consumer endowment, his attributes and then to his environment. Section 4 presents the results of the estimates. In Section 5 we check the robustness of the main findings to the endogeneity of consumption and wealth, to non-responses and to the possible presence of outliers. Section 6 presents evidence regarding the effects of background risk on the propensity to bear risk. In Section 7 we characterize empirically the regime of the attitude towards risk to which households belong (i.e. whether they are risk-averse or either risk-neutral or risk lovers). Section 8 provides evidence on whether risk attitudes help predict consumers choices. Section 9 discusses the *consistency with* observed behavior of our findings on the shape of the wealth-risk aversion relation. Section 10 summarizes and concludes.

1. Measuring Risk Aversion

To measure absolute risk aversion and tolerance, we exploit the 1995 wave of the Survey of Household Income and Wealth (SHIW), which is run biannually by the Bank of Italy. The 1995 SHIW collects data on income, consumption, financial wealth, real estate wealth, and several demographic variables for a representative sample of 8,135 Italian households. Balance-sheet items are end-of-period values. Income and flow variables refer to 1995.[6]

The 1995 wave has a section designed to elicit attitudes towards risk. Each participant is offered a hypothetical lottery and is asked to report the maximum price that he would be willing to pay to participate. Specifically:

> *"We would like to ask you a hypothetical question that we would like you to answer as if the situation was a real one. You are offered the opportunity of acquiring a security permitting you, with the same probability, either to gain 10 million lire or to lose all the capital invested. What is the most that you are prepared to pay for this security?"*

Ten million lire correspond to just over Euro 5,000 (or roughly $5,000). The ratio of the expected gain of the hypothetical lottery to average household

[6] See the appendix for a detailed description of the survey contents, its sample design, interviewing procedure and response rates.

consumption is 16 percent; thus, the lottery represents a relatively large risk. We consider this as an advantage since expected utility maximizers behave as risk neutral individuals with respect to small risks even if they are risk-averse to larger risks (Arrow, 1970). Thus, facing consumers with a relatively large lottery represents a better strategy to eliciting risk attitudes.[7] The interviews are conducted personally at the consumer's home by professional interviewers. In order to help the respondent understand the question, the interviewers show an illustrative card and are ready to provide explanations. The respondent can answer in one of three ways: a) declare the maximum amount he is willing to pay to participate, which we denote Z_i; b) don't know; c) unwilling to answer.

Clearly, $Z_i < 10$ million lire, $Z_i = 10$, and $Z_i > 10$ million lire imply risk aversion, risk neutrality and risk loving, respectively. This characterizes attitudes towards risk qualitatively. But we can do more; a measure of the Arrow-Pratt index of absolute risk aversion can be obtained for each consumer. Let w_i denote household i's endowment, which for a moment is assumed to be non-random. Let $u_i(.)$ be its utility function and $\tilde{P}_i$ be the random prize of the lottery for individual i, taking values 10 million and $-Z_i$ with equal probability. The maximum entry price is thus given by:

(1) $$u_i(w_i) = \frac{1}{2}u_i(w_i + 10) + \frac{1}{2}u_i(w_i - Z_i) = Eu_i(w_i + \tilde{P}_i)$$

where E is the expectations operator. Taking a second-order Taylor expansion of the right-hand side of (1) around w_i gives:

(2) $$Eu_i(w_i + \tilde{P}_i) = u_i(w_i) + u_i'(w_i)E(\tilde{P}_i) + \frac{1}{2}u_i''(w_i)E(\tilde{P}_i^2)$$

Substituting (2) into (1) and simplifying we obtain:

(3) $$R_i(w_i) \cong -u_i''(w_i)/u_i'(w_i) = 4(5 - Z_i/2)/(10^2 + Z_i^2)$$

Equation (3) uniquely defines the Arrow-Pratt measure of absolute risk aversion in terms of the parameters of the lottery in the survey. Absolute risk tolerance is

[7] In this vein, Rabin (2000) argues that if an expected utility maximizer refuses a small lottery at all levels of wealth than he must exhibit clearly unrealistic levels of risk aversion when faced with large-scale risks. This again suggests that offering large lotteries is a better way to characterize the risk aversion of expected utility maximizers.

defined by $T_i(w_i)=1/R_i(w_i)$. Obviously, for risk-neutral individuals (i.e. those reporting $Z_i=10$, implying that the expected loss is equal to the expected gain), $R_i(w_i)=0$ and for the risk-prone (those with $Z_i>10$, so that the expected loss exceeds the expected gain), $R_i(w_i)<0$. According to (3) absolute risk aversion may vary with consumer endowment and with all the attributes that are correlated with his preferences. A few comments on this measure and on how it compares with those used in other studies are in order. First, our measure requires no assumption on the form of the individual utility function, which is left unspecified. Second, it is not restricted to risk-averse individuals but extends to the risk-neutral and the risk lovers. Third, our definition provides a point estimate, rather than a range, of the degree of risk aversion for each individual in the sample. These features mark a difference between our study and that of Barsky, Juster, Kimball and Shapiro (1997) who only obtain a range measure of (relative) risk aversion and a point estimate under the assumption that preferences are strictly risk-averse and utility is of the CRRA type. Moreover, their sample consists of individuals aged 50 or above, which makes it hard not only to study the age profile of risk aversion but also to test its relationship with background risk since the latter is likely to matter most for the young.[8] These relationships are instead the focus of our analysis.

1.1 Risk Aversion with Background Risk

The measure of risk aversion in (3) is for non-random initial wealth, but it is easily generalized to the case of background risk using the results of Kihlstrom, Romer and Williams (1981) and Kimball (1993). For this purpose we have to restrict the analysis to risk-averse individuals (i.e. those reporting $Z_i < 10$).

Let $\tilde{y}_i$ denote a zero-mean background risk for individual i, whose variance is σ^2. Denoting with $E_x(x=y,P)$ the expectation with respect to the random variable $\tilde{x}_i$, our indifference condition for undertaking the lottery and paying Z_i becomes

[8] However, the Barsky et al. measure of risk aversion has other advantages. Since the risk tolerance question is asked in both wave I and II of the survey they use and a subset of the respondents is common to both waves, they can account for measurement errors in their measure of relative risk aversion. Furthermore they collect information on intertemporal substitution and can thus study its relation with risk aversion. But they have no direct information on background risk.

(4) $E_y u_i(w_i + \tilde{y}_i) = E_P E_y u_i(w_i + \tilde{y}_i + \tilde{P}_i)$

where we have implicitly assumed that the background risk and the lottery are independent, which is assured by construction. If preferences are risk-vulnerable as in Gollier and Pratt (1996), we can use the equivalence:

(5) $E_y u_i(w_i + \tilde{y}_i) = v_i(w_i)$

where $v_i(w_i)$ is a concave transformation of u_i, which implies that $v_i(w_i)$ is more risk-averse than $u_i(w_i)$. In other words, if consumers h and j are both risk-averse and their preferences are risk-vulnerable, then, assuming $w_j = w_h$, h is more risk-averse than j if $\tilde{y}_h$ is riskier than $\tilde{y}_j$, i.e. if he faces more background risk.[9]

We can thus account for background risk by expressing our measure of risk aversion in terms of the utility function $v_i(w_i)$ to get

(6) $R_i(w_i) \cong -v_i''(w_i)/v_i'(w_i) = 4(5 - Z_i/2)/(10^2 + Z_i^2)$

Risk aversion will now vary not only with the consumer's endowment and attributes but also with any source of uncertainty characterizing his environment. If measures of the latter are available, one can directly test for standardness of preferences.

Interestingly, the shape of the relation between R (or risk tolerance) and w can have implications for the sign of the effect of background risk on absolute risk aversion. Hennessy and Lapan (1998) show that a positive and concave relation of risk tolerance with wealth is sufficient for preferences to be standard as in Kimball (1993). Similarly, Eekhoudt, Gollier, and Schlesinger (1996) show that a sufficient (but not necessary) condition for absolute risk aversion to increase with background risk is that it is a decreasing and convex function of the endowment, an assumption that is satisfied, for instance, by CRRA utility. Gollier and Pratt (1996) argue that the convexity of absolute risk aversion should be regarded as a natural assumption[10], "... since it means that the wealthier an agent

[9] Preferences are said to be risk-vulnerable if the presence (or the addition) of an exogenous zero-mean background risk increases the aversion to any other independent risk. An alternative, but slightly more restrictive, preference property leading to analogous behavior is "standardness", developed by Kimball (1993). Standardness corresponds to vulnerability with respect to the set of risks that are marginal-utility increasing.

[10] Notice that if consumers are risk-averse at all levels of wealth and if absolute risk aversion is a strictly decreasing function of wealth, then absolute risk aversion must be convex in wealth.

is, the smaller is the reduction in risk premium of a small risk for a given increase in wealth". Though plausible, this assertion is not backed by any empirical evidence. Our results lend support to this conjecture in that they imply that absolute risk aversion is a convex function of the endowment.

2. Descriptive Evidence

The lottery question was submitted to the whole sample of 8,135 household heads, but only 3,458 answered and were willing to participate. Out of the 4,677 who did not, 1,586 reported a "do not know" and 3,091 overtly refused to answer or to participate with positive price (25 bet more than 20 millions). This is likely to be due to the complexity of the question, which might have led some participants to skip it altogether because of the relatively long time required to understand its meaning and to provide an answer.[11]

Table I reports descriptive statistics for the whole sample of 8,135 households, for the sample of 3,458 lottery respondents and, for the latter, for several sub-samples. Out of 3,458 individuals willing to participate in the lottery the great majority 96 percent) are risk averse, in that they report a maximum price lower than the prize of the lottery; 144 individuals are either risk neutral (125, or 3.6 percent of the sample), or risk lover (19, only a tiny minority). The table reports characteristics also for these three sub-samples. Those who responded to the lottery question are on average 6 years younger than the total sample and have higher shares of male-headed households (79.8 compared to 74.4 percent), of married people (78.9 and 72.5 percent respectively), of self-employed (17.9 and 14.2 percent) and of public sector employees (27.5 and 23.3 percent respectively). They are also somewhat wealthier and slightly better educated (1.3 more years of schooling). These differences seem to suggest that there are some systematic effects explaining the willingness to respond. At the same time, however, the small difference in education between the total sample and the sample of

[11] On the basis of these considerations and of the actual amounts reported (relative to the values reported for household wealth) it is likely that some respondents misunderstood the question and gave erroneous answers. In Section 4, we argue that measurement error due to misunderstanding of the lottery question is unlikely to affect the consistency of our analysis.

respondents seems to suggest that - in so far as education is also a proxy for better understanding - non-responses can be ascribed only partly to differences in the ability to understand the question.[12]

The two sub-sample of risk-lovers and risk-neutrals on the one hand and risk-averse consumers on the other, exhibit several interesting differences. For most characteristics the pattern has a clear ordering with the highest (or lowest) value for the risk-lovers-risk- neutrals and the lowest (or highest) for the risk-averse. Risk averse are younger and less educated; they are less likely to be male, to be married and to live in the North. Strong differences also emerge comparing the type of occupation: among the risk averse the share of self-employed is 17.4 percent, among the risk-prone or risk neutral it is much higher at 29.2 percent. This ordering is reversed for public sector employees. The risk-lovers and risk-neutral are public employees in 27 percent of the cases, while the risk-averse in 28 percent. These differences are likely to reflect self-selection, with more risk averse individuals choosing safer jobs. Finally, notice that the risk-averse are significantly less wealthy than the risk-lovers or neutrals (170 million lire of median net worth compared to 330 million).

Figure 1 focuses on the group of risk-averse consumers and shows the cross-sectional distribution of the degree of relative risk aversion, obtained by multiplying our measure of absolute risk aversion by household consumption. The distribution is right-skewed and the median of relative risk aversion is 4.8, somewhat higher than the commonly used value of 3, but with considerable heterogeneity ranging from 0.2 to 36.3. Furthermore, 90 percent of the cross-sectional distribution is comprised between 2.2 and 9.9, with 1,878 households (56 percent) falling in the range 2.5-6.5. As we will see, most of this variability cannot be explained by any observable characteristics.

Table I also reports also the characteristics of the modestly risk-averse consumers (at or below the sample median of the reported price Z_i) and of the high risk-averse (above median). Highly risk-averse consumers are on average

[12] A probit regression suggests that the probability of responding to the lottery question is higher among younger, more educated, healthy, male-headed households. Single persons are less likely to

two-year older, somewhat less well educated, less likely to be married and much more likely to live in the South. They are also less wealthy than the modestly risk-averse, both in terms of net worth, financial wealth and consumption (the median net worth of the two groups is 154.9 and 198.5 million lire respectively). Finally, the share of the self-employed is 15.6 percent for the highly risk-averse and 20.1 percent for the modestly risk averse, but that of public sector employees is 28.3 and 26.3 percent. Thus, being risk-averse as opposed to risk-lover or risk-neutral, as well as differences in the degree of risk aversion seem to explain sorting into riskier occupations.

3. Empirical Specification

Most of the literature assumes that agents are risk averse and is interested in assessing how risk aversion varies with the consumer's attributes and in particular with his endowment. Accordingly, the next four sections focus on risk-averse individuals. In Section 7 we look at the determinants of the regime of risk attitudes.

To estimate the relation between our index of absolute risk aversion and consumption or wealth we use the following specification (we omit the household index i for brevity):

$$(7) \qquad R(c) = \frac{ae^{\gamma H+\eta}}{c^{\beta}} = \frac{\kappa}{c^{\beta}}$$

where c is consumption, H is a vector of consumer characteristics affecting individual preferences, η is a random shock to preferences, a is a constant and γ and β are two unknown parameters.[13] Equation (7) is a generalization of absolute risk aversion under CRRA preferences; the latter obtain when $\beta = 1$ in which case $\kappa = ae^{\gamma H+\eta}$ measures relative risk aversion. Notice that $R()$ is always positive and is decreasing in c for all positive values of β. Furthermore, if $\beta > 0$, it is always

respond. In addition, the response probability is higher among public employees and depends positively on the number of earners.

[13] Notice that our empirical specification (7) does not allow for heterogeneity in the β parameter. If β varies across individuals our estimates would be affected by heteroschedasticity. However, a formal test cannot reject the null hypothesis that the error term is homoschedastic.

convex in c. Though simple, this formulation is flexible enough to allow us to analyze the curvature of absolute risk tolerance, which is defined as:

(8) $T(c) = \kappa^{-1} c^{\beta}$

Thus, if $\beta > 0$, risk tolerance is an increasing function of c; furthermore, it will be concave, linear or convex in c depending on whether β is less than, equal to or greater than 1. Since β measures the speed at which $R()$ declines with wealth, $T()$ is a concave (respectively convex) function of c if absolute risk aversion falls as consumption increases at a speed lower (respectively greater) than that characterizing CRRA preferences. Since most theoretical ambiguities rest on the curvature of T, not R, our approach is not restrictive.

Although equation (7) is assumed, a utility function that gives rise to a measure of absolute risk aversion as in (7) is

(9) $u(c) = \int e^{-\frac{a e^{\gamma H + \eta} c^{1-\beta}}{1-\beta}} = \int e^{-\frac{\kappa c^{1-\beta}}{1-\beta}}$

which converges to the CRRA utility $u(c) = \frac{c^{1-\kappa}}{1-\kappa}$ as β tends to 1.

Taking logs on both sides of (7), our empirical specification becomes:

(10) $\log(R) = \log a + \gamma H - \beta \cdot \log c + \eta$

The relation between absolute risk aversion and consumption as well as the curvature of absolute tolerance is thus parameterized by the value of β.

As pointed out earlier, when background risk, $\tilde{y}_i$, is present our measure of risk aversion must be interpreted as measuring the risk aversion of the indirect utility function $v(c) = Eu(c + \tilde{y})$. The question that arises is whether we can draw implications for the relation between the risk aversion of $u()$ and the level of the endowment from the relation between the risk aversion of $v()$ and the endowment.[14] In the Appendix we show that taking a second order Taylor expansion of the indirect utility function around c, yields the following index of the absolute risk aversion of this approximated utility:

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[14] The indirect utility function inherits several properties of $u()$. In particular, if $u()$ is DARA then also $v()$ is DARA. Furthermore, as shown by Kihlstrom, Romer and Williams (1981), comparative risk aversion is preserved by the indirect utility if $u()$ is non-increasing risk aversion.

$$R_v(c) = \kappa c^{-\beta} \frac{1 + p_u t_u s^2/2}{1 + p_u r_u s^2/2}$$

where κ is a constant, s is the coefficient of variation of the consumer's endowment and r_u, p_u and t_u denote, respectively, the degree of relative risk aversion, relative prudence and relative tolerance of the utility function $u()$.[15] Notice that $\kappa c^{-\beta}$ is the absolute risk aversion of $u()$ and that $R_v(c,s) > \kappa c^{-\beta}$ if, given $s>0$ and assuming the consumer is prudent (i.e. $p_u > 0$),relative risk tolerance is larger than relative risk aversion. Furthermore, since the term in square brackets is increasing in s, $R_v()$ too is increasing in s. Taking logs and using the relations between r_u, p_u and t_u spelled out in the Appendix, when there is background risk our empirical specification becomes

(11) $\log(R_v) = \log a + \gamma H - \beta \cdot \log c + \delta s^2 + \eta$

where $\delta = \beta p_u$. This formulation allows to test directly whether background risk affects risk attitudes. This requires two conditions to hold: consumers must be prudent $p_u > 0$ and risk aversion must be decreasing ($\beta > 0$).

4. Results

Table II shows the results of the estimation of equation (10) using different measures of consumer resources. The analysis is conducted on the sample of risk-averse consumers. Possible misinterpretations of the survey question, as well as difficulties in figuring out the maximum price to be paid suggest that the left-hand-side variable, R, is likely to suffer measurement error. This will be reflected in the residual η but, in so far as it is uncorrelated with the explanatory variables in equation (10), it will not lead to bias but only to a loss of efficiency.

In the first column of the Table we regress $log(R_i)$ only on (log) consumption and do not include any consumers characteristics that can proxy for differences in tastes. As a measure of consumption we use total expenditure on durable and non-durable goods. Since preliminary estimates show that OLS residuals are far from being normal, we report boostrapped standard errors

[15] See the Appendix for the definition of relative prudence and tolerance.

computed with 100 replications. The estimate of β is 0.0902 and is highly statistically significant leading to the rejection of preferences with constant absolute risk aversion. The estimated value of β implies that absolute risk aversion declines with wealth but at a rate that is far slower than that implied by constant relative risk aversion preferences. In fact, the hypothesis that $\beta = 1$ can be strongly rejected (F=5,039.47). It follows that absolute risk tolerance is a concave function of consumer resources.

In the second column of the table we include a set of strictly exogenous individual characteristics, such as gender, age, region of birth and number of siblings. If tastes are impressed in our chromosomes or evolve over life in a systematic way or are affected by the culture of the place of birth or by the possibility of relying on the support of a brother or sister, then these variables should have predictive power. The analysis shows that only age and the region of birth in fact do, with risk aversion increasing with age. Being male has a negative effect on the degree of risk aversion but it is not statistically significant. Furthermore, a test of the hypothesis that the coefficients on gender, age and number of siblings are jointly equal to zero cannot be rejected at the standard levels of significance F=3.63, *p-value*=0.0124). Finally, the joint significance of the 19 regional dummies[16] included in the regression, capturing the region of birth, cannot be rejected (see the bottom of Table II). Furthermore, the coefficients on these dummies (not shown) reveal a pattern: compared to those born in the central and southern regions, consumers born in the North are somewhat less risk-averse. One possible interpretation is that the dummies are capturing regional differences in culture, which are transmitted by the upbringing. In addition to these variables, we insert in the regression also a dummy equal to one if the consumer has ever experienced unemployment or temporary layoffs and two dummies for his father occupation: the first dummy is equal to 1 if the consumer's father is/was a self-employed (zero otherwise); the second dummy is equal to 1 if he is/was a public sector employee (zero otherwise). This allows us to test to what

[16] The Italian territory is divided into 20 regions and 95 provinces. The latter correspond broadly to US counties. We will use the provincial partitioning in Section 6.

extent unfortunate past events, such as experiences of unemployment spells of layoffs, affect one's willingness to undertake risk in the future and to check whether parents attitudes towards risk - as reflected in their occupation choice - are transmitted to their children. The estimates show that none of these variables has a significant effect on the degree of risk aversion. Yet, as we show in Section 8 the degree of risk aversion has considerable explanatory power on the occupation choice of the consumer. In turn, the occupation choice is strongly affected by the parents occupation, implying strong intergenerational persistence in the tradition of Galton (1869).[17] Since we find that parents' occupation has no effect on their kids attitudes towards risk, our results suggest that taste persistence across generations is not an explanation for the observed persistence in occupation choice. Inquiring further into the role of other demographic variables such as family size or education by including them in the regression is problematic since these variables are to some extent endogenous. Thus, the interpretation of their coefficients would be unclear; accordingly we elect to focus only on this set of controls that are not subject to the respondent's choice.

The last two columns of the table show a set of results based on total and financial wealth, instead of consumption. The basic findings are confirmed: absolute risk aversion is a decreasing and convex function of wealth (total or financial) but CRRA preferences are strongly rejected. The elasticity of absolute risk aversion to total wealth and to financial wealth is lower than to consumption, but not greatly so, suggesting similar degrees of aversion to consumption, wealth and financial risk. In all cases most of the variance of observed risk aversion is left unexplained, as the low R^2s show, suggesting that most of the taste heterogeneity across consumers cannot be accounted for by the set of variables that we can observe. The estimated relation between absolute risk aversion and consumer resources is consistent with Arrow's (1965) hypothesis that absolute risk aversion should decrease as the endowment increases while relative risk aversion should

[17] In the probit regression for the decision to be self-employed (to become a public sector employee) reported in panel A of Table VII a dummy variable indicating whether the father is/was a self-employed (public sector employee) has a coefficient equal to 0.461 with a *t-statistic* equal to 7.655 (0.326, t = 4.589).

increase: but the latter is consistent with the former only if the wealth elasticity of absolute risk aversion is less than one, as our findings indicate.

5. Robustness

5.1 Endogenous Consumption and Wealth

The results we have reported thus far do not take into account that consumption and wealth are endogenous variables which are themselves affected by consumer preferences. Thus, the estimated coefficients are potentially affected by endogeneity bias. The direction of the bias, however, is not clear a priori. If more risk-averse individuals choose safer but less rewarding prospects, they may end up being poorer and consume less than the less risk-averse. This would tend to overstate the negative relation between risk aversion and wealth. However, if the more risk averse are also more prudent, ceteris paribus, they will compress current consumption, save more and end up accumulating more assets.[18] In this case, our estimates of the relationship between risk aversion and wealth will be biased towards zero, which could partly explain why, in our estimates, risk aversion declines only slightly as wealth increases. On the other hand, the relation between risk aversion and consumption would be biased downward, implying that the true elasticity of absolute risk aversion to consumption is even less than what we obtain.

To address this issue we re-estimate equation (10) with instrumental variables. Finding appropriate instruments for consumption and wealth is no easy task. We rely on three sets of instruments. First, we rely on characteristics of the father of the household head, namely his education and year of birth, on the ground that wealth is likely to be correlated with that of one's family, proxied by the father's education and cohort. Second, we use measures of windfall gains, such as a dummy for the house being acquired as a result of a bequest or gift, the value

[18] Risk aversion and prudence usually go together. If the utility function is exponential, absolute risk aversion and prudence are measured by the same parameter; if it is CRRA, absolute prudence is equal to absolute risk aversion $+1/c$; if preferences are described by equation (11) absolute prudence is equal to absolute risk aversion $+\beta/c$.

of transfers received and an estimate of the capital gain on the house since the time of acquisition. Third, we use consumer characteristics that are likely to be correlated with wealth and consumption and are at least partly exogenous, such as education attainment and education interacted with age. Overall, the instruments explain about 30 percent of the variance of (log) consumption, almost 25 percent of the variance of (log) total wealth and about 17 percent of that of (log) financial wealth.

Table III shows the results when consumption, total wealth and financial wealth are used. We report the specification including age, gender, number of siblings, past labor market experience, occupation of the father of the household head and region of birth. Since for some consumers the information on their parents' characteristics or on some other instruments were missing the sample size is smaller by about 200 observations with respect to the OLS estimates.[19] In all cases the instrumental variables estimates result in a larger estimate (in absolute value) of the parameter β. For instance, when consumption is used as a measure of consumer's endowment the estimated β is 0.1610, almost twice as the OLS estimate. But the difference with respect to the OLS estimates does not change the previous conclusions: absolute risk aversion is a decreasing function of wealth and both CARA and CRRA preferences are rejected. Figure 2 reports the risk aversion-consumption relation when the OLS and IV estimators are used and compares these profiles to those implied by the assumption of constant relative risk aversion.

To verify further the robustness of our results, we have estimated our basic instrumental variable specification on a restricted reference sample of 2,158 households. This was obtained from the sample of risk-averse consumers by excluding households with total wealth below 20 million lire (594 observations), corresponding to twice our hypothetical lottery prize (in fact, it could be argued that responses are affected by the size of the lottery that individuals face); those

[19] Differences in results between the OLS and the IV estimates are not due to differences in sample. Using OLS on the smaller sample yields estimates of the parameters similar to those in Table III.

who reported non-positive financial assets (147 observations)[20], below age 21 or above age 75 (54 observations) in an attempt to take into account mis-reporting and underreporting of assets; and those who are either too young or too old on the ground that difficulties in grasping the lottery question should probably be concentrated at the two tails of the age distribution. The results based on consumption as scale variable, shown in the last column of Table III, confirm those obtained on the whole sample, shown in the first column.[21]

5.2 Sample Selection

One additional concern with our results, given the relatively small number who answered the lottery question, is that non-response may be systematically related to attitudes towards risk. To address this problem we have re-estimated our model using Heckman (1976) two-step estimator correcting the second stage estimates of risk aversion for selection bias. In the first-stage probit equation, we have included, in addition to gender, age, number of siblings and region of birth, a set of explanatory variables that are likely to affect willingness to participate in the survey, such as education, education interacted with age, age squared, marital status, household size, number of earners and employment sector. The results, not shown for brevity, confirm the estimates of Tables II. The Mills ratio has a small coefficient and is only statistically significant in one case, when total wealth is used as the scale variable, implying that self selection is unlikely to be a problem.

[20] In the survey, financial assets include also currency, in addition to bank and postal deposits and bonds and stocks.

[21] Another possibility is that the quality of our indicator of risk aversion depends on the size of the lottery relative to the resources of the consumer; in particular, it may be that for some consumers the lottery is too large making them unwilling to accept. Notice that the framing of the question is such that the consumer chooses the maximum loss he is willing to incur, which he can choose as small as he wishes. To address this issue further we have estimated our basic equation splitting the sample below and above median wealth. Results are very similar to those for the whole group. The OLS estimate of β is 0.1294 for households with below median wealth and 0.1691 for those with above median wealth. Both coefficients are statistically significant but we cannot reject the hypothesis that they are equal.

5.3 Quantile Regressions

Finally, we check our results for departure of the distribution of residuals from symmetry by estimating least absolute deviation regressions using Amemyia (1982) two-stage estimator to account for endogeneity bias. Given the considerable heterogeneity in the measure of risk aversion, quantile regressions may help give a sense of the determinants of risk aversion for the median consumer. In addition, unlike the conditional mean, quantiles are invariant to monotonic transformations such as taking logs, as in equation (10), our empirical specification. Table IV shows the results from the estimation when consumption, total wealth and financial wealth are alternatively used to measure the endowment. The main predictions of the OLS and IV analysis reported in Tables II and III are confirmed: for the median consumer absolute risk aversion declines with endowment and the sensitivity is somewhat larger for consumption than for wealth. Furthermore, the estimates of β, though significantly different from zero (contrary to CARA preferences) are far below 1 in absolute value (rejecting CRRA utility).

6. Risk Aversion and Background Risk

In a world of incomplete markets the attitude towards risk, measured by the willingness to accept a fair lottery, may vary between consumers not only because of differences in taste parameters but also because they face different environments. In Section 1 we have discussed how risk aversion can be affected by background risk. To test whether the attitudes towards risk are affected by the presence of uninsurable, independent risks we need a measure of background risk. We use two proxies. The first is obtained from a special section of the 1995 SHIW in which households were asked a set of questions designed to elicit the perceived probability of being employed over the twelve months following the interview and the variation in earnings if employed. We use this information to construct measures of the first two moments of the distribution of future earnings following the methodology developed in Guiso, Jappelli and Pistaferri (1998). The second proxy relies on per capita GDP at the provincial level for the period 1952-

1992, which we use to compute a measure of the variability of GDP in the province of residence.

As to the first measure, it is based on four questions on labor income expectations that are asked to half of the overall sample in a special section of the 1995 SHIW questionnaire. The selection of the sub-sample is random, based on whether the year of birth of the household head is even or odd. The employed and job seekers are asked to report, on a scale from 0 to 100, their chances of keeping their job or finding one in the next twelve months. Each individual assigning a positive probability to being employed is then asked to report the minimum and the maximum income he expects to earn if employed and the probability of earning less than the midpoint of the distribution of future earnings conditional on working. These data can be combined to obtain an estimate of expected earnings and their variance, which we use as a gauge of background risk. Since these questions were addressed to only half the sample and of those interviewed only 4,218 individuals (in 2,605 households) replied, when combined with the information on the lottery, we end up with a reference sample of 1,335 observations, of which 1,295 are risk-averse. The survey elicits information on the probability distribution of individual earnings, rather than household income. Since the lottery question is put to the household head, to match background risk with the risk-aversion measure we rely on heads' expectations. This raises two issues. First, for the variance of the earnings of the household head to be able to identify background risk, income risk must be exogenous. However, as we show later, the attitude towards risk affects job choice, with more risk-averse individuals choosing safer occupations. This tends to produce a negative correlation between earnings risk and risk aversion, counteracting the background-risk effect. Second, the household head's willingness to bear risk may well depend on the exposure to risk of other family members. If the head's job choice is not affected (or is only slightly affected) by the earnings risk faced by other members of the household - for instance because occupational choice takes place before meeting the spouse - then the earnings riskiness of the other members can help identify the effect of background risk. Thus, we will provide also estimates that take the variance of the earnings of the spouse and of an additional earner in the household as explanatory variables.

Table V reports the estimation results. The first column adds to our basic specification the square of the coefficient of variation of the endowment obtained dividing the standard deviation of the earnings of the household head by household consumption. If the household head does not work, we set his or her earnings variance equal to zero. The estimated coefficient of the coefficient of variation of the earnings of the household head is statistically significant but is negative, which suggests that the self-selection effect dominates any background-risk effect. To try to identify the latter, in the second column, in addition to the household head's earnings variance, we add that of the spouse and of an additional earner scaled by the square of family consumption. If the spouse does not work, we set her or his earnings variance equal to zero. Similarly, if there is no additional earner we replace his earnings variance with a zero. Interestingly, while the own-earnings variance still carries a negative and significant coefficient, the variance of the earnings of the additional earner and of the spouse have a positive impact on the degree of risk aversion, consistent with the background risk explanation. Their precision, however, is too low to permit conclusions. Furthermore, if occupational choices within the household are a collective decision, the riskiness of the occupation of one member may affect the job choice of another and our estimates would be biased downward.

To address this problem we use the second indicator of background risk, obtained from time series data on provincial GDP. For each province we regress the (log) GDP on a time trend and compute the residuals. We then calculate the variance of the residuals and attach this estimate to all households living in the same province. This is an estimate of aggregate risk and should be largely exogenous unless risk-averse consumers move to provinces with low variance GDP (we return to this issue shortly). The third column reports the estimates using this measure as a proxy for background risk and consumption as scale variable. The degree of risk aversion is increasing in the variance of per capita GDP in the province of residence even after controlling for gender, age, number of siblings, labor market history, occupation of the father of the household head and region of birth, and the effect is highly statistically significant. This is consistent with background risk models: increasing our measure of background risk by one standard deviation increases absolute risk aversion by about 3 percent. If risk-averse individuals tend to move from high-variance to low-variance provinces this would tend to generate a negative correlation between risk aversion and background risk; thus the above is, if anything, a lower bound of the true effect of background risk. The estimates are robust to a cluster correction for province effects as well as to the use of wealth instead of consumption to measure household resources.[22] Furthermore, as shown in the fourth column they are robust to the presence of outliers: using LAD estimates, the coefficient of background risk is somewhat lower but more precisely estimated.

There is however one final concern. As shown in Section 3, the coefficient of the background risk term is $\delta=\beta p_u$; if $0<\beta<1$, as our analysis suggests, then $p_u = \beta + \kappa c^{(1-\beta)}$ and depends on the level of consumption (see the Appendix). So far, our estimates have ignored this interaction between consumption and background risk and the implied restrictions on the parameters β and k. To tackle this issue we use a non-linear instrumental variable estimator imposing the above definition of p_u and relative restrictions. More specifically, we estimate the equation

$$(12) \qquad \log(R) = k_0 + \delta X + \beta \cdot \log c + \beta\left[\beta + \exp(k_0 + \delta X)c^{1-\beta}\right]s^2 + \eta$$

where X is a vector including the gender dummy, age, number of siblings and the dummies for labor market experience, for the occupation of the father of the household head and for the region of birth. The values of the estimated parameters are reported in the last column of Table V. The point estimate of β is 0.187, it is highly statistically significant (standard error equal to 0.0276 and its value is slightly larger than the estimate of β reported in column 3 (0.159).

[22] When the cluster correction is used the point estimate (which is obviously unchanged) of the coefficient of the variance of the shocks to provincial GDP retains its significance. When wealth is used instead of consumption, the point estimate is somewhat greater and estimated with greater precision.

7. Wealth, Risk Loving and Risk Aversion

Thus far we have limited the analysis to the determinants of the degree of risk aversion among individuals who are risk-averse. As Table I shows, while the vast majority of the sample are risk-averse, 4 percent of the respondents are not and are either willing to pay the expected value of the lottery - i.e. are risk-neutral - or are ready to pay more than the expected value - i.e. are risk lovers. In this section we look at the determinants of the regime of the attitude towards risk. To this purpose, we construct a discrete variable that is equal to 1 for the risk-averse and zero otherwise. We then estimate a probit model relating this variable to a set of observable exogenous individual characteristics and to measures of consumer endowment. Results are shown in Table VI. Past spells of unemployment, as well as the parent's attitudes towards risk (proxied by their occupation) have no predictive power on whether a person is risk averse. The risk attitude regime is also independent of age (or, equivalently, year of birth) and of the number of siblings but is strongly affected by gender, with men 3.5 percentage points less likely to be risk-averse than women, which is consistent with some of the findings of Schubert, Brown, Gysler and Brachinger (1999). Overall, the hypothesis of joint significance of the demographic characteristics cannot be rejected. Furthermore, region of birth is systematically related to being risk-averse as opposed to being risk-neutral or lover: those born in the southern regions are more likely to be risk-averse than those born in the North.

The regressions in the table also include a second order polynomial in a measure of household endowment: in the first column we include the level of consumption; in the second, total wealth and in the third financial wealth. The analysis suggests that the probability of being risk-averse is high but decreasing at low values of wealth and again high and increasing for high values, whereas it is low for values of wealth in between. These results are consistent with the model of Friedman and Savage (1948), which implies that the utility function may be concave (implying risk aversion) at very low and at very high levels of wealth and convex (or perhaps linear) at intermediate levels (implying risk loving or neutrality). This hypothesis reconciles the theoretical prediction that individuals should not enter fair lotteries, and much less unfair ones, with the evidence that individuals (particularly low-income individuals) gamble and even purchase unfair lotteries. In addition, it is consistent also with the evidence that many consumers buy both lottery tickets and insurance.[23]

8. Predicting Behavior with Risk Aversion

Attitudes towards risk should affect consumers' willingness to bear risk in a variety of situations. In this section we document that our measure of risk preferences does have predictive power with respect to consumer choices. If different jobs differ not only in expected return but also in the riskiness of those returns, individuals should sort themselves into occupations on the basis of their risk aversion. Similarly, the willingness to hold riskier portfolios should be lower among risk-averse consumers than among the risk-neutral or risk-prone and among the former should be lower for those who dislike risk more strongly. Similar arguments can be made for the demand for insurance, the decision to migrate, the propensity to change job and the consumer health condition in so far as it depends on how cautious a consumer is. Table VII checks these predictions.

8.1 Choice of Occupation

Panel A of Table VII reports the results of estimating probit regressions for occupation choices. We focus on the decision to be self-employed (first two columns) and to become a public sector employee (last two columns). All regressions include as controls the worker's age, number of siblings, household size and number of earners, dummies for gender, marital status, education, region of birth, homeownership and dummies for the occupation of the household's head father. The first column shows the regression for the whole sample including as explanatory variables a dummy for risk-averse consumers. The benchmark is the group of risk neutral and risk-lover consumers. Risk-averse consumers are less likely than risk-lovers and risk neutral to be self-employed, and the coefficient is statistically significant at less than the 0.5 percent level. The difference is

[23] See Friedman and Savage (1948) for a thorough analysis.

economically relevant: being risk-averse rather than risk-lover or neutral lowers the probability of being self-employed by 11 percentage points, or 61 percent of the sample share of self-employed. This evidence suggests that self-selection is indeed an important feature and thus supports our interpretation in Section 6 of the negative correlation between the degree of absolute risk aversion and the variance of earnings. The second column restricts the sample to risk-averse households and uses as explanatory variable our measure of absolute risk aversion. Since the group of risk-lovers and neutral includes relatively few observations we feel more confident exploiting the variability in the degree of risk aversion rather then differences in the regime of attitudes towards risk. Obviously, within the class of risk-averse individuals those who are more strongly risk-averse should be less likely to choose risky jobs. This is confirmed by the estimates, which imply a negative coefficient for the degree of risk aversion: increasing absolute risk aversion by one standard deviation lowers the probability of being self-employed by 1.6 percentage points (9 percent of the unconditional probability).

The third and fourth columns estimate the probability of being a public sector employee on the whole sample and the sample of risk-averse individuals. Consistent with the general perception that public jobs are more secure[24], our estimates show that risk-averse individuals are more likely than the risk-lovers and neutral to work in the public sector, though the coefficient is only significant at the 18 percent level. Compared with risk-prone, the risk-averse have a 1.7-point higher chance of being in the public sector (corresponding to 6 percent of the unconditional probability). Furthermore, among the risk-averse, the probability of choosing the safer occupation is an increasing function of the degree of risk aversion: increasing the latter by one standard deviation raises the probability of being a public sector employee by 2 percentage points (about 7.5 percent of the sample mean), suggesting again that risk preferences have a strong impact on job choice.

[24] In Italy for instance, public sector employees cannot be laid off except in a few extreme circumstances of misconduct. In addition, public sector jobs secure less variable on-the-job wages (see Guiso, Jappelli and Pistaferri, 1998).

8.2 Asset Allocation

The second panel of Table VII shows the effect of the risk attitude indicators and of the degree of risk aversion on the ownership and portfolio share of risky financial assets, i.e. private bonds, stocks and mutual funds. A second order polynomial in total financial assets is added to the right hand side controls. When estimated on the whole sample of households, the probability of holding risky financial assets (first column) is less than half as great among risk-averse consumers as among the risk-neutral and risk lovers. Compared to the latter, risk-averse investors have a 20-point lower chance of holding risky securities, corresponding to 130 percent of the sample mean (equal to 15.5 percent). Among risk-averse consumers (second column), the probability of holding risky assets is a decreasing function of our measure of absolute risk aversion, and the coefficient is precisely estimated. A one standard deviation increase in absolute risk aversion lowers the probability of holding risky assets by 1.1 percentage points (7.5 percent of the unconditional probability). The third and fourth columns report Tobit estimates of the portfolio share of risky assets (ratio of risky to total financial assets). This set of estimates confirms the probit estimates: the share invested in risky assets declines as the degree of risk aversion increases, consistent with the predictions of the classical theory of portfolio choice, and is lower among the risk-averse than among the risk-neutral and risk lovers (although the coefficient is not statistically significant).

8.3 Insurance Demand

The third panel of Table VII reports the estimates of the effect of risk attitudes on the demand for life, health and casualty insurance, respectively. Standard insurance theory predicts that, provided that insurance premiums depart from fair pricing, more risk-averse individuals should buy more insurance. We test this prediction by focusing on the sub-sample of risk-averse individuals and estimate a Tobit model for the amount of insurance purchased (i.e. the value of insurance premiums) scaled with consumption. Second order polynomials in wealth and earnings are included among the right hand side variables. In all cases we find that more-risk averse consumers buy less insurance, and the effect is statistically significant. This finding contradicts simple models of insurance demand but is not necessarily in contrast with extended models. One possible explanation is that insurance companies are able to price-discriminate on the basis of customers' risk aversion. This would lead to higher premiums (which we do not observe and therefore cannot control for) for more risk-averse consumers, who would then reduce insurance demand. This explanation relies on risk aversion being observable. Another, perhaps more convincing, explanation is that individuals can undertake activities to self-insure against the consequences of adverse events. This leads them to replace market insurance with self-insurance. It can be shown that if market insurance is sold at highly unfair prices, while self-insurance is relatively efficient - in the sense that one extra euro of current spending results in a large reduction in the loss - an increase in risk aversion can reduce market insurance and increase self-insurance.[25]

8.4 Moving Decisions, Job Changes and Health Status

Compared with staying in the region of birth, moving to another region entails undertaking a risky prospect. Similarly, leaving a well known job and taking a new one implies incurring new risks. Thus, one expects risk-averse (or more risk-

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[25] Consider the static insurance model and assume that the loss L is a decreasing and convex function of the investment s in self-insurance (i.e $L'<0$, $L''>0$). Let a be the insurance coverage, Π the market insurance premium, w initial wealth and p the probability that the adverse state occurs. The consumer chooses a and s so as to maximize expected utility:

$$pu(w-(1-a)L(s)-s-a\Pi)+(1-p)u(w-s-a\Pi)$$

To illustrate, assume utility is exponential with absolute risk aversion parameter θ and let $\mu>1$ be the mark up on the fair insurance premium. From the first order conditions the following two equations relating a and s can be obtained:

$a=1-(1/\theta L(s))\log(\mu(1-p)/(1-\mu p))$ [from the foc on a, call this the aa locus]

$a=1+(1/\mu p L'(s))$ [from combining the foc on s and a, call this the ss locus]

Both functions are downward sloping with slopes $da/ds_{|aa}=(L'/\theta L^2)\log(\mu(1-p)/(1-\mu p))$ and $da/ds_{|ss}=-(L''/\mu p(L')^2))$, respectively. The relative slope of the two loci depend on the efficiency of self insurance (how fast the loss declines with s, i.e. on L') and on the efficiency of market insurance, i.e. on μ. If self insurance is relatively efficient L' is large in absolute terms) and market insurance is relatively inefficient (μ is large) the aa locus will be steeper than the ss locus. Notice now that an increase in the degree of absolute risk aversion shifts the aa locus upwards but leaves the ss locus unchanged. Thus, starting from an internal solution, if the aa locus is steeper than the ss locus the increase in risk aversion leads to a decline in market insurance and an increase in self insurance. By international standards departures from fair insurance are stronger in Italy and this may perhaps explain the difference between our results and those of Barsky et al. (1997) who find a positive effect of a measure of risk aversion on the demand for insurance in the US.

averse) individuals to be less likely to move and to change job than the risk-neutral and lovers (or the less risk averse). Also, since risk-averse consumers should avoid risky behavior and act more prudently, they should have better health status. In panel D of Table VII we test these three implications, starting with the first. The first two columns estimate a model for the probability that an individual has moved from his region of birth to another region. In the sample, 17.2 percent of the household heads were born in a region different from the one where they currently live. Since the regressions include a full set of dummies for region of birth, local factors affecting the decision to move, such as labor market conditions, wage prospects in the area, etc., are accounted for. Compared to the risk neutral and lovers, the probability of being a mover is lower among the risk-averse, but the latter effect is not statistically significant (first column). The second column reports the estimates for the restricted group of risk-averse individuals. The degree of risk aversion has a negative and highly statistically significant effect on the probability of being a mover; increasing the degree of risk aversion by one standard deviation lowers the probability of being a mover by 2 percentage points, or 12 percent of the sample mean. The third and fourth columns show the results for the propensity to change job. The left-hand side variables is a dummy equal to 1 if the household head has changed more than 2 jobs, and zero otherwise. About 33 percent of the consumers in our sample have changed job more than twice. Being risk averse compared to being risk neutral or risk lover lowers the probability of being a job changer but the coefficient is not precisely estimated. Yet, in the group of risk averse individuals, a higher degree of risk aversion has a negative and statistically significant effect on the probability of changing job; a one standard deviation increase in risk aversion lowers the probability of taking the risks connected to changing job by 1.4 percentage points. The last two columns report probit regressions for the probability of being affected by a chronic disease. When the total sample is used the estimates indicate that the risk-averse are significantly less likely than the risk lovers and the risk-neutral to incur a chronic disease, with an effect equal to 16 percentage points, about 77 percent of the sample share of households with a chronic disease. When the sample is restricted to the risk-averse, the degree of risk aversion has moderate predictive power on health status; one standard deviation increase lowers the probability of a chronic disease by 1 percentage points (5 percent of the sample mean).

Overall, the evidence in Table VII implies that attitudes towards risk have considerable explanatory power for several important consumer decisions. Thus, our evidence suggests that leaving out measures of risk aversion in empirical analysis of households behavior is likely to be a substantial problem.

9. Consistency with Observed Behavior

If our findings on the relation between wealth and risk-aversion do indeed reflect the structure of individual preferences, then this should be reflected in actual behavior; i.e. observed behavior should be consistent with the shape of the measured risk-aversion-wealth relation. In this section we discuss some implications of our empirical characterization of the wealth-risk-aversion relation. First, if relative risk aversion is increasing in wealth, as implied by our findings, the portfolio share of risky assets should decline as wealth increases. Second, if, as our results suggest, absolute risk tolerance is a concave function of the consumer endowment, the portfolio share of risky assets should be an increasing function of age. The first implication is clearly contradicted by the data since portfolio shares are found to be an increasing function of wealth. This is obviously in contrast also with constant relative risk aversion preferences. One strategy that has been pursued in the literature is to maintain the CRRA characterization of the utility of consumption but assume that wealth enters the utility function directly as a luxury good, for instance through a joy-of-giving bequest motive. As Carroll (2000) shows, this implies that a larger proportion of lifetime wealth will be devoted to the risky assets. Clearly, this mechanism can still explain the data even if the utility function of consumption is characterized by IRRA, provided that the joy-of-giving motive is sufficiently strong. Another explanation is that there are portfolio management costs that decline with the size of the investment in risky assets (which is increasing in wealth); if they are sufficiently important, this mechanism can overturn any incentive to lower the portfolio share of risky assets coming from IRRA. Thus, our results do not in principle conflict with the evidence.

To check the second implication - i.e. that with concave tolerance the age portfolio profile is upward sloping - we have run a regression of the portfolio share of risky assets on total wealth, age and a set of controls including city size, household size, gender and education of household head. According to our results, the age profile of the portfolio share of risky assets is concave and peaks around the age of 55. For the elderly, the profile is decreasing, which results from the strength of the incentives to decumulate assets after retirement, including the riskier ones.

Our results help also reconcile some portfolio puzzles that have been noticed in the literature. Simulation models, such as those discussed by Heaton and Lucas (2000), reveal that portfolio shares of risky assets close to those observed in reality, require simultaneously three ingredients: a) background risk must be "large"; b) it must be positively correlated with stock market returns; c) stock holders must have a high degree of relative risk aversion, 8 in Heaton and Lucas (2000) simulations. The first two conditions are met by the rich segment of the population because they own most of the business wealth which is highly volatile (relative to labor income) and co-moves with the stock market. If preferences are well described by our findings, than it is well possible that stockholders have a degree of relative risk aversion close to the one implied by the Heaton and Lucas simulations. In our sample, the relative risk aversion of the bottom 10% of the wealth distribution is 4.7 on average and its consumption is 22 million lire ($11.000). The consumption of the top 10%, who own 61 percent of the total risky assets, is $31,000. Thus for the latter, the predicted degree of relative risk aversion, holding other characteristics constant (i.e. place of birth, exposure to background risk etc.), would be 11.94 (=4.7x((consumption of the rich/consumption of the poor)$^{0.9}$).

10. Conclusions

Using the 1995 Bank of Italy Survey of Household Income and Wealth, we have constructed a direct measure of absolute risk aversion. The measure is based on a simple yet powerful question on the maximum price a consumer is willing to pay to enter a lottery. Its main advantage is that it does not rely on any assumption as to the form of individual utility. As a consequence, it applies not only to the risk-averse, but also to risk-neutral and risk-prone individuals, providing a point estimate of the degree of risk aversion for each individual in the sample. This estimate has then been used to gather direct evidence on the nature of the relationship between individual risk predisposition on the one hand and individual endowment, demographic characteristics and measures of uninsurable risk exposure on the other.

So far there is very limited evidence on the sign of the relationship between risk attitude and wealth and no evidence at all on the curvature of this relationship. Our findings suggest that among risk averse consumers the degree of absolute risk aversion is decreasing in individual endowment - thus rejecting CARA preferences but the elasticity to consumption is far below the unitary value predicted by CRRA utility. Consequently, absolute risk tolerance is a concave function of consumer endowment. How reasonable is this finding? One way to answer the question is to run the following experiment. Suppose that a consumer with annual consumption of 20 million lire ($10,000, roughly the 17th percentile) is willing (at most) to pay 0.5 million lire ($500) to enter the lottery. Than, using equation (6), the implied value of his absolute risk aversion would be 0.1895 and his degree of relative risk aversion would be 3.7905. Suppose that relative risk aversion is constant and equal to this value. Than, if our consumer had an annual consumption of 100 million lire ($50,000, about the 98th percentile of the distribution) he would report a price of 7.2 million lire ($3,100) to participate in our hypothetical lottery. This seems an implausibly high figure, very close to the expected value of the lottery. Intuitively, CRRA implies that absolute risk tolerance increases "too fast" with consumption. If instead absolute risk tolerance increases with consumption at the speed implied by our estimates, the price that the richer consumer would be willing to pay to enter the lottery would be around 1.5 million lire, a figure that seems to us much more reasonable.

As argued, our findings are also consistent with the empirical evidence that young households take on relatively less portfolio risk than more mature households. In fact, according to Gollier and Zeckhauser (1997), the concavity of absolute risk tolerance is a necessary and sufficient condition for such behavior to be optimal.

Individual risk aversion appears also to be characterized by a substantial amount of unexplained heterogeneity. In fact, consumers attributes and demographic characteristics are of little help in predicting the degree of risk aversion. The only exception is the region of birth, which is likely to capture regional differences in risk predisposition and culture that are transmitted with upbringing within the family. In a world of incomplete markets, individual attitudes towards risk may vary across households not only because of differences in tastes, but also because of differences in the environment. We address this issue by analyzing the impact that various measures of earnings uncertainty have on the degree of risk aversion. We find unequivocal evidence that employment-related risk shape consumers attitudes to accept risk.

Finally, we verify the predictive power of our measure of risk attitude with respect to consumer choices, such as occupation, portfolio composition, insurance, health-related conduct and moving and job change decisions. Apart from market insurance, which might be replaced by self-protecting actions, for virtually every type of behavior we investigate, our risk attitude measure makes qualitatively correct predictions: as expected, potentially risky conduct is negatively correlated with risk aversion and effects are economically important. Overall, these results suggest that attitudes towards risk have considerable explanatory power for a number of important consumer decisions. Given the amount of heterogeneity that characterizes risk aversion and its unobservable nature, our evidence suggests that excluding measures of risk aversion from the empirical analysis of household behavior is likely to constitute a serious problem. As a consequence, an effort should be made to elicit indicators of attitudes towards risk of the sort used here.

APPENDIX

A1. The SHIW

The Bank of Italy Survey of Household Income and Wealth (SHIW) collects detailed data on demographics, households' consumption, income and balance sheet items. The survey was first run in the mid-60s but has been available on tape only since 1984. Over time, it has gone through a number of changes in sample size and design, sampling methodology and questionnaire. However, sampling methodology, sample size and the broad contents of the information collected have been unchanged since 1989. Each wave surveys a representative sample of the Italian resident population and covers about 8,000 households, - although at times specific parts of the questionnaire are asked to only a random sub-sample. Sampling occurs in two stages, first at municipality level and then at household level. Municipalities are divided into 51 strata defined by 17 regions and 3 classes of population size (more than 40,000, 20,000 to 40,000, less than 20,000). Households are randomly selected from registry office records. They are defined as groups of individuals related by blood, marriage or adoption and sharing the same dwelling. The head of the household is conventionally identified with the husband, if present. If instead the person who would usually be considered the head of the household works abroad or was absent at the time of the interview, the head of the household is taken to be the person responsible for managing the household's resources. The net response rate (ratio of responses to households contacted net of ineligible units) was 57 percent in the 1995 wave. Brandolini and Cannari (1994) present a detailed discussion of sample design, attrition, and other measurement issues and compare the SHIW variables with the corresponding aggregate quantities.

A2. Definitions of the variables

In the empirical analysis all demographic variables - age, education, gender, number of brothers and sisters, marital status, region of birth, occupation type and sector - refer to the household head.

Bond, stock and mutual fund ownership and amounts: Households are asked first to report ownership of the specific financial instrument and then to report in which bracket (out of 14) the amount held falls. Asset amounts are then imputed assuming that the household holds the mid-point of the interval. It is clear from this procedure that while ownership data only suffer from non-reporting, the information on the amounts is affected by imputation errors. For details on how financial assets values are computed in the SHIW see Guiso and Jappelli (1999).

Consumption, net worth and financial wealth: Consumption is the sum of the expenditure on food, entertainment, education, clothing, medical expenses, housing repairs and additions, and imputed rents. It also includes expenditures on durable goods (vehicles, furniture and appliances, art objects). Net worth is the total of financial and real assets net of household debt. Financial wealth is given by the sum of cash balances, checking accounts, savings accounts, postal deposits, government paper, corporate bonds, mutual funds and investment in fund units and stocks. Real assets include investment real estate, business wealth, primary residence and the stock of durables.

Education of the household head's father: This variable is originally coded as: no education (0); completed elementary school (5 years); completed junior high school (8 years); completed high school (13 years); completed university (18 years); graduate education (more than 20 years). For each of the five categories, we define a dummy variable indicator.

Education of the household head: This variable is originally coded as: no education (0); completed elementary school (5 years); completed junior high school (8 years); completed high school (13 years); completed university (18 years); graduate education (more than 20 years). We define three indicators: the first is equal to 1 when education is up through junior high school (zero otherwise); the second is equal to 1 when it is through high school (zero otherwise) and the third is equal to 1 for university or more (zero otherwise).

Indicators of background risk: We use two indicators, the variance of expected earnings at the individual level and the variance of shocks to per capita GDP in the province of residence. The first is computed directly from survey questions asking: a) the probability of keeping one's job (if employed) or of finding one (if unemployed) in the twelve months following the interview; b) the minimum and maximum earnings expected conditional on being employed. After making some assumptions on the shape of the on the job probability distribution of earnings and on the value of the unemployment compensation to each individual in the sample, Guiso, Jappelli and Pistaferri (1998) use this information to recover measures of expected earnings and their variance. The second indicator is obtained from time series data on per capita GPD at the province level from 1952 to 1992. For each province we regress the logarithm of per capita GDP on a linear trend and compute the variance of the residuals from this regression. We than impute this variance to all households leaving in the same province.

Indicator of health: It consists in a dummy variable based on the answers to the questions on chronic diseases.

Risk aversion: the Arrow-Pratt measure of absolute risk aversion and the risk attitude indicators are obtained from a direct question to a survey lottery. Each survey participant is offered a hypothetical lottery and is asked to report the maximum price that he would be willing to pay in order to participate. The wording of the lottery question and the methodology implemented to compute risk aversion are described in the text.

Year of birth of the household head's father: this variable is used to define ten-year intervals, starting from 1900. An additional interval is defined for those born in or after 1950. We then construct six indicators: the first is equal to one if the household head's father was born between 1900 and 1909, the second is one if he is born between 1910 and 1919, and so on.

Windfall gains measures: six measures are used. The first is a dummy for home ownership as a result of gift or bequest. The second is the sum of the settlements received related to life (excluding annuities), health and theft and casualty insurance. The third measure is the sum of severance payments, unemployment benefits and redundancy allowance. The fourth is the sum of any additional financial aid from central or local governments, other public institutions or charities. The fifth consists of gifts/monetary contributions received from friends or family living outside the household dwelling. The last instrument is a measure of windfall gains (or losses) on housing constructed using time series data on house prices at the province level over the years 1965-1994. For homeowners, we compute the house price change since the year when the house was acquired or since 1965 if it was acquired earlier. To non-homeowners, we attach the house price change since the year when they started working or since 1965. This can be justified on the ground that they start saving to buy a home as soon as they start working.

A3. Risk aversion of the indirect utility function

Let $v(c) = Eu(c+\tilde{y})$ denote the indirect utility function. Taking a second order Taylor approximation of the rigth-hand side around the endowment c, we can approximate the indirect utility by

(A1) $v(c) = u(c) + u''(c)\,\sigma^2/2$

Using (A1) the degree of absolute risk aversion of $v()$ can be expressed as

(A2) $$R_v(c) = -\frac{v''(c)}{v'(c)} = R_u(c)\frac{1+P_uT_u\,\sigma^2/2}{1+P_uA_u\,\sigma^2/2}$$

where $R_u(c) = -\frac{u''}{u'}$, $P_u(c) = -\frac{u'''}{u''}$, $T_u(c) = -\frac{u^{iv}}{u'''}$ denote, respectively, the degree of absolute risk aversion, absolute prudence and absolute tolerance with respect to the utility function $u()$. From (A2) it is clear that, for a prudent consumer, a sufficient condition for (a zero mean) background risk to make him more risk averse is that $T_u > R_u$.

Let s denote the coefficient of variation of the consumer endowment (i.e. $s=\sigma/c$) and let r_u, p_u and t_u denote the degree of relative risk aversion, relative prudence and relative tolerance, respectively (obtained multiplying the absolute degrees by c). We can then rewrite (A2) as

(A3) $$R_v(c) = R_u(c)\frac{1+p_ut_u\,s^2/2}{1+p_ur_u\,s^2/2}$$

If the utility function is given by (9) in the text, than $R_u = kc^{-\beta}$, $r_u = kc^{1-\beta}$, $p_u = \beta + r_u$, $t_u = \beta + p_u$. Substituting into (A3) and taking logs we obtain

(A4) $\log R_v = \log \kappa - \beta \log c + \beta p_u s^2$

which shows that the parameter β of the utility function *u()* can be recovered even if there is background risk.

Tables and Figures

Table 1: Descriptive Statistics for the Total Sample, for the Sample of Respondents and Various Sub Samples

The figures for consumption, total wealth and financial wealth are the sample medians expressed in million lire. The variable "North" includes the following regions: Piemonte, Valle d'Aosta, Lombardia, Trentino Alto Adige, Veneto, Friuli Venzia Giulia, Liguria and Emilia Romagna; "Center" includes Toscana, Umbria, Marche, Lazio, Abruzzo and Molise and "South" includes all the remaining regions. Low risk averse are those who are willing to bet at least 1 million lire, which is the median of the bet distribution.

Variable	Sample of respondents					Total sample
	Risk averse			Risk lovers and neutral	Total	
	High	Low	Total			
Age	49.24	47.39	48.50	49.34	48.54	54.23
Male %	77.98	81.16	79.24	93.75	79.84	74.35
Years of education	8.76	9.98	9.25	10.81	9.31	8.03
Married %	77.88	79.64	78.58	87.50	78.95	72.50
No. of earners	1.84	1.86	1.85	1.81	1.84	1.80
No. of components	3.23	3.15	3.20	3.00	3.19	2.94
No. of siblings	2.55	2.33	2.46	1.90	2.44	2.50
Area of birth: North	34.44	44.07	38.27	53.90	38.91	37.43
Center	23.09	20.18	21.94	19.86	21.85	24.75
South	42.47	35.75	39.80	26.24	39.24	37.82
Self-employed %	15.57	20.14	17.38	29.17	17.87	14.23
Public employee %	28.33	26.37	27.55	27.08	27.53	23.26
Value of Z	0.53	3.78	1.82	11.19	2.21	-
Abs. Risk aversion	0.189	0.110	0.157	-0.005	0.151	-
Rel. Risk aversion	6.53	4.34	5.62	-0.25	5.38	-
Consumption	30.28	34.35	32.00	41.20	32.40	28.80
Financial wealth	9.97	18.10	12.76	49.58	13.42	10.39
Total wealth	154.95	198.47	170.50	329.85	173.25	155.85
N. of observations	1,998	1,316	3,314	144	3,458	8,135

Table 2 : Risk Aversion, Consumption and Wealth: OLS Estimates

The left-hand-side variable is the log of absolute risk aversion; *c* is expenditure on durable and non-durable goods; *w* is total household net worth and is equal to the sum of real wealth (housing, land and durable goods) and financial wealth net of debt; *wf* is household financial wealth. Regressions in column (2) to (4) include 19 dummies for the region of birth of the household head. The number of observations in these regressions is slightly smaller than that in column (1) because for some households some of the right hand side variables are missing. Male is a dummy equal to 1 if the head is a male; age and number of siblings refer to the household head. Unemployment experience is a dummy equal to 1 if the household head has ever undergone periods of unemployment or of temporary layoff. Father self-employed and public sector employee are two dummies equal to 1 if the household head's father was self employed or a public sector employee, respectively. Bootstrapped standard errors (based on 100 replications) are reported in parentheses.

Variable	(1)	(2)	(3)	(4)
Log(c)	-0.0902	-0.0669		
	(0.0125)	(0.0147)		
Log(w)			-0.0187	
			(0.0039)	
Log(wf)				-0.0412
				(0.0049)
Male		-0.0151	-0.0121	-0.0103
		(0.0171)	(0.0194)	(0.0204)
Age		0.0010	0.0014	0.0014
		(0.0005)	(0.0006)	(0.0006)
No. of siblings		0.0027	0.0016	0.0000
		(0.0031)	(0.0030)	(0.0035)
Unemployment experience		-0.0023	0.0107	-0.0130
		(0.0210)	(0.0206)	(0.0232)
Father self-employed		-0.0248	-0.0260	-0.0217
		(0.0165)	(0.0165)	(0.0176)
Father public sector employee		-0.0070	-0.0149	-0.0153
		(0.0229)	(0.0207)	(0.0198)
Constant	-7.8786	-8.3698	-8.8718	-8.6676
	(0.1295)	(0.1430)	(0.0496)	(0.0620)
Region of birth	NO	YES	YES	YES
No. of observations	3,314	3,072	2,953	2,761
Adjusted R^2	0.0149	0.0497	0.0496	0.0630
F test for region of birth = 0	-	11.01	8.38	5.82
(p-value)		(0.0000)	(0.0000)	(0.0000)
F test for $\beta = -1$	5,039.47	3,872.65	59,286.91	36,660.26
(p-value)	(0.0000)	(0.0000)	(0.0000)	(0.0000)

Table 3: Risk Aversion, Consumption and Wealth: IV Estimates

The left-hand side variable is the log of absolute risk aversion; *c* is expenditure on durable and non-durable goods; *w* is total household net worth and is equal to the sum of real wealth (housing, land and durable goods) and financial wealth net of debt; *wf* is household financial wealth. All regressions include 19 dummies for the region of birth of the household head. Male is a dummy equal to 1 if the head is a male; age and number of siblings refer to the household head. Unemployment experience is a dummy equal to 1 if the household head has ever undergone periods of unemployment or of temporary layoff. Father self-employed and public sector employee are two dummies equal to 1 if the household head's father was self employed or a public sector employee, respectively. The set of instruments includes dummies for the education of the household head, education dummies interacted with age, dummies for the education of the father of the household head and his year of birth; measures of windfall gains (a dummy for the house being acquired as a result of a bequest or gift, insurance settlements and other transfers, capital gains on the house since the time of acquisition). The estimates in column (4) are conducted on a restricted sample obtained excluding households with total wealth below 20 million, those who reported non-positive financial assets, those with head aged less than 21 or above 75. Bootstrapped standard errors (based on 100 replications) are reported in parentheses.

Variable	(1)	(2)	(3)	(4)
Log(*c*)	-0.1610			-0.1342
	(0.0402)			(0.0554)
Log(*w*)		-0.0246		
		(0.0096)		
Log(*wf*)			-0.0633	
			(0.0167)	
Male	-0.0173	-0.0264	-0.0220	-0.0195
	(0.0166)	(0.0196)	(0.0159)	(0.0220)
Age	0.0016	0.0023	0.0025	0.0016
	(0.0005)	(0.0006)	(0.0006)	(0.0006)
No. of siblings	-0.0009	-0.0007	-0.0036	-0.0038
	(0.0030)	(0.0035)	(0.0038)	(0.0048)
Unemployment experience	-0.0121	0.0243	-0.0056	-0.0101
	(0.0227)	(0.0183)	(0.0217)	(0.0248)
Father self-employed	-0.0136	-0.0202	-0.0147	-0.0076
	(0.0155)	(0.0152)	(0.0153)	(0.0206)
Father public sector employee	0.0054	-0.0114	-0.0092	-0.0005
	(0.0228)	(0.0198)	(0.0210)	(0.0240)
Constant	-7.3217	-8.7442	-8.4069	-7.6226
	(0.4241)	(0.1185)	(0.1672)	(0.5868)
Region of birth	YES	YES	YES	YES
No. of observations	2,923	2,808	2,621	2,158
Adjusted R^2	0.0359	0.0441	0.0461	0.0304
F test for region of birth = 0	4.20	5.51	5.02	5.87
(p-value)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
F test for $\beta = -1$	667.73	8,038.10	3,700.46	427.99
(p-value)	(0.0000)	(0.0000)	(0.0000)	(0.0000)

Table 4: Risk aversion, consumption and wealth: 2SLAD estimates

The left-hand-side variable is the log of absolute risk aversion; *c* is expenditure on durable and non-durable goods; *w* is total household net worth and is equal to the sum of real wealth (housing, land and durable goods) and financial wealth net of debt; *wf* is household financial wealth. All regressions include 19 dummies for the region of birth of the household head. Male is a dummy equal to 1 if the head is a male; age and number of siblings refer to the household head. Unemployment experience is a dummy equal to 1 if the household head has ever undergone periods of unemployment or of temporary layoff. Father self-employed and public sector employee are two dummies equal to 1 if the household head's father was self employed or a public sector employee, respectively. Columns (1) to (3) report 2-stages LAD estimates. The set of instruments includes dummies for the education of the household head, education dummies interacted with age, dummies for the education of the father of the household head and his year of birth; measures of windfall gains (a dummy for the house being acquired as a result of a bequest or gift, insurance settlements and other transfers, capital gains on the house since the time of acquisition). Bootstrapped standard errors (based on 100 replications) are reported in parentheses.

Variable	(1)	(2)	(3)
Log(*c*)	-0.1686		
	(0.0599)		
Log(*w*)		-0.0305	
		(0.0147)	
Log(*wf*)			-0.0714
			(0.0265)
Male	0.0029	-0.0043	-0.0013
	(0.0144)	(0.0142)	(0.0140)
Age	0.0009	0.0019	0 .0020
	(0.0005)	(0.0007)	(0.0007)
No. of siblings	-0.0012	-0.0019	-0.0036
	(0.0022)	(0.0022)	(0.0027)
Unemployment experience	-0.0235	0.0077	-0.0094
	(0.0146)	(0.0143)	(0.0134)
Father self-employed	-0.0015	-0.0130	-0.0044
	(0.0100)	(0.0141)	(0.0121)
Father public sector employee	-0.0038	-0.0226	-0.0208
	(0.0191)	(0.0237)	(0.0170)
Constant	-7.0656	-8.5253	-8.1713
	(0.6130)	(0.1511)	(0.2429)
Region of birth	YES	YES	YES
No. of observations	2,923	2,808	2,621
Pseudo R^2	0.0356	0.0380	0.0364

Table 5: Risk aversion and background risk

The left-hand-side variable is the log of absolute risk aversion; c is expenditure on durable and non-durable goods. All regressions include 19 dummies for the region of birth of the household head. Male is a dummy equal to 1 if the head is a male; age and number of siblings refer to the household head. Unemployment experience is a dummy equal to 1 if the household head has ever undergone periods of unemployment or of temporary layoff. Father self-employed and public sector employee are two dummies equal to 1 if the household head's father was self employed or a public sector employee, respectively. In the first and second columns for the variable "earnings variance of the household head", we use the variance of the household head's earnings and replace it with a zero if the household head is not working and the variance of his earnings is missing. A dummy for non-working household head is also included. In the second column, we also include the variance of the earnings of the wife and of an additional earner scaled with household consumption squared. If there is no wife or additional earner or if they do not work (and are not seeking work), the missing variances of their earnings are replaced with a zero. Dummies for non-working head, wife and additional earner are also included in the regression. In the last three columns the measure of background risk is the variance of the shocks to log(GDP) in the province estimated from annual data of provincial GDP over the period 1952-1992. The set of instruments includes dummies for the education of the household head, education dummies interacted with age, dummies for the education of the father of the household head and his year of birth; measures of windfall gains (a dummy for the house being acquired as a result of a bequest or gift, insurance settlements and other transfers, capital gains on the house since the time of acquisition). Bootstrapped standard errors (based on 100 replications) are reported in parentheses.

Variable	IV	IV	IV	2SLAD	2SNLLS
	(1)	(2)	(3)	(4)	(5)
Log(c)	-0.1597	-0.1739	-0.1588	-0.0982	
	(0.0758)	(0.0945)	(0.0327)	(0.0367)	
c					0.1867
					(0.0276)
Earnings variance	-0.2262	-0.1933	-	-	
of household head/c^2	(0.1838)	(0.2058)			
Earnings variance	-	-0.1057	-	-	
of spouse/ c^2		(1.1617)			
Earnings variance	-	0.5401	-	-	
of other earner/ c^2		(1.0411)			
Variance of shocks to per	-	-	2.8895	1.8085	
capita GDP			(1.0233)	(0.5728)	
Male	-0.0419	-0.0452	-0.0199	0.0056	-0.0163
	(0.0341)	(0.0298)	(0.0195)	(0.0080)	(0.0181)
Age	0.0043	0.0045	0.0016	0.0009	0.0018
	(0.0012)	(0.0015)	(0.0005)	(0.0003)	(0.0005)
No. of siblings	0.0000	0.0010	-0.0007	-0.0013	-0.0007
	(0.0060)	(0.0068)	(0.0034)	(0.0014)	(0.0027)
Unemployment experience	-0.0186	-0.0139	-0.0110	-0.0094	-0.014
	(0.0320)	(0.0363)	(0.0214)	(0.0089)	(0.0195)
Father self-employed	-0.0023	-0.0035	-0.0162	0.0014	-0.0065
	(0.0211)	(0.0237)	(0.0160)	(0.0063)	(0.0172)
Father public sector employee	0.0084	0.0044	0.0040	0.0003	-0.0065
	(0.0330)	(0.0370)	(0.0209)	(0.0100)	(0.0172)
Constant	-7.3622	-7.1457	-7.3523	-7.7853	-6.9443
	(0.7918)	(1.0335)	(0.3389)	(0.3822)	(0.2962)
Region of birth	YES	YES	YES	YES	NO
No. of observations	1,115	1,052	2,901	2,901	2,901
Adjusted R^2	0.0403	0.0395	0.0391	0.0185	0.9983

(Pseudo R^2 for the 2SLAD)					
F test for region of birth = 0	2.38	3.77	6.41	9.93	-
(*p*-value)	(0.0010)	(0.0000)	(0.0000)	(0.0000)	
F test for $\beta = -1$	90.55	221.19	559.87	603.02	-
(*p*-value)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	

Table 6: Regimes of attitudes towards risk

The left-hand-side variable is an indicator that is equal to 1 if the consumer is risk-averse, 0 otherwise. c is expenditure on durable and non-durable goods; w is household net worth and wf financial wealth. The endowment variables are in million lira. All regressions include 19 dummies for the region of birth of the household head. Male is a dummy equal to 1 if the head is a male; age and number of siblings and past unemployment experience refer to the household head. Father self-employed and public sector employee are two dummies equal to 1 if the household head's father was self employed or a public sector employee, respectively. Standard errors are reported in parentheses.

Variable	(1)	(2)	(3)
c	-0.0070		
	(0.0043)		
c^2	1.78e-06		
	(2.70e-05)		
w	-	-0.0005	
		(0.0001)	
w^2	-	6.87e-08	
		(3.72e-08)	
wf			-0.0029
			(0.0006)
wf^2			1.35e-06
			(4.72e-07)
Male	-0.5581	-0.5550	-0.5423
	(0.1520)	(0.1521)	(0.1535)
Age	-0.0048	-0.0020	-0.0012
	(0.0033)	(0.0033)	(0.0033)
No. of siblings	0.0422	0.0412	0.0392
	(0.0247)	(0.0246)	(0.0247)
Unemployment experience	-0.0880	-0.0883	-0.0810
	(0.1218)	(0.1212)	(0.1210)
Father self-employed	-0.0204	0.0190	0.0011
	(0.0957)	(0.0972)	(0.0970)
Father public sector employee	-0.0408	-0.0227	-0.0477
	(0.1210)	(0.1214)	(0.1214)
Constant	2.5425	2.3050	2.2669
	(0.2958)	(0.2660)	(0.2661)
Region of birth	YES	YES	YES
No. of observations	2,988	2,988	2,988
Pseudo R^2	0.0809	0.0877	0.0976
F test for region of birth = 0	34.81	33.79	32.86
(p-value)	(0.0026)	(0.0036)	(0.0049)
F test for exogenous characteristics = 0	17.83	16.21	15.14
(p-value)	(0.0067)	(0.0127)	(0.0192)

Table 7: Predicting behavior with risk aversion

In panel A the left-hand-side variable is a dummy equal to 1 if the household head is a self-employed (first two columns) or a public employee (last two columns). In panel B, in the first two columns, it is a dummy equal to 1 if the household holds risky financial assets; in the last two columns it is the portfolio share of risky financial assets. Risky assets include private bonds, stocks and mutual funds. The share of risky assets is relative to total financial assets. In panel C the left-hand-side variable is the value of insurance premiums as a share of current consumption. We consider life (first column), health (second column) and theft and casualty insurance (third column). In panel D, in the first two columns, it is a dummy variable equal to 1 if the consumer lives in a region different from the one where he was born. In the second two columns it is a dummy equal to 1 if the consumer has changed job at least twice over his working life. In the last two columns it is a dummy equal to 1 if the household head is affected by a chronic disease. "Risk-averse" is a dummy variable equal to 1 if the consumer is risk-averse, i.e. if the maximum price he/she is willing to pay for the lottery is lower than its fair value of 10 million lire. "Risk-neutral" is similarly defined. "Absolute risk aversion" is the measure of absolute risk aversion discussed in Section 1. All regressions include as explanatory variables age, number of siblings, household size and number of earners, dummies for gender, marital status, education, region of birth and home ownership. The regressions in panel A also include the two dummies for the occupation of the household's head father; those in panel B include a second order polynomial in financial assets, whereas those in panel C include second order polynomials in wealth and earnings. *t*-statistics are reported in parenthesis.

A: choice of occupation

	Self-employed (probit regression)		Public sector employee (probit regression)	
Variable	Whole sample	Sample of risk-averse	Whole sample	Sample of risk-averse
Risk averse	-0.3513 (0.1234)	-	0.1704 (0.1261)	-
Absolute risk aversion	-	-1,459.82 (615.1)	-	1,484.1 (580.4)
No. of observations	3,341	3,203	3,341	3,203

B: demand for risky assets

	Ownership of risky assets (probit regressions)		Portfolio share of risky assets (tobit regressions)	
Variable	Whole sample	Sample of risk-averse	Whole sample	Sample of risk-averse
Risk averse	-0.1733 (0.1305)	-	-0.1129 (0.0760)	-
Absolute risk aversion	-	-1,504.4 (678.8)	-	-1,143.4 (425.6)
No. of observations	3,401	3,260	3,034	2,901

Table 7: continue

C: demand for insurance

	Insurance premiums as a share of consumption (Tobit regressions; sample or risk-averse)		
Variable	Life insurance	Health insurance	Theft and casualty insurance
Absolute risk aversion	-96.839 (48.121)	-55.974 (22.878)	-63.783 (15.909)
No. of observations	3,264	3,264	3,249

D: moving decision, job change and health status (chronic disease)

	Moving to another region (probit regressions)		Propensity to change job (probit regression)		Health (probit regression)	
Variable	Whole sample	Sample of risk-averse	Whole sample	Sample of risk-averse	Whole sample	Sample of risk-averse
Risk averse	-0.0796 (0.1360)	-	-0.0686 (0.1068)		-0.5766 (0.1196)	-
Absolute risk aversion	-	-1698.8 (595.3)	-	-920.8 (531.2)	-	935.216 (621.89)
No. of observations	3,401	3,260	3,404	3,263	3,401	3,260

Figure 1: Cross sectional distribution of relative risk aversion

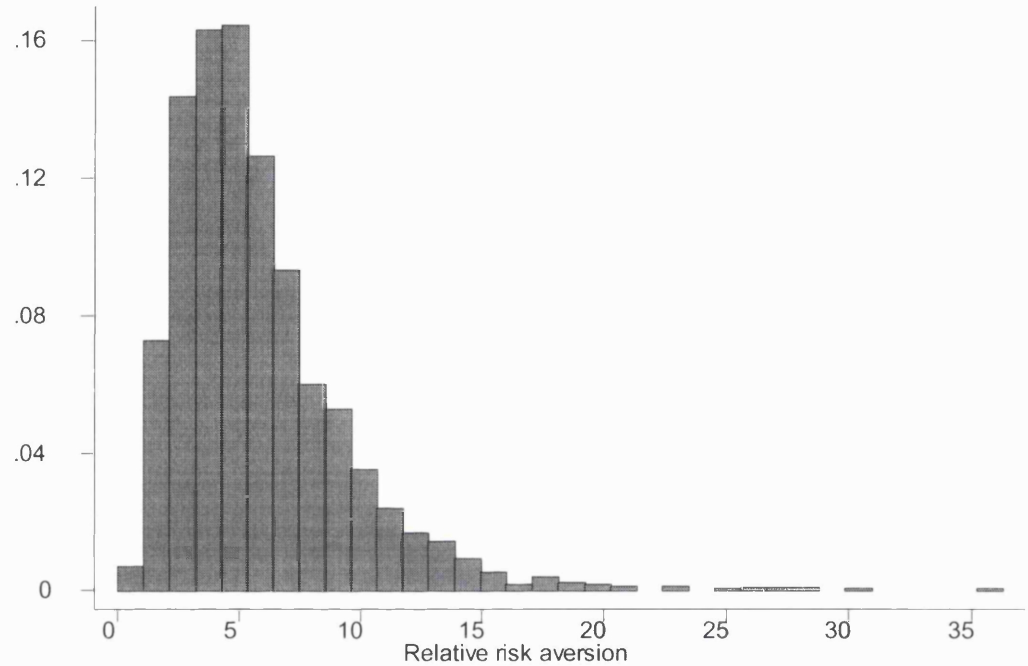
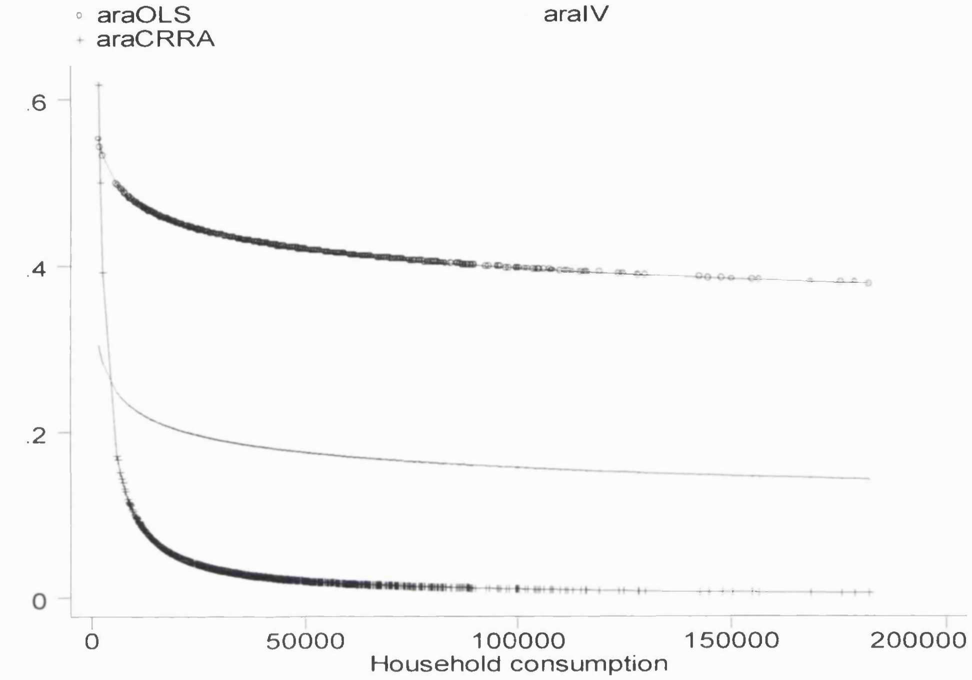


Figure 2: Risk aversion and consumer endowment[26]



[26] The profiles are based on the following expressions: araOLS $= c^{-\beta_{OLS}}$; araIV $= c^{-\beta_{IV}}$; araCRRA $= (c/1000)^{-1}$.

Chapter Three
Households Savings in the US[1]

Household saving is still little understood and even the most basic facts, such as how saving changes over the life cycle, are controversial. Understanding saving is important not only because the division into consumption and saving concerns one of the most fundamental household decisions, but also because saving as a private insurance interacts with social policy as public insurance and, consequently, it is of utmost policy relevance. In this chapter, we analyze the saving behaviour of US households. In particular, we use micro data from the Consumer Expenditure Survey (CEX) from 1982 to 1995. This data set is the only micro data source in the US that contains exhaustive and complete information on consumption at the household level. Together with the information it contains on income it allows us to define saving and saving rates at the household level. While far from perfect, the CEX constitutes an indispensable data source for the analysis of consumption and saving behaviour. Our work extends the analysis of Attanasio (1994, 1998) and Gokhale, Kotlikoff and Sabelhaus (1996) in two dimensions. First, we extend the sample to include data up to 1995. Second, we consider explicitly the differences between mandatory and discretionary saving.

While the CEX constitutes the only available source that contains detailed data on both income and consumption, we should mention some of the problems with such a data source. First, the information on accumulated wealth and financial savings is rather scant, with financial wealth disaggregated in only four categories and the level questions asked only once. As a consequence, it is impossible to obtain a measure of capital gains to be added to disposable income in order to compute an economically meaningful measure of the flows of saving. Second, there are indications that the CEX data have important measurement problems. Both consumption and income are underestimated, but the problem seems to be more serious for consumption. This is likely to be a consequence of

[1] This chapter is part of a research project joint with Orazio Attanasio.

the way the consumption questions are asked, which relies on recall. In addition, while the questions on wealth are about the market value of the stock of financial wealth, it is not clear whether they are completely understood. Therefore, the results we present should be interpreted with caution.

The US constitutes a particularly interesting case study for at least three reasons. First, the US is the biggest country in the world and behaviour in the US is always seen as important because of this. Second, household saving rates appear to have declined significantly over the last 20 years in the US, for reasons that are not completely obvious and about which there is less than complete consensus. Moreover, a major issue related to the assessment of the size of such decline regards the evaluation of capital gains, whose importance has risen dramatically over the past fifteen years with growing stock market prices and more and more households participating both directly and indirectly to the stock market. The extent of the decline of household savings does not appear so dramatic when savings are computed residually, by subtracting total expenditure from a measure of disposable income inclusive of capital gains. The importance of capital gains is reflected also in the differences between a measure of savings obtained by adding up individual saving components, at market value, and a residual measure based on the difference between earned income and consumption. However, accounting accurately for capital gains is not an easy task because of scant data on household asset holdings and the resulting impossibility of relating changes in asset prices to personal portfolios. A third reason for analysing the case of the US is that this country has experimented with several pieces of fiscal legislation with the explicit aim of increasing saving. Behind these concerns there is the widespread feeling that a large fraction of US households, and in particular those belonging to the so-called baby boom generation, are not saving enough to provide for a comfortable retirement - although accounting appropriately for capital gains might change somewhat the picture. This situation is set against the background of an impending social security crisis or reform due to the fact that current demographic trends make the current pay-as-you-go social security system, with the current parameters, unsustainable in the long run.

The rest of the chapter is organized as follows. Part 1 illustrates briefly the data and points to the Appendix for a more extensive description. Part 2 consists of two sections: in the first, we carry out a cross-sectional analysis of the data and present various concepts and measures of saving, wealth, income and expenditure. In order to explain the saving patterns by age groups, a set of covariates is also introduced. For brevity reasons, I have chosen to include only the Figures and Tables for 1983, 1988 and 1995. Unless mentioned otherwise, the Figures and Tables corresponding to other years do not differ in any major respect from the ones displayed and are available upon request. In order to purge the data from cohort effects and identify life-cycles changes in saving behavior, in the second section of Part 2 we combine the data from the fifteen cross-sections and define cohort-corrected age-saving profiles. Part 3 relates the observed saving patterns to the existing pension policies and more generally to the institutional environment, after outlining its evolution and its main features. Part 4 concludes.

1. The US Consumer Expenditure Survey

The data we use are taken from the US Consumer Expenditure Survey (CEX)[2]. They are available for the period 1980 first quarter to 1996 first quarter. However, for the analysis we do not use the observations involving 1980 and 1981, since several measures indicate low data quality in this first part of the survey. In addition, we exclude composite households, households living in rural areas or in student housing, households with head younger than twenty years old and incomplete income respondents. Finally, we leave out those households reporting zero yearly consumption. Overall, the sample used consists of 75,283 households, for a total of 211,923 observations.

The CEX allows to construct two measures of saving. The first is computed by adding individual saving components, whereas the other measure consists of the residual of income minus consumption. As to the first measure, several issues are worth mentioning. First of all, for most financial variables, the

[2] For a more extensive description of the data, see the appendix A1 to Chapter One.

CEX provides information only on flows, which makes it impossible to determine the stock dimension of savings. Data also on stocks are available only for some variables, namely checking and saving accounts and stocks and bonds. The information on these latter types of financial savings is generally somewhat scarce due to many invalid non-responses or refusals to respond. Since the problem of missing data is particularly serious for the variables on flows, whenever advisable we have computed savings as first differences in the stocks. Thus, for each year we have determined mean holdings by year of birth of the household head and then we have computed the annualized difference in the mean stock for each cohort. Because of the severity of the problem of missing financial saving observations, the analysis based on the first measure of saving uses a sample of only 46,051 households. Another problem regarding the first definition of savings concerns the unavailability of important saving components, such as those related to cash, capital gains, consumer loans, mortgages and real asset holdings. An important issue is also the unavailability of data on employer's mandatory and voluntary contributions to funded and unfunded pension schemes. For all these reasons, the saving measure obtained by adding up individual components is expected to differ substantially from the residual measure.

The residual measure of savings is determined by subtracting household total consumption, which includes expenditure on durable and non-durable goods and on services, from total disposable income. Before constructing the yearly figures, the monthly consumption data are deseasonalized and deflated using the US BLS aggregate Consumer Price Index. Total disposable income is computed by subtracting the total amount of personal taxes and social security contributions from household total gross yearly income as reported at the time of the last interview. Income figures are deflated and include labor, business, asset and transfer income. Apart from total income and expenditure, all the other yearly income and saving variables are determined by taking household-level averages when the respondent reports different annual values at different interviews.

2. Household Savings

The analysis that follows focuses first on cross-sectional saving patterns and then on cohort behavior to identify life-cycle changes. For the analysis, all the data are weighted by the available household weights to represent the universe of US households.

2.1 Cross-Sectional Profiles of Household Savings

In the first part of this section we focus on the individual components of household savings and classify them into two groups:

Discretionary Savings, which are defined as changes in wealth that are under the control of the household and concern both the absolute and relative composition of the asset portfolios;

Mandatory Savings and Contributions to Pay-As-You-Go Systems, which are characterized by some strong degree of pre-commitment. They include both mandatory and voluntary contributions to public or private schemes and are related to changes in wealth accumulated through funded or unfunded pension schemes. Unfortunately, since for most items only global estimates are available, the distinction between contributions to funded schemes versus pay-as-you-go systems is not always possible.

As we have mentioned in the Data section, the information available does not allow to come up with an accurate measure of total household savings by simply adding up the individual items because of lack of information on many household assets and liabilities. Despite this, studying the profiles of the items for which information is available is important for understanding the impact of demographic changes on saving aggregates and for assessing the impact of changes in pension institutions. Total household savings will be analyzed in the second part of this section.

2.1.1 Discretionary Savings

Discretionary savings, defined as the sum of financial and real savings, are likely to alternate with mandatory savings as the most important component of household savings at the various stages of the life-cycle. Unfortunately, the CEX does not permit an accurate computation of discretionary saving since it does not allow a sensible measurement of real wealth. The same problem, however, is common to many other data sets containing information on saving behaviour. Overall, although the stocks of the wealth components are definitely measured more accurately in the Survey of Consumer Finances (SCF), the CEX has two main advantages over the SCF. First, currently it provides 17 years of data, available on a consistent basis at an annual frequency, versus 5 waves of the SCF. Second, and more importantly, it allows one to compute the flow measure of saving as the difference of income and consumption which, while excluding capital gains, is directly related to discretionary behaviour.

On the basis of the CEX, *financial saving* can be defined as the sum of:
Net deposits in checking, brokerage and similar accounts and in saving accounts held at banks, savings and loans, credit unions, etc.; plus
Net purchases of US Saving Bonds; plus
Net purchases of stocks, bonds, mutual funds and other similar securities; plus
Contributions to individual retirement accounts where withdrawals may be made only after retirement (BLS derived); plus
Contributions to life insurance; plus
Contributions to health insurance.

For the reasons explained in the Data section, we have chosen to measure the first three components of financial savings as annualized difference between the stocks in two subsequent years for the same cohort defined on the ground of the year of birth of the household head. This implies that the first year available for the analysis is 1983. Stock, bonds, mutual funds and other similar securities are valued at their estimated market value. An important item for which no direct information is available is consumer loans, other than bank account overdrafts.

Figure 1 shows the age profile of the weighted mean of financial savings from the 1983, 1988 and 1995 waves. All amounts are in dollars per year. We use the US CPI to convert all amounts in 1996 dollars. The profiles for the different waves do not differ in any major respect and the time effects appear to be quite limited, especially among those early in the life-cycle. Savings appear to be low (or even negative) among the young (less than 40 years old); they are higher among those aged 45-65, peaking around the age of 60. Those older than 65 exhibit dissavings. The level of savings of the middle-aged and of the elderly appears to be somewhat lower in the most recent waves of the survey, suggesting that those in their fifties and older save somewhat less (dissave somewhat more) in the 90s than in the 80s. Yet, generally speaking, interpreting these cross-section profiles in terms of life-cycle patterns can be quite misleading. In fact, each age category also represents also a cohort and the cross-sectional lines do not portray a life-cycle profile, but the combination of age-specific and cohort-specific effects.

As to the distribution of saving across individual asset categories, although the evidence in Table 1 for the years 1983, 1988 and 1995 is somewhat mixed, the leading saving component appears to be net deposits in checking, saving and similar accounts. Among those exhibiting positive financial savings, the median of the portfolio share of the net investment in this type of asset is almost 30 percent, versus a median of 25 percent for the share of purchases of stocks and bonds, of 20 percent for the contributions to health insurance, of 15 percent for those to IRAs and of 10 percent to life insurance.[3] Net deposits in checking and saving accounts exhibit the highest variability across households, both in terms of total investment and in terms of portfolio share. Over the life-cycle, this component takes on negative values especially among those in their 30s and among the elderly. Among those exhibiting some dissaving, the median portfolio contribution of the deposits in checking and saving account is –96 percent, that of the investment in stocks and bonds is –70 percent; the median of the contribution to health insurance is 40 percent, that of the contribution to IRAs and to life insurance is below 20 percent, for each asset.[4] Over the period 1983-95, the portfolio share of checking and saving accounts decreases and in the 90s, on average, it contributes negatively to the total. Instead, the shares of stocks and bonds increases steadily. Also, the health insurance share increases more or less

[3] The mean shares conditional on total financial savings being positive are –23 percent for the investment in checking and saving accounts, 5 percent for that in stocks and bonds, 50 percent for the contributions to health insurance, 40 percent for those to IRAs and 28 percent for those to life insurance.

[4] The mean shares are –200 percent for the investment in checking and saving account, -80 percent for that in stocks and bonds, 90 percent for the contributions to health insurance, 70 percent for that to IRAs and 50 percent to life insurance.

steadily over the period considered and exhibits a particularly pronounced rise in the mid-90s, especially among those in their 40s and older who also appear to be the age group saving relatively more through health insurance. Other important categories appear to be life insurance and individual retirement accounts (IRAs), which absorb a rather constant share of household savings over time, exhibiting a slight increase starting from the late 80s, which is particularly pronounced for the youngest. Life insurance and IRAs represent relatively less important saving categories for those aged 60 and older.

Information on stocks is available only for few of the items appearing in the definition of financial saving. Specifically, the CEX provides data only on the following *wealth* categories:

Amount held in checking, brokerage and similar accounts and in saving accounts at banks, savings and loans, credit unions, etc. as of the last day of the month before that of the last interview;

Amount of US Saving Bonds as of the last day of the month before that of the last interview;

Estimated market value of all stocks, bonds, mutual funds and other similar securities held on the last day of the month before that of the last interview.

Information on the amount held in dedicated saving plans, individual retirement accounts and on the stock of consumer debt is not available.

Figure 2 shows the weighted mean of the amounts held in checking and saving accounts and in stocks and bonds in the 1983, 1985 and 1995 waves. All amounts are in 1996 dollars. For all cross-sections the stock held in financial assets increases with age up to around 65. Then, the profile levels off and some asset decumulation can be observed. According to the figures in Table 2, households tend to hold a relatively greater share of their assets in checking and saving accounts, especially if they are young or old. Investment in stocks and bonds peaks among households in their 50s. The vertical difference between the amounts held in checking and saving accounts and the amounts held in bonds and stocks tends to shrink over the years, for all age groups. Finally, the cross-sectional profiles suggest that the degree of financial market participation has increased over time especially among those aged between 40 and 60.

The measurement of *real wealth*, and in particular of real estate, is very deficient in the CEX. In the first years of the survey, only tenure information on the residence (and some general information about the type of building) was available. With this information it is possible to measure, for any group of individuals in the CEX, the proportion of renters, home owners with a mortgages or in their own right. Since 1988, substantially richer information is available about the mortgages outstanding, including their value, the time since it was started and so on. Unfortunately, even though a question on the value of the residence (and about its rental value) is present in the questionnaire, this information has proved to be of very low quality. We look at real assets in grater detail in section 2.2, where the focus is shifted to cohort behavior.

2.1.2 Mandatory Savings and Contributions to Pay-As-You-Go Systems and Private Pensions.

The CEX provides global estimates at the household level for pay deductions and contributions to social security, private pension, public and private retirement schemes. The figures are derived by the BLS and, presumably, are quite accurate. However, they do not allow to distinguish between contributions to funded and to unfunded plans, nor between voluntary and mandatory payments. Specifically, the CEX provides the following information:

Total amount of government retirement deducted from last pay annualized;

Total amount of railroad retirement deducted from last pay annualized;

Total amount of private pensions;

Total deductions for social security.

Information on employer's contributions to these and other retirement schemes is not directly available from the CEX, although it is possible to establish whether the employer is contributing to a private pension of any of the earners in the household. In this respect the CEX is unique, as any information on employers' contributions is missing in most data sets.

Figure 3 shows the 1983, 1988 and 1995 cross-sectional weighted mean of total retirement contributions, computed summing all the individual items listed above. Two are the main features of this set of figures: the hump-shape and the pronounced shift upward of the cross-sectional profiles over time suggesting an increase in retirement contributions, which appears to be particularly pronounced between the ages thirty to fifty. The upward shift is due primarily to the sharp increase over time in the contributions to private pension schemes and in the deductions for social security. However, once again, the interpretation of the features of these contours should be guarded as these are cross-sectional profiles combining the influence of both age and cohort effects. As to the distribution among the individual saving components, reported in Table 3, social security contributions are the most important item and for all years and age groups represent at least 70-80 percent of total contributions. The share rises above 90 percent for the young and the elderly. As to private pension contributions, they exhibit a discernible hump-shaped profile that shifts decisively upwards from the late 80s early 90s on. Yet, private pension contributions represent more than 10 percent of total contributions only for those aged between 40 and 60 and it is for this age group that the share and the actual contributions increases over time are most significant. Railroad and government retirement never represent more than five-six percent of total contributions and, if anything, their relative and absolute importance diminishes over time for all age groups.

2.1.3 Household Income

The CEX provides a measure of *total gross income* computed by the BLS and obtained by summing family earnings income, Social Security and Railroad benefits, supplemental security income checks, unemployment compensation, public assistance and welfare payments, interests on saving accounts and bonds, dividends, royalties, income from estates and trusts, pensions and annuities from private companies, military or government, income from roomers, boarders and other rental units, child support, cash scholarships and fellowships or stipends not based on working and food stamps. Information on total household income is available for all the units in the sample we have selected.

In Figure 4 and in Table 4, we report the relative weight of some components in total household income in 1983, 1988 and 1995. In each of the years covered by the survey, in the cross sections, the largest component of household income is earnings, whose share ranges from 68 to 73 percent and tends to increase slightly over the sample period considered, especially among those in their 60s early 70s. Earnings account for more than 90 percent of total income among those aged less than 50; among those aged more than 50, their share decreases rapidly to around 20 percent for the elderly. Earnings[5] exhibit the familiar hump-shape, peaking slightly later over the life cycle in the 90s with respect to the 80s. The time effects appear to be small. Retirement income increases slightly over time and accounts for less than 10 percent of income for those aged between 40 and 60, but rises to over 60 percent among the over 60. Financial income, including bank accounts interests, dividends, royalties, etc., accounts for a slightly decreasing share of total income over time; it makes up for less than 5 percent of total income for those younger than 50, but accounts for more than 10 percent for those above 60. Welfare and unemployment benefits account for around 1 percent and exhibit a temporary, but conspicuous drop in the late 80s affecting mainly those less than 60.

Disposable income is simply gross income minus the total amount of personal taxes, derived by BLS, and the contributions to social security. Personal taxes include federal, state and local income taxes and property taxes. Disposable income is about $36,000 p.a. in 1996 dollars for the average household in the age-year cross-sections and it corresponds to about 85% of average total gross income. The median is approximately 83 percent of the mean. As reported in Table 5, the share of total income absorbed by social security increases slightly over time from 4 to about 6 percent. The share accounted for by income taxes diminishes slightly.

Figure 5 shows the cross-sectional weighted mean of total gross income and of total disposable income. All amounts are in 1996 dollars. The familiar

[5] The charts with the cross-sectional profiles of earnings, retirement income, financial income and welfare benefits are not included.

hump-shape is immediately recognizable, although the cross-sectional age profiles peak in the mid- to late forties, slightly earlier than expected given that early retirement typically begins only after age 50. Another feature of the contours is the uniform upward shift in the 80s, followed by a downward shift in the 90s. The corresponding profiles based on the median instead of the mean do not differ in any major respect.

Annuatized retirement income is the main source of income for elderly households. It includes social security and railroad benefits and pensions and annuities from private companies, military or government. In the data social security benefits cannot be disentangled from railroad benefits, which in any case are a small share of total income, given the relatively minor weight they have in terms of contributions, as it has been discussed before. Data on annuities and life insurance are very limited in the CEX. On the other hand, it is well known that the market for annuities is of very limited importance in the US.

Figure 6 displays the cross-sectional age profiles of Social Security benefits and of private pensions. All amounts are in 1996 dollars per year. Total annuatized income appears to have increased over time as a result of the increase in private pension income in the late 80s and in social security benefits in the 90s, with the latter being relatively smaller. The Figure and Table 6 suggest that social security benefits are the largest source of annuatized retirement income for those households whose head is in his mid- to late sixties. For those in their fifties, that are the ones more likely to have taken on early retirement, private pensions are relatively more important and their absolute and relative weight appears to have increased over the years.

Finally, in Figure 7 we look at the replacement ratio of retirement income and earnings by plotting the profiles of mean earnings and mean retirement income in 1983 and 1995. The Figure shows that social security benefits and private pensions replace a relatively small share of working life income and this explains the fall in household savings, that is discussed in the next section, after households reach retirement age.

2.1.4 Saving as Residual

In this section we compute saving as a residual, subtracting all consumption expenditure from total disposable income. Total consumption includes expenditure on non-durable goods (mainly food and services), semidurables (clothing), durables (mainly cars and furniture), rent, health and education. Total consumption is about $33,000 p.a. in 1996 dollars for the average household in the age-year cross-sections. The median is approximately equal to 68% of the mean.

The cross-sectional profiles of median total expenditure and of median disposable income for 1983, 1988 and 1995 are reported in the Figure 8. The familiar hump-shaped profile of total expenditure is immediately detectable and it does not differ in any important way from the profile of mean expenditure. Three features of the Figure are worth pointing out. First, total expenditure tends to peak at or near the age when disposable income peaks as well. Second, the profiles suggest that some dissaving characterizes behavior at the ends of the age distribution, as predicted by the standard neoclassical model for consumption, as consumption drops at a smaller rate than income. Last, expenditure appears to fall slightly among the young in the 90s, but for all households aged 50 or above it increases over the years. This pattern can be explained mainly by the decrease in family size over time.

The vertical difference between the income and expenditure profiles depicted above is reported in Figure 9, which looks at median total saving, measured as residual, for the 1983, 1988 and 1995 cross-section. We focus on median saving, because the profile for mean savings is noisier, as it might be expected since median savings are more robust to outliers. This can be caused either by households having abnormally high incomes (due for example to bonuses) or expenditure (due for example to infrequent purchases of durable goods) in the year when they are surveyed. The cross-sectional profiles suggest that saving is very limited early in the life cycle. Afterwards, it increases and remains positive during the working life and its profile matches quite closely the profile of disposable income, peaking at approximately the same age. After retirement, saving diminishes substantially. An interesting feature of the Figure is the slight increase in savings that in many of the sample years appears to characterize the behavior of the eldest. Such behavior among the elderly is common to many countries and is considered a puzzle *vis-à-vis* most economic theories.

2.1.5 Saving Rates

Finally, we compute the saving rates, by dividing our residual measure of saving by total disposable income. In Figure 10, we report two cross-sectional definitions. In the left-hand side panel, we report the age profile of the saving rate defined as ratio of mean saving to mean disposable income. In the right-hand panel, we include the median of individual household saving rates. We do not report the mean as the saving ratios are very much affected by few observations with very low levels of income. The first set of profiles are more directly comparable to aggregate saving figures and correspond to the mean of the individual saving rates weighted by the individual income share of aggregate income. This first measure of the saving rate is much lower and much more volatile than the median saving rate. The profiles suggest that saving rates have fallen somewhat during the early 80s and the early 90s.

The saving rates figures emerging from the analysis carried out on the CEX hardly match those from the National accounts, which is not surprising given the difficulties in matching the CEX household consumption and income data to the aggregate figures. Moreover, to go from the age profiles to the aggregate, one would have to consider the weight (both in terms of size and of income) that each age group has on the population. For these reasons, the absolute level of saving rates is not of particular interest. The most interesting feature of this picture and those that follow is in the *shape* of the life cycle profile. In Figure 10, the most apparent feature of the saving rate profile, whether measured by the median of the ratios or the ratio of means, is the hump shape. Such a shape is roughly consistent with the implications of the life cycle model. As mentioned above, however, the presence of cohort effects makes the interpretation of these profiles problematic.

2.1.6 Covariates

The main contribution of this section is to provide evidence on a set of household specific variables whose evolution over time and the life cycle might explain the patterns of household consumption, income and saving that we have documented in the previous sections. Thus, in Figure 11 we focus on the cross-sectional distribution of a set of variables that are usually believed to explain some of the life cycle and time variation in consumption, income and saving behavior. Specifically, we focus on household size, employment rates, home ownership and ownership of life insurance.

An important feature of US household population has been the reduction in the average size of households over the years and the phenomenon appears to affect particularly those households whose head is in his forties. The cross-sectional evidence on male labor force participation rates suggests that participation has declined slightly in the late 80s and early 90s, particularly among those aged 50 and above, reflecting the increase in early retirement. As to home-ownership rates, the age profiles do not exhibit strong time effects, but over the years tend to peak slightly later. Finally, the life-insurance-ownership profiles exhibit a pronounced hump-shape and a moderate downward shift over the years covered by the survey.

2.2 Life Cycle Profiles of Household Savings

As we have pointed out several times, all the analysis carried out in the previous paragraph is cross-sectional and does not identify life-cycle changes. In fact, the cross-sectional profiles do not correspond to the life-cycles ones unless all individuals at each point in time differ only by their age (and possibly a completely idiosyncratic component). Yet, if being born in different years causes individual behavior and attributes to differ in a systematic way, in order to identify household behavior over the life-cycle we need to purge the data from cohort effect. This can be achieved by focussing on cohort-specific profiles. The large sample size allows us to define aggregation units that are small enough to be homogeneous without loss of statistical precision. Therefore, cohorts are defined over the date of birth of the household head at five years ranges and the average cell size is 1000 observations. Table 7 provides more details on our cohort definition. Since the cohorts are defined by a five-year interval and the survey covers more than five years, adjacent cohort profiles overlap, which implies that different cohorts are observed at the same age, but the observations correspond to different survey years. Differences between overlapping cohorts could therefore be due to either time or cohort effects. For simplicity, we will ignore the time effects (or set them to zero) and use each cohort profile to identify the "pure" age effects on the variables of interest.

This section is organized as section 2.1: first we focus on the individual saving components and then on total household saving measured as the residual of income minus consumption. Finally, we look at the cohort profiles of a set of household characteristics that are thought to have a role in explaining life-cycle expenditure and saving behavior. For each of the cohorts in our sample, the Figures display a set of smoothed age-profiles, obtained by regressing the cohort data on a full set of cohort dummies and a fifth-order age polynomial. All the variables discussed in this section are defined exactly as in 2.1.

2.2.1 Discretionary Savings

Figures 12 reports the age profiles for financial savings. All the amounts are in 1996 dollars per year and were deflated using the US CPI. The use of cohort techniques allows us to examine the differences between the profiles of different generations. The cohort effects are clearly visible, especially among the older groups. The profiles in the Figure suggest that saving tends to be low, but increasing among the young and steadily decreasing among the elderly. Towards the end of the life cycle, it appears to become negative. The contours suggest also that the younger generations save somewhat less than the middle-aged and much less than the older. At the end of the life cycle, the profiles are rather steep and relatively younger cohorts appear to approach zero saving at earlier ages. For all cohorts, savings appear to peak around the age of forty-five, which is slightly before than expected.

Figure 13 displays the non-smoothed age profiles of the shares of households holding individual retirement accounts (IRAs), which are an important component of discretionary financial savings. The most interesting feature of the contours is the steep increase in the shares of holders of IRAs in the mid-80s and their subsequent drop in the 90s. The phenomenon concerns all cohorts and is linked to the 1981 Economic Recovery Tax Act, which substantially expanded IRA eligibility. In the late 80s, higher-income taxpayers with employer-provided pensions were excluded from making tax-deductible contributions; by the end of the 80s total tax-deductible contributions fell by over 60 percent and have remained low since then. Figure 14 reports the age profiles for the stocks of checking and saving accounts and of stocks and bonds.

The age profiles for checking and saving accounts are fully consistent with those for financial savings and suggest that the stocks accumulated by the younger generations are smaller than those accumulated by the elder ones at any point of the life cycle. The picture for stock and bond holdings is quite different. In fact, the age profiles are higher the younger the generation, with those born in the 50s holding, at the age of forty, a stock of wealth, which is higher than the stock of those born in the late 30s and 40s. For all cohorts, stock and bond holdings are low and grow slowly early in the life cycle. Yet, the rate of accumulation increases fast with age and peak around the age of sixty-five to seventy. The contours suggest a dramatic increase for all cohorts in the amounts invested over the years covered by the survey. The increase appears particularly pronounced for those cohorts born after the mid-30s. As to checking and saving accounts, the rate of accumulation is quite uniform over the whole life cycle up to the age of sixty, when holdings peak. Both sets of profiles exhibit some levelling off around the age of sixty/seventy and thereafter they decline slightly. In addition, it is interesting to notice that the older generations hold relatively more checking and saving accounts and relatively less stocks and bonds than the younger cohorts. In fact, the vertical difference between the contours for the stocks of checking and saving accounts and for those of stocks and bonds is smaller the younger the cohort. The fact that the young hold relatively more equity, together with the rise in stock prices might help to reconcile the profiles in the right panel of the figure – suggesting that the young have higher levels of asset stocks - with that on saving flows in Figure 12 – suggesting that the young save relatively less.

This evidence from the CEX is consistent with that from the US Survey of Consumer Finances discussed by Bertaut and Starr-McCluer (2000) who find that, between the early eighties and the late nineties, the composition of financial assets has changed appreciably with the relative importance of time and savings deposits declining while the importance of equity, pension funds and mutual funds has risen. Several factors appear to underline these trends. The first is the growth in stock prices over the period, with the Standard & Poor 500 stock price index rising from 165 in 1983 to 600 in 1995. Such growth, together with subdued inflation, implies an average real increase of over 10 percent per-year. The second is the development of mutual funds, which rose from around 600 in the early eighties to above 5000 in the nineties. The large number of institutions offering mutual funds, the proliferation of types of funds available and the rise of no-load funds have made it easier and less costly for households to attain a diversified portfolio of stock. Another important factor is the introduction and success of tax-deferred retirement accounts, as documented in Figure 13. The combination of rising stock prices and the growth of investment in equity, especially through mutual funds and retirement accounts has been associated with a significant increase in the equity share of households' financial assets.

We have mentioned in the section describing the Data that the CEX provides very limited information on real asset holdings, especially in the first years covered by the survey. Yet, the information on tenure, which is accurate, allows to measure the proportion of renters, homeowners with a mortgage and in its own right. In Figure 15 we report three sets of cohort-age profiles: the lowest, but increasing set refers to the fraction of homeowners without a mortgage, the hump-shaped set of contours refers to the share of homeowners with a mortgage and the uniformly increasing and concave set refers to the overall fraction of homeowners in the population. The three sets of profiles do not exhibit very strong cohort effects. The share of homeowners without mortgage tends to increase with age for all cohorts and the steepest increases occur among those households with heads in their fifties. The share of homeowners with mortgage increases steeply early in the life cycle, peaks around the age of 40 and then slowly declines. The cohort effects are slightly more pronounced here with the older generations exhibiting a relatively lower share of households with mortgage. As to the overall shares, they increase over the life cycle of all cohorts and tend to level off among those who enter their forties, independently on the cohorts, which end up exhibiting similar shares of homeownership at the peak. Yet, for the younger generations, the contours are particularly steep early in the years and appear to be much steeper than those for the older cohorts. Overall, the profiles in Figure 15 suggest that the younger cohorts are more likely to become homeowners earlier in the life cycle, but they are also more likely to take on a mortgage.

2.2.2 Mandatory Saving and Contributions to Pay-As-You-Go Systems

Figure 16 displays the cohort profiles for total retirement contributions. As we have mentioned before, all these figures are derived by the BLS and, presumably, are quite accurate. However, they do not allow to distinguish between contributions to funded and unfunded plans, nor between voluntary and mandatory payments. The cohort effects are strongly positive, as expected, with the younger generation contributing relatively more to social security and retirement plans. Also, the profiles for the younger cohorts are quite steep early in the life cycle. Total retirement contributions appear to peak around the age of fifty-five to sixty.

Figure 17 reports the age profiles of the shares of households holding a private pension. Private pensions represent a relatively small share of total retirement contributions. Yet, over the years, their importance has increased both in relative and in absolute terms. The Figure shows that also the fraction of households with private pensions has increased dramatically and the increase has been particularly large among the younger cohorts, with those born after 1945 exhibiting the steepest profiles.

2.2.3 Household Income

Figure 18 displays the actual and smooth cohort profiles for total gross income and for total disposable income. The familiar hump-shape characterizes the two sets of contours implying that the hump-shapes observed in the cross-sections are not spurious, with both sets of profiles peaking around the age of forty-five to fifty. Quite surprisingly, the cohort effects are rather small. Also, they tend to be negative among those born after 1950, with the younger generation exhibiting a profile slightly below that of the immediately preceding cohort. Those born between 1930 and 1950 exhibit the highest profile and appear to be better off than the younger and elder generations. The cohort effects are more pronounced and have a clear negative effect on the cohort profiles of household tax payments (not reported), with younger households paying less than the older ones. Finally, we have examined the cohort effects on the individual income components (whose charts are also not included). Household earnings profiles are very similar to those of gross income until approximately the age of sixty, after which they decline much more rapidly; overall, the cohort effects are extremely modest, especially among the generations born before 1930 or after 1950. The cohort effects are strong and negative on the profiles of financial income, which consists of interests on savings accounts and bonds, dividends, royalties and income from estates and trusts. Such profiles slope upward very slightly early in the life cycle, peak around the age of sixty and, after the peak, exhibit a very modest decline. The most interesting feature of the chart is the large downward shift of the profiles of the younger generations. Among those born after 1940, the cohort differences are very small; instead, among those born before 1940, they are very pronounced, with each generation positioning at a significantly higher level than the generation immediately following it. The cohort effects appear to be rather large and negative also on the profiles of public assistance and unemployment benefit income, with the contours of the younger generations positioned below those of the older ones. Such contours exhibit a rather steep decline during the first part of the life-cycle, up to the age of forty; between the age of forty and sixty they appear to be quite flat; afterwards they start declining again at a fast rate. Finally, the profiles of retirement income, are virtually flat near zero during the first part of the life-cycle, but slope upwards around retirement age, which appears to be lower the younger the cohort. Among the retired, the profiles of the younger cohorts are slightly higher suggesting that these generations have or can expect to have a relatively higher income from pensions and social security.

Figure 19 displays the smooth cohort profiles for social security benefits and for pensions and annuities from private companies, military or government, which add up to annuatized income as defined in paragraph 3.1. The higher set of contours refers to social security benefits; the lower set refers to pensions and annuities. The Figure confirms the cross-sectional results: social security is the largest source of annuatized income for those aged 60 and above; for those in their fifties, who are likely to have taken early retirement, private pensions are relatively more important. The cohort effects on the social security benefits profiles are quite small and do not exhibit any clear pattern. The effects on the pensions profiles are much more pronounced with the contours corresponding to the younger cohorts much higher than those of the older ones, which help explain the dip in the cross-sectional profiles towards the end of the age spectrum.

2.2.4 Saving as Residual

In this section we focus on the cohort profiles of savings, computed residually by subtracting total household expenditure from total disposable income. Figure 20 portrays the cohort age profiles for median total household expenditure. The profiles are similar in most respects to those of income: both are hump-shaped, peak around the same age and exhibit similar, although more pronounced cohort effects. Also, the expenditure profiles of those born between 1930 and 1950 are higher that the profiles of the younger cohorts, but they are slightly lower or undistinguishable from those of the older ones. The expenditure contours increase and decrease at a somewhat lower rate than income at the ends of the life-cycle, suggesting that some dissaving is taking place among the young and the elderly. Starting from the age of seventy, consumption levels off.

In Figure 21, we report the cohort-age profile for median saving, computed as residual. Four features are worth noticing in this chart. First, the profiles exhibit the familiar hump-shape, with savings increasing at a rather fast rate among the young, peaking in the late forties and then decreasing at a declining rate. Second, the cohort effects are similar to those of income and expenditure and, although modest, are such that, once again, we can divide the cohorts in three groups: the young, born after 1950, the middle aged born between 1930 and 1950 and the elderly, born before 1930. Within each group the behaviour is quite similar, but there are important differences across groups. The youngest cohorts have the lowest intercept and therefore the lowest saving life cycle profile. The profiles of the middle-aged, who are close to the peak of their saving contours in the years covered by the survey, are higher than those of the younger cohorts. However, the highest profiles are those for the oldest generations, who, however, are observed over a part of their life cycle where saving has already declined considerably. Third, despite the pronounced reduction, the levels of saving remain positive also in old age. Fourth, the level of saving rates is remarkably high, given what we know about the recent performance of aggregate saving rates in the US. Similar levels are obtained if one considers average cohort savings over average cohort income. It is obvious that such a high level of saving rates is indicative of measurement and data problem. While both consumption and income are likely to be under-reported in the CEX, the problem seems to be more serious for consumption.[6] However, unless there are reasons to believe that measurement problems vary systematically with age and cohorts, the figures we present are still informative about the evolution of saving over the life cycle. Having said this, however, the saving figures, and in particular their level, have to be taken with much caution.

2.2.5 Saving Rate

Finally, Figure 22 reports the profiles for the median saving rate computed by dividing the residual measure of saving by disposable income. The profiles of the saving rate computed as ratio of mean saving and mean income differs in only two respects: they are shifted downward and the hump-shape is more pronounced with lower (negative) saving rates at the left tails of the age distribution. As mentioned in section 2.1.5, the figures emerging from this analysis are hardly comparable to those in the National accounts, due to the differences between the latter and the CEX as to the income and consumption measures. As a consequence, the focus should be on the shape of the contours and not as much

[6] If one tries to reproduce national accounts consumption using weighted CEX figures, one gets about 65% of Personal Consumption Expenditure.

on the absolute levels. The profiles displayed in the picture below indicate, once again a hump shape for the saving rate, even though the decline in the latest part of the life cycle is not very strong. The saving rate seems to peak in the late forties and then slowly declines. Cohort effects do not display a clear pattern: the youngest cohorts born after 1940 exhibit the lowest saving rates; those born between 1930 and 1935 the highest. The evidence in Figure 22 contradicts that in Attanasio (1994, 1998) who only considers data up to 1992. Attanasio (1998) finds negative cohort effects for the middle cohorts and interprets these as a possible explanation of the decline in aggregate saving rates in the US. The addition of the following years appears to reverse that finding.

Obviously the results we have obtained should be interpreted with care. It should be remembered that the cohort effects and the age profiles are identified only under the arbitrary assumption that there are no time effects in saving rates. There are versions of the life cycle model that predict the absence of cohort effects (rather than time effect, see Deaton and Paxson, 1994). Further investigations of this result are granted. The fact that Attanasio's result is reversed once one adds the last few years seem to suggest that the last few years are somewhat special. A plausible hypothesis for the behaviour of the last few years, is that of capital gains in the stock market, which would obviously constitute an important time effect that the present identification strategy is ruling out.

2.2.6 Covariates

In the last section of this part we look at the cohort profiles of a set of household characteristics that are thought to have a role in explaining life-cycle expenditure and saving behavior. Figure 23 displays the cohort age profiles of household size in the top-left panel, employment rates in the top-right panel, home ownership in the bottom-left panel and ownership of life insurance in the bottom-right panel.

The profiles for family size in the top-left panel exhibit the familiar hump-shape and clear negative cohort effects, with the contours for the younger cohorts being lower and peaking slightly later than those of the older generations. In the top-right panel, we report both the proportion of household heads who are employed and the proportion of household heads who are retired. The most noticeable feature of these two sets of profiles concerns the phenomenon of earlier retirement characterizing the younger cohorts. Thus, the contours for the employment rate are somewhat lower and start sloping down at lower ages for the earlier cohorts; whereas the contours for the retirement rate are somewhat higher and start sloping upward earlier. The profile for homeownership (bottom-left panel) suggests that the proportion of home-owners is slightly smaller among the young generation, but the profiles for the young are very steep. The cohort effects are strongly negative for life insurance with a lower proportion of younger households in the younger generations holding a life insurance. The proportion of households with a life insurance is relatively low also among the older cohorts.

3. Pension Policies

Much of the current debate on pension policies in the US is dominated by two important facts. The first is the decline of household saving rates, as measured in the National Income and Product Accounts as well as in the Flow of Funds figures. According to these, household saving rates went from being close to double figures at the beginning of the 1980s, to being negative last year. The other is the fact that the current Pay-As-You-Go social security system (OASDI) is unsustainable in the medium run, given its current parameters. Even though the system is currently enjoying a surplus because of the presence of a large generation in the labour force, it is projected to go into deficits in a few years and to exhaust the funds in less than 30 years. These two facts have stimulated a wide-ranging debate among academics and policy makers about fiscal incentives to saving, the reform of the pension system and more generally on the determinants of saving. The proposals for reform have varied from simple adjustments to the current formula, to the indexation of retirement age to changes in life expectancy, to the privatization of the system and the institution of individual retirement accounts. Before mentioning briefly the debate on the reform of the social security system, we review some of the evidence on the decline in household saving rates and the debate on fiscal incentives to saving.

The low saving rates of US households have induced many commentators and policy makers to advocate fiscal incentives to savings, as the perception was that US households were not saving 'enough' to provide for their retirement. Many commentators seem to worry particularly about the saving behaviour of the baby boomers, as it is felt that this generation will not be able to rely on the social security system currently in place, because of the problems mentioned above. The last set of results we presented, indicating negative cohort effects in the saving rates of the baby boomers seems to support this view. However, without a full understanding of the causes of the decline in household saving, it is not clear that US households are saving 'too little' or 'not enough'. Unfortunately, a fully convincing explanation of the decline in household saving rates has not been found. Besides this study, a few other works have analyzed household savings at the micro level. These include Bosworth, Burtless and Sabelhaus (1991), Attanasio (1994), Gokhale, Kotlikoff and Sabelhaus (1996) and Attanasio (1998). The evidence that seems to emerge from these studies is that the baby boomers are not responsible for the decline in saving rates observed from the early 1980s to the early 1990s. As we showed in section 2, US households do exhibit a pronounced hump shaped saving profile, so that, at each point in time, the generations that save the most are those approaching retirement at that age. Starting with the early 1980s, the generations that were in that position were the parents of the baby boomers, but there is some evidence in the literature that their saving was, for some reason, 'shifted down' relative to that of previous and subsequent generations. One possible explanation is that these generations were about to enjoy a generous social security system and therefore did not have strong incentives to save. At least in some of the papers cited above, the baby boomers seemed to be saving more than their parents *at similar ages*. The most recent further declines in household saving rates are harder to explain, as the baby boomers are now in a phase of their life cycle when they should be saving the most. However, these trends seem to be somehow reflected in our estimates of cohort effects, which are the lowest for these cohorts, as we have documented above. Notice that this contradicts the finding in Attanasio (1998), based on data up to 1992.[7] A possible explanation, that merits serious investigation, is that the observed low saving rates are related to the recent capital gains on financial wealth and real estate that are often not included in the definition of saving. If people perceive that these capital gains are sustainable, then the incentive to save out of current earnings is not strong.

The existing studies of the recent decline in saving rates, including the present one, suffer from important limitations. The first and probably most important is data availability. While the analysis of household behaviour requires micro data that measure income, consumption, wealth and so on, such data are available only since the early 1980s and have important limitations. The CEX is of very limited size and, as we saw, contains only scant information on wealth. On the other hand, the SCF is available only every three years and contains very limited information on the flows of saving. The second limitation is that much of the evidence on many of the hypotheses mentioned above, is based on strong identifying assumptions. A good example, is the problem of disentangling year, age and cohort effects from the evidence on repeated cross-sections. Without additional information and/or the structure provided by a theoretical model, it is not possible to disentangle, in a purely statistical way, age, cohort and time effects. In other words, even if we observe baby boomers saving more at 35 when their parents were at the same age, we cannot say whether this is a cohort effect or a year effect. This identification problem is compounded by the fact that we have virtually no information on saving behaviour at the micro level during the 1960s and 1970s. Finally, we still do not have a fully satisfactory theoretical model of saving behaviour that we can use with confidence for policy analysis. There are two reasons for being unsatisfied. First, while the most sophisticated analyses of Euler equations for consumption that allow for the effects of demographic and labour supply variables seem to be able to fit the data, they are of limited usefulness in the analysis of saving behaviour and as a guidance to policy analysis.

[7] Because of the positive cohort effects for the cohorts that were about to enter the part of the life cycle where saving is the highest Attanasio (1998) was predicting an increase in saving rate, that obviously did not occur.

This is due to the fact that, while we can say that a flexible (and complex) version of the life cycle model seems to fit the data, we do not know how to use in a structural fashion all but the simplest versions of the model. This situation is behind the somewhat schizophrenic approach of the profession that alternates between very descriptive analyses of saving behaviour and very structural studies of consumption. Second, it seems that a variety of factors, but in particular education, information and economic literacy, are important determinants of saving behaviour and especially of saving for retirement[8] and yet we still do not have analytical tools sufficiently developed that account fully for these issues.

The worry about the level of household saving and its adequacy to finance the retirement of the baby boomers is probably behind the large attention to fiscal incentives to savings. One does not have to look very far to find many quotes of policy makers stating that Americans should be encouraged to save more. Regardless of whether this objective is indeed justified, a large fraction of the policy debate on saving in the US has focussed on the effectiveness of these tax incentives as provided first by the IRA legislation and then by the 401(k) legislation. It is certainly undeniable that these pieces of legislation have had a profound effect on the way Americans save, in more than one way. We have seen above the massive increase in participation to the IRA program during the years in which the tax incentives were most generous. The 401(k) programs have now grown so much that 401(k) accounts represent a substantial part of household retirement wealth. Whether these programs have had a net positive effect in stimulating national saving, however, is still hotly debated. Venti and Wise (1987, and many others) and Poterba, Venti and Wise (1997) have argued in many occasions that the IRA and 401(k) fiscal incentives did create a substantial amount of new saving over and above the amount that these programs cost in loss tax revenue. On the other hand, Engen and Gale (1997) and Engen, Gale and Scholz (1996) have forcefully claimed that this is not the case. The main problem with this debate is that the evidence strongly rests on identification assumptions that, by their nature, are un-testable. The main problem is simple to explain and typical

[8] See, for instance, Bernheim and Scholz (1993).

of the evaluation of program participation. While it is true that IRA or 401(k) participants save more than non-participants, the fact that they participate into a program is likely to be correlated with a high 'taste for saving'. Therefore, the comparison between the two groups is not informative about whether program participants would have saved less in the absence of the program.

The only study in the large literature on the effectiveness of the IRA legislation in stimulating saving that uses information on consumption (and therefore on saving as a residual) uses the CEX (see Attanasio and DeLeire, 1994). Attanasio and DeLeire exploit the panel dimension of the CEX and circumvent the identification problem that plagues this literature by comparing recent and 'old' IRA contributors' consumption and saving behaviour[9]. The idea is quite simple. Within a simple life cycle model, the fiscal incentive can have an impact only through the substitution effect induced by the increased rate of return to saving. If such an effect is strong enough to counteract the income effect, consumers would reduce their consumption (and increase their saving) *when they start to participate in the scheme* and would remain at that (lower) level of consumption afterwards. It is therefore possible to compare those participants who joined the program recently to those that have been in the program for some time. If the scheme works, one would observe that consumption growth is significantly lower for the new participants than for the old. In the CEX, one can identify all the households at the final interview that were contributing to an IRA and can compute the rate of growth of consumption for those that were already contributing at the first interview and those that were not. These rates of growth are not significantly different, even after controlling for income growth and a variety of other variables. This test is different from the others in the literature because it uses the structure provided by economic theory (i.e. the fact that the program can only work through the substitution effect). Attanasio and DeLeire (1994) also look at the changes in non-IRA financial assets for the two groups and find evidence that the change for the new participants is significantly lower than that of the non-participants, a further indication of the fact that the scheme does

[9] The statement is not uncontroversial. As any identification assumption, the one use by Attanasio and Deleire is not testable and therefore open to criticism.

not generate new saving, but only a re-shuffle of existing saving (or saving that would have been carried out even in the absence of the program). The identification assumption for the validity of this test is that the two groups (new and old participants) do not differ in the unobservable 'taste for saving'.

4. Conclusions

In this chapter, we have presented some evidence on the behavior of aggregate saving rates. Using micro data and some strong identifying restrictions, our results uncover two important facts. First, the life cycle profile for savings and saving rates is roughly hump shaped and peaks in the late 40s. Second, there seems to be important differences in saving behavior across cohorts, with the youngest cohorts born after 1940 exhibiting the lowest saving rate and those born before 1930 the highest. These results should be interpreted with extreme care, as they are based on strong identification assumptions that, by definition, cannot be tested. However, if these assumptions hold, our results contribute to the understanding of US household saving behavior and as such are relevant for the policy debate on the incentives to savings. In fact, by identifying saving behavior over the life cycle after accounting for differences due to cohort-specific preferences, our analysis provides a framework to investigate the potential causes of the decline in saving rates and to check the desirability of specific policy interventions aimed at stimulating saving. Yet, as discussed in the last section of the chapter, determining *ex-post* the actual effectiveness of most common incentives is not straightforward, but rests crucially on identifying assumptions that, by their nature, are un-testable.

Tables

Table 1: Composition of Financial Savings[10]

Year: 1983

	Net deposits in checking, saving, brokerage and similar accounts	Net purchases of stocks, bonds, mutual funds and similar securities	Contributions to individual retirement accounts	Contributions to life insurance	Contributions to health insurance
Age: 20-24	0.3468	0.5231	0.0253	0.0466	0.0582
Age: 25-29	0.4737	-0.0786	0.1696	0.2323	0.2030
Age: 30-34	0.2096	0.4858	0.1064	0.1169	0.0812
Age: 35-39	-0.9346	-2.2066	0.9547	0.7762	0.4103
Age: 40-44	-1.5482	-0.0812	0.2617	0.2555	0.1121
Age: 45-49	0.7458	-1.9788	0.8920	0.7714	0.5697
Age: 50-54	0.1559	-2.6806	1.8853	0.9328	0.7066
Age: 55-59	0.2030	0.2334	0.5087	0.0316	0.0233
Age: 60-64	0.7130	0.0819	0.0991	0.0482	0.0579
Age: 65-69	0.6647	0.2233	0.0183	0.0369	0.0569
Age: 70-74	-1.0015	-0.4867	0.0681	0.0585	0.3616
Age: 75+	0.8726	-0.3026	0.0156	0.0511	0.3632

Year: 1988

	Net deposits in checking, saving, brokerage and similar accounts	Net purchases of stocks, bonds, mutual funds and similar securities	Contributions to individual retirement accounts	Contributions to life insurance	Contributions to health insurance
Age: 20-24	-0.0931	0.7243	0.0780	0.0923	0.1985
Age: 25-29	0.3187	0.0685	0.0929	0.1987	0.3212
Age: 30-34	-1.1480	-0.7629	0.8028	0.9262	1.1820
Age: 35-39	-0.9740	-0.5391	0.1455	0.1815	0.1861
Age: 40-44	0.0158	-2.4481	1.0187	1.1979	1.2157
Age: 45-49	-0.4704	-0.7220	0.0797	0.0583	0.0544
Age: 50-54	-1.2390	-0.7620	0.4868	0.2433	0.2709
Age: 55-59	-3.0401	-0.2079	0.9619	0.6655	0.6206
Age: 60-64	0.5154	0.1917	0.1507	0.0481	0.0942
Age: 65-69	-1.6901	0.2804	0.1661	0.0712	0.1725
Age: 70-74	-0.9398	-1.3617	0.1297	0.2543	0.9175
Age: 75+	-0.7128	1.2760	0.0091	0.1326	0.2951

10 The figures in this set of tables are computed by dividing the amount of the relevant asset by total financial savings in absolute value.

Year: 1995

	Net deposits in checking, saving, brokerage and similar accounts	Net purchases of stocks, bonds, mutual funds and similar securities	Contributions to individual retirement accounts	Contributions to life insurance	Contributions to health insurance
Age: 20-24	0.1157	0.5296	0.0576	0.0575	0.2396
Age: 25-29	-0.0833	0.2729	0.1608	0.1361	0.5135
Age: 30-34	0.2182	0.1873	0.1670	0.1315	0.2960
Age: 35-39	-2.8295	-4.4411	1.9179	1.3102	3.0426
Age: 40-44	0.1586	0.2480	0.1651	0.1634	0.2649
Age: 45-49	0.2801	0.2063	0.1242	0.1529	0.2365
Age: 50-54	-4.8756	1.1297	1.1113	1.3541	2.2804
Age: 55-59	-1.9041	0.1243	0.1433	0.2608	0.3757
Age: 60-64	-0.2556	0.5186	0.3020	0.1355	0.2995
Age: 65-69	0.4805	0.2034	0.0243	0.0593	0.2325
Age: 70-74	-0.7531	-0.5999	0.0146	0.0793	0.2590
Age: 75+	-1.8058	0.3374	0.0281	0.0632	0.3771

Table 2: Composition of the Stock of Financial Savings

Year: 1983

	Stock of checking, saving, brokerage and similar accounts	Stock of stocks, bonds, mutual funds and similar securities
Age: 20-24	0.6031	0.3969
Age: 25-29	0.7609	0.2391
Age: 30-34	0.6343	0.3657
Age: 35-39	0.7109	0.2891
Age: 40-44	0.6170	0.3830
Age: 45-49	0.6959	0.3041
Age: 50-54	0.6135	0.3865
Age: 55-59	0.6465	0.3535
Age: 60-64	0.6456	0.3544
Age: 65-69	0.7254	0.2746
Age: 70-74	0.7258	0.2742
Age: 75+	0.6683	0.3317

Year: 1988

	Stock of checking, saving, brokerage and similar accounts	Stock of stocks, bonds, mutual funds and similar securities
Age: 20-24	0.6762	0.3238
Age: 25-29	0.7922	0.2078
Age: 30-34	0.6966	0.3034
Age: 35-39	0.7000	0.3000
Age: 40-44	0.6480	0.3520
Age: 45-49	0.6870	0.3130
Age: 50-54	0.6123	0.3877
Age: 55-59	0.5471	0.4529
Age: 60-64	0.6422	0.3578
Age: 65-69	0.5813	0.4187
Age: 70-74	0.6576	0.3424
Age: 75+	0.6242	0.3758

Year: 1995

	Stock of checking, saving, brokerage and similar accounts	Stock of stocks, bonds, mutual funds and similar securities
Age: 20-24	0.5320	0.4680
Age: 25-29	0.7429	0.2571
Age: 30-34	0.5645	0.4355
Age: 35-39	0.5649	0.4351
Age: 40-44	0.5141	0.4859
Age: 45-49	0.6010	0.3990
Age: 50-54	0.5336	0.4664
Age: 55-59	0.4640	0.5360
Age: 60-64	0.5201	0.4799
Age: 65-69	0.5582	0.4418
Age: 70-74	0.6100	0.3900
Age: 75+	0.5981	0.4019

Table 3: Composition of Total Retirement Contributions

Year: 1983

	Deductions for social security	Contributions to private pensions	Deductions for government retirement	Deductions for railroad retirement
Age: 20-24	0.9296	0.0358	0.0333	0.0013
Age: 25-29	0.8587	0.0889	0.0440	0.0083
Age: 30-34	0.8449	0.0906	0.0590	0.0055
Age: 35-39	0.8236	0.0979	0.0724	0.0062
Age: 40-44	0.8156	0.0915	0.0812	0.0117
Age: 45-49	0.7850	0.1371	0.0722	0.0057
Age: 50-54	0.7795	0.1332	0.0841	0.0032
Age: 55-59	0.7956	0.1079	0.0810	0.0156
Age: 60-64	0.8260	0.0871	0.0869	0.0000
Age: 65-69	0.9294	0.0263	0.0443	0.0000
Age: 70-74	0.9058	0.0119	0.0819	0.0004
Age: 75+	0.9484	0.0346	0.0171	0.0000

Year: 1988

	Deductions for social security	Contributions to private pensions	Deductions for government retirement	Deductions for railroad retirement
Age: 20-24	0.9236	0.0607	0.0157	0.0000
Age: 25-29	0.9060	0.0716	0.0217	0.0006
Age: 30-34	0.8972	0.0835	0.0190	0.0003
Age: 35-39	0.8582	0.1046	0.0342	0.0030
Age: 40-44	0.8443	0.1030	0.0460	0.0067
Age: 45-49	0.8337	0.1134	0.0424	0.0104
Age: 50-54	0.8035	0.1207	0.0693	0.0064
Age: 55-59	0.8198	0.1378	0.0320	0.0103
Age: 60-64	0.8430	0.0966	0.0593	0.0011
Age: 65-69	0.7806	0.1090	0.1104	0.0000
Age: 70-74	0.8295	0.1155	0.0549	0.0000
Age: 75+	0.9746	0.0254	0.0000	0.0000

Year: 1995

	Deductions for social security	Contributions to private pensions	Deductions for government retirement	Deductions for railroad retirement
Age: 20-24	0.9071	0.0885	0.0038	0.0007
Age: 25-29	0.8452	0.1237	0.0311	0.0000
Age: 30-34	0.8009	0.1752	0.0231	0.0008
Age: 35-39	0.7951	0.1829	0.0220	0.0000
Age: 40-44	0.8388	0.1285	0.0327	0.0000
Age: 45-49	0.7591	0.1887	0.0480	0.0041
Age: 50-54	0.7674	0.2018	0.0307	0.0000
Age: 55-59	0.7781	0.1691	0.0405	0.0123
Age: 60-64	0.8170	0.1594	0.0235	0.0000
Age: 65-69	0.8376	0.1570	0.0055	0.0000
Age: 70-74	0.9039	0.0582	0.0379	0.0000
Age: 75+	0.8383	0.1214	0.0403	0.0000

Table 4: Gross Income Components

Year: 1983

	Earnings	Retirement income	Financial income	Welfare benefits	Other
Age: 20-24	0.9087	0.0043	0.0101	0.0349	0.0420
Age: 25-29	0.9116	0.0040	0.0213	0.0253	0.0378
Age: 30-34	0.9213	0.0055	0.0121	0.0204	0.0407
Age: 35-39	0.9109	0.0106	0.0184	0.0135	0.0466
Age: 40-44	0.8908	0.0238	0.0185	0.0160	0.0508
Age: 45-49	0.9045	0.0262	0.0133	0.0147	0.0412
Age: 50-54	0.8635	0.0467	0.0467	0.0090	0.0341
Age: 55-59	0.8332	0.0926	0.0457	0.0134	0.0152
Age: 60-64	0.5303	0.3317	0.1139	0.0118	0.0123
Age: 65-69	0.2972	0.6110	0.1502	0.0039	-0.0622
Age: 70-74	0.1916	0.6051	0.1367	0.0022	0.0644
Age: 75+	0.0920	0.6452	0.1412	0.0019	0.1198

Year: 1988

	Earnings	Retirement income	Financial income	Welfare benefits	Other
Age: 20-24	0.8945	0.0029	0.0211	0.0184	0.0631
Age: 25-29	0.9245	0.0048	0.0043	0.0168	0.0496
Age: 30-34	0.9331	0.0070	0.0129	0.0100	0.0370
Age: 35-39	0.9138	0.0093	0.0112	0.0129	0.0527
Age: 40-44	0.9170	0.0142	0.0173	0.0059	0.0456
Age: 45-49	0.9090	0.0254	0.0141	0.0070	0.0446
Age: 50-54	0.9102	0.0278	0.0140	0.0059	0.0421
Age: 55-59	0.7617	0.0980	0.0557	0.0043	0.0802
Age: 60-64	0.5901	0.2335	0.1001	0.0048	0.0716
Age: 65-69	0.3161	0.5551	0.1142	0.0021	0.0124
Age: 70-74	0.1401	0.6547	0.1654	0.0009	0.0389
Age: 75+	0.0795	0.7129	0.2506	0.0006	-0.0435

Year: 1995

	Earnings	Retirement income	Financial income	Welfare benefits	Other
Age: 20-24	0.8705	0.0103	0.0059	0.0389	0.0743
Age: 25-29	0.9352	0.0051	0.0045	0.0146	0.0405
Age: 30-34	0.9480	0.0167	0.0080	0.0156	0.0118
Age: 35-39	0.9276	0.0161	0.0127	0.0123	0.0313
Age: 40-44	0.9406	0.0224	0.0055	0.0091	0.0224
Age: 45-49	0.9432	0.0322	0.0097	0.0082	0.0068
Age: 50-54	0.9132	0.0511	0.0275	0.0055	0.0027
Age: 55-59	0.8320	0.0901	0.0278	0.0089	0.0412
Age: 60-64	0.5819	0.3108	0.0592	0.0088	0.0393
Age: 65-69	0.3276	0.5734	0.0663	0.0110	0.0217
Age: 70-74	0.2773	0.5619	0.0711	0.0025	0.0871
Age: 75+	0.1657	0.6821	0.1041	0.0089	0.0391

Table 5: Disposable Income, Income Tax and Social Security Contribution

Year: 1983

	Disposable Income	Income Tax	Social Security Contributions
Age: 20-24	0.8515	0.0921	0.0564
Age: 25-29	0.8134	0.1298	0.0567
Age: 30-34	0.8332	0.1096	0.0572
Age: 35-39	0.8201	0.1250	0.0549
Age: 40-44	0.8381	0.1100	0.0519
Age: 45-49	0.8377	0.1091	0.0533
Age: 50-54	0.8190	0.1310	0.0501
Age: 55-59	0.8494	0.0975	0.0531
Age: 60-64	0.8761	0.0922	0.0318
Age: 65-69	0.9237	0.0554	0.0208
Age: 70-74	0.9084	0.0768	0.0147
Age: 75+	0.9521	0.0401	0.0078

Year: 1988

	Disposable Income	Income Tax	Social Security Contributions
Age: 20-24	0.8644	0.0673	0.0683
Age: 25-29	0.8495	0.0809	0.0696
Age: 30-34	0.8404	0.0916	0.0680
Age: 35-39	0.8463	0.0874	0.0663
Age: 40-44	0.8322	0.1040	0.0638
Age: 45-49	0.8428	0.0914	0.0658
Age: 50-54	0.8520	0.0853	0.0627
Age: 55-59	0.8561	0.0899	0.0539
Age: 60-64	0.8682	0.0884	0.0434
Age: 65-69	0.8958	0.0793	0.0249
Age: 70-74	0.9483	0.0414	0.0103
Age: 75+	0.9108	0.0811	0.0082

Year: 1995

	Disposable Income	Income Tax	Social Security Contributions
Age: 20-24	0.8735	0.0565	0.0700
Age: 25-29	0.8538	0.0722	0.0740
Age: 30-34	0.8269	0.0975	0.0757
Age: 35-39	0.8408	0.0840	0.0751
Age: 40-44	0.8376	0.0866	0.0758
Age: 45-49	0.8118	0.1113	0.0769
Age: 50-54	0.8404	0.0849	0.0747
Age: 55-59	0.8454	0.0880	0.0666
Age: 60-64	0.8525	0.0957	0.0519
Age: 65-69	0.9099	0.0567	0.0334
Age: 70-74	0.9147	0.0534	0.0320
Age: 75+	0.9320	0.0464	0.0216

Table 6: Social Security Benefits and Private Pensions

Year: 1983

	Private Pensions	Social Security Benefits
Age: 20-24	0.2004	0.7996
Age: 25-29	0.4078	0.5922
Age: 30-34	0.3167	0.6833
Age: 35-39	0.3294	0.6706
Age: 40-44	0.4448	0.5552
Age: 45-49	0.3478	0.6522
Age: 50-54	0.5735	0.4265
Age: 55-59	0.5585	0.4415
Age: 60-64	0.5024	0.4976
Age: 65-69	0.3047	0.6953
Age: 70-74	0.2523	0.7477
Age: 75+	0.2120	0.7880

Year: 1988

	Private Pensions	Social Security Benefits
Age: 20-24	0.0002	0.9998
Age: 25-29	0.2249	0.7751
Age: 30-34	0.5354	0.4646
Age: 35-39	0.3054	0.6946
Age: 40-44	0.5101	0.4899
Age: 45-49	0.6774	0.3226
Age: 50-54	0.4455	0.5545
Age: 55-59	0.6792	0.3208
Age: 60-64	0.4102	0.5898
Age: 65-69	0.3572	0.6428
Age: 70-74	0.3745	0.6255
Age: 75+	0.2321	0.7679

Year: 1995

	Private Pensions	Social Security Benefits
Age: 20-24	0.1661	0.8339
Age: 25-29	0.2498	0.7502
Age: 30-34	0.2791	0.7209
Age: 35-39	0.2562	0.7438
Age: 40-44	0.4984	0.5016
Age: 45-49	0.5179	0.4821
Age: 50-54	0.6489	0.3511
Age: 55-59	0.6025	0.3975
Age: 60-64	0.4654	0.5346
Age: 65-69	0.3978	0.6022
Age: 70-74	0.3800	0.6200
Age: 75+	0.2376	0.7624

Table 7: Cohort Composition

Cohort	Year of Birth	Averge Cell Size	Years in the Sample	Ages Observed
1	1971-1975	274	91-96	20-25
2	1966-1970	615	86-96	20-30
3	1961-1965	1131	82-96	20-35
4	1956-1960	1666	82-96	22-40
5	1951-1955	1717	82-96	27-45
6	1946-1950	1620	82-96	32-50
7	1941-1945	1244	82-96	37-55
8	1936-1940	997	82-96	42-60
9	1931-1935	910	82-96	47-65
10	1926-1930	944	82-96	52-70
11	1921-1925	971	82-96	57-75
12	1916-1920	870	82-96	62-80
13	1911-1915	670	82-96	67-83
14	1906-1910	443	82-96	72-90
15	1892-1905	412	82-95	77-90

Figures

Figure 1: Financial Savings

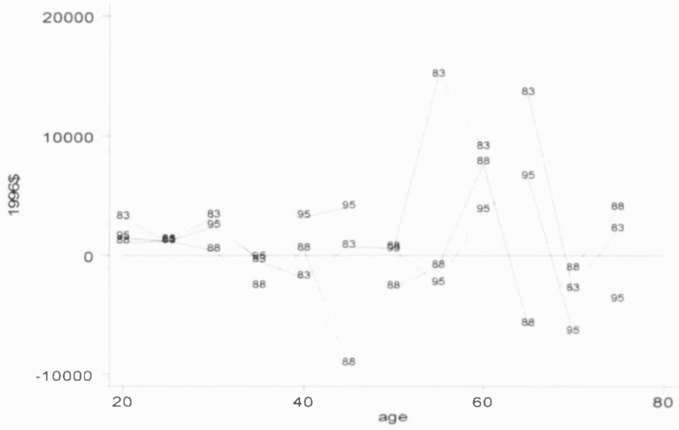


Figure 2: Stock of Financial Savings

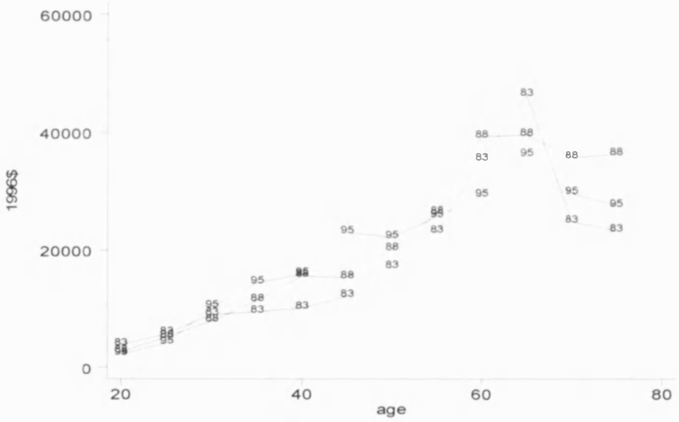


Figure 3: Total Retirement Contributions

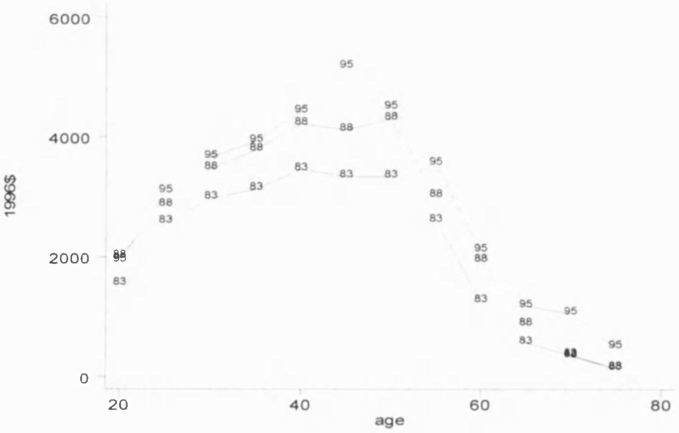


Figure 4: Gross Income Components

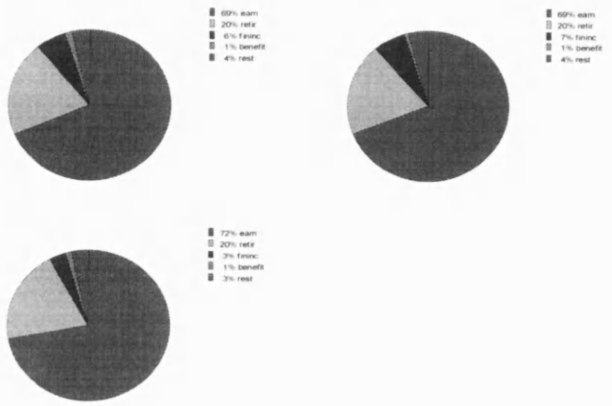


Figure 5: Total Gross Income and Total Disposable Income

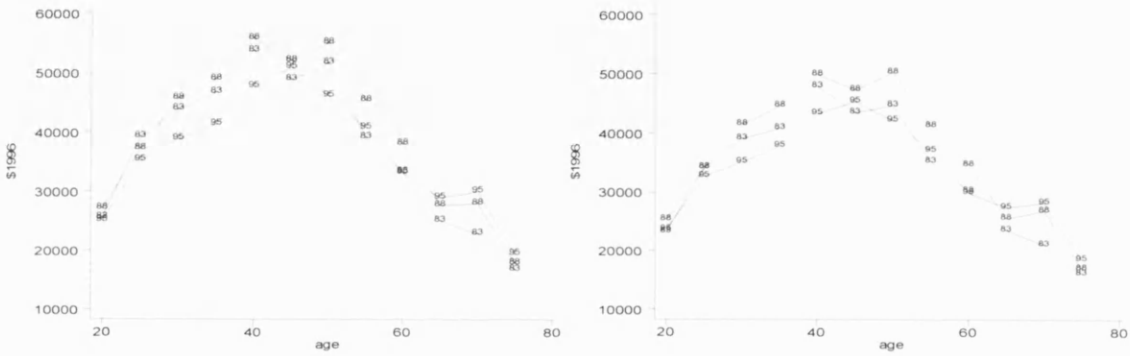


Figure 6: Social Security Benefits and Private Pensions

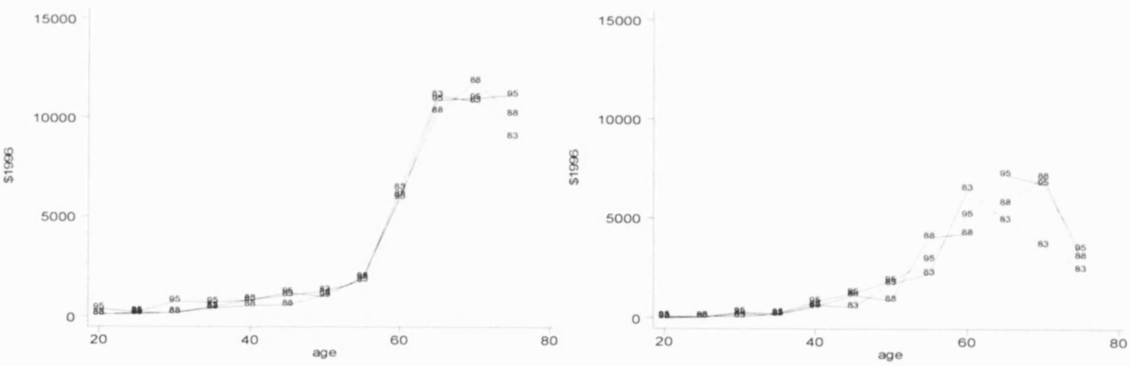


Figure 7: Earnings and Retirement Income

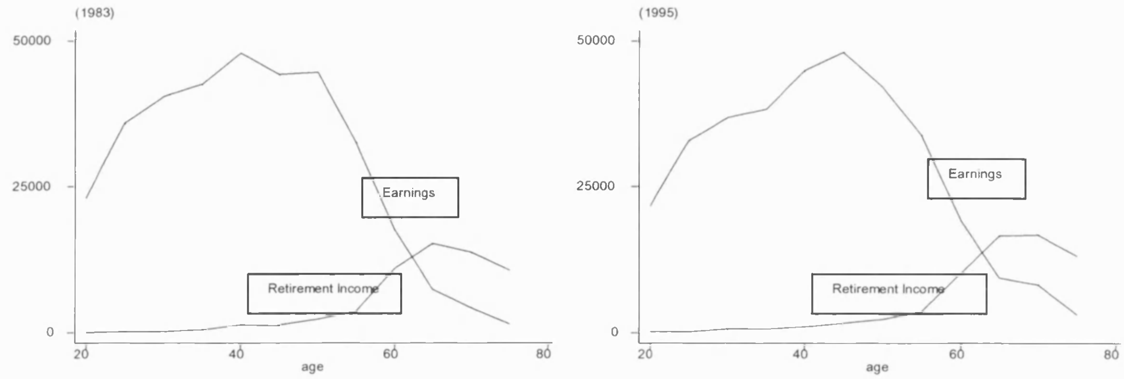


Figure 8: Total Expenditure and Disposable Income (median)

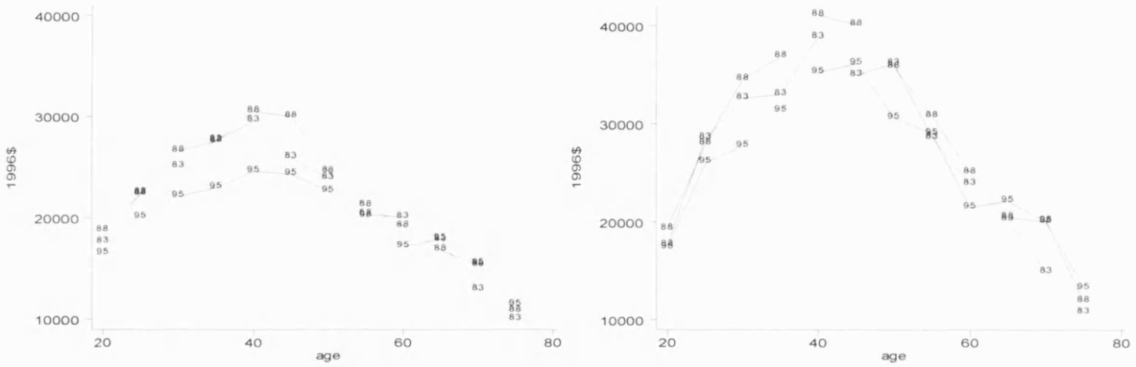


Figure 9: Total Household Saving (median)

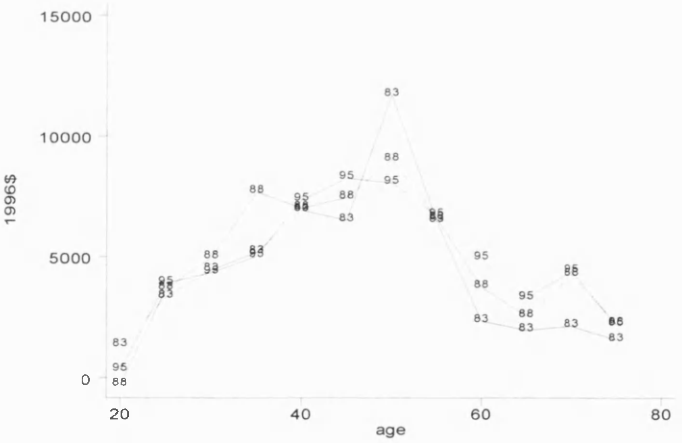


Figure 10: Saving Ratios: Ratio of Mean Saving to Mean Income and Median Saving Rate

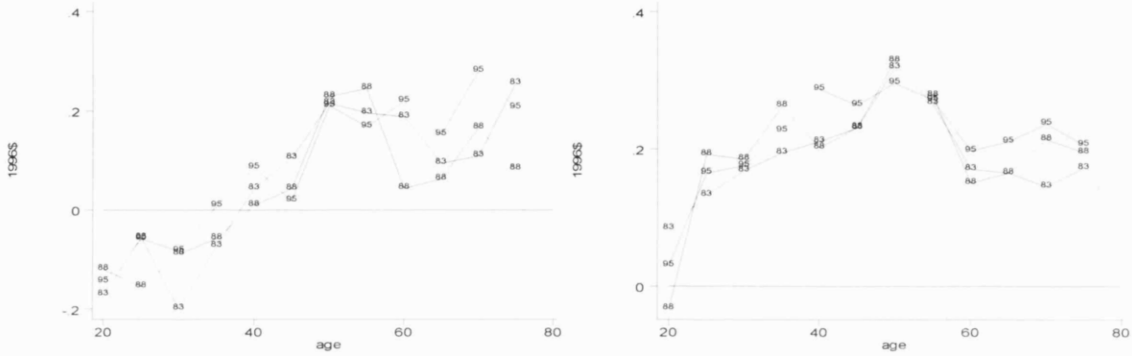


Figure 11: Household Size, Employed and Retired, Homeowners and Owners of Life Insurance

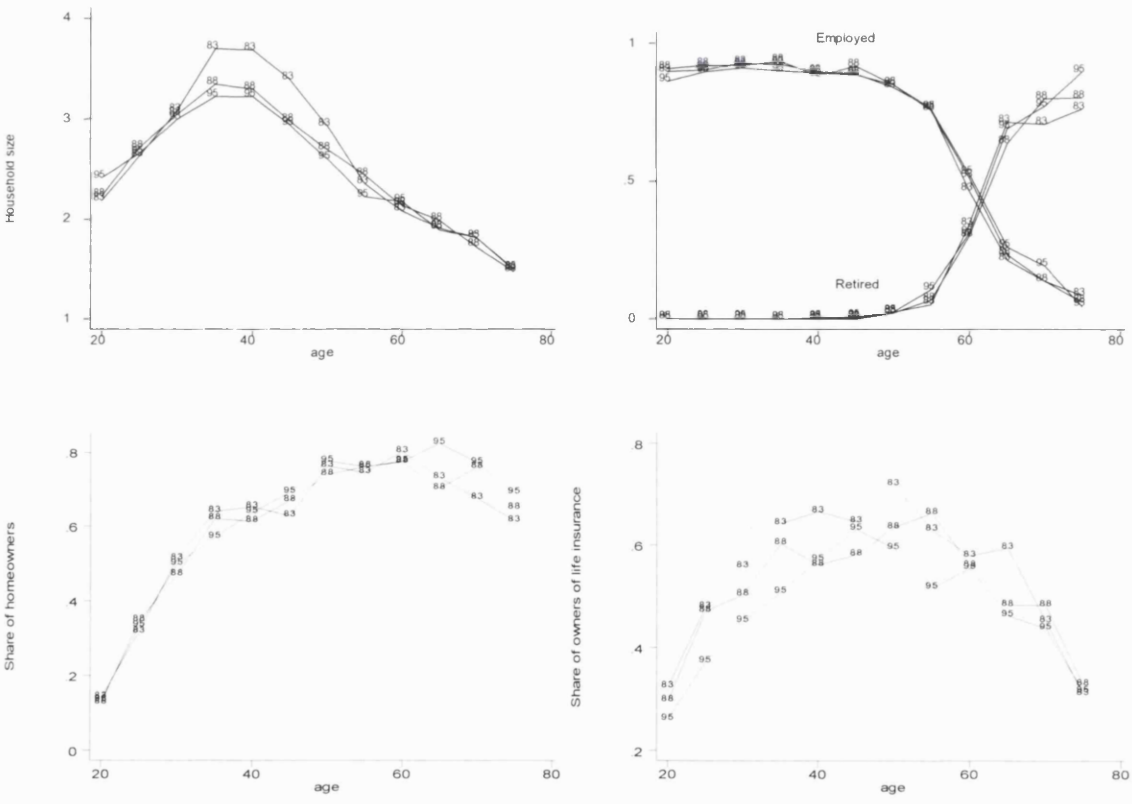


Figure 12: Financial Savings by Cohort

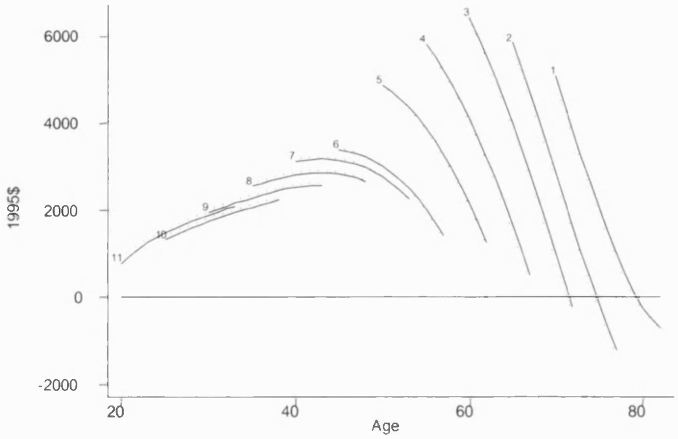


Figure 13: Share of Households with Individual Retirement Accounts by Cohorts

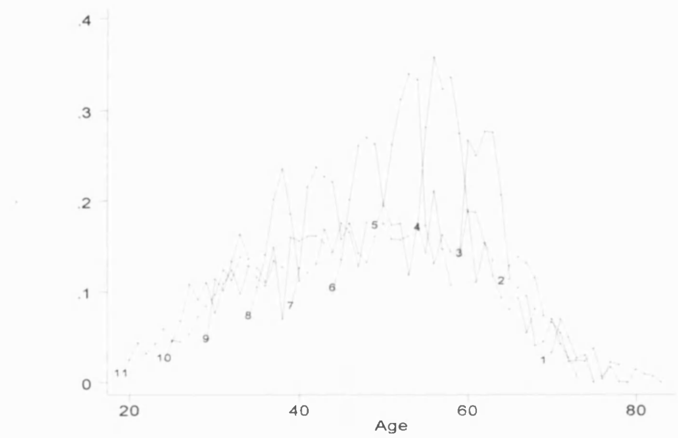


Figure 14: Stock of Financial Wealth by Cohorts

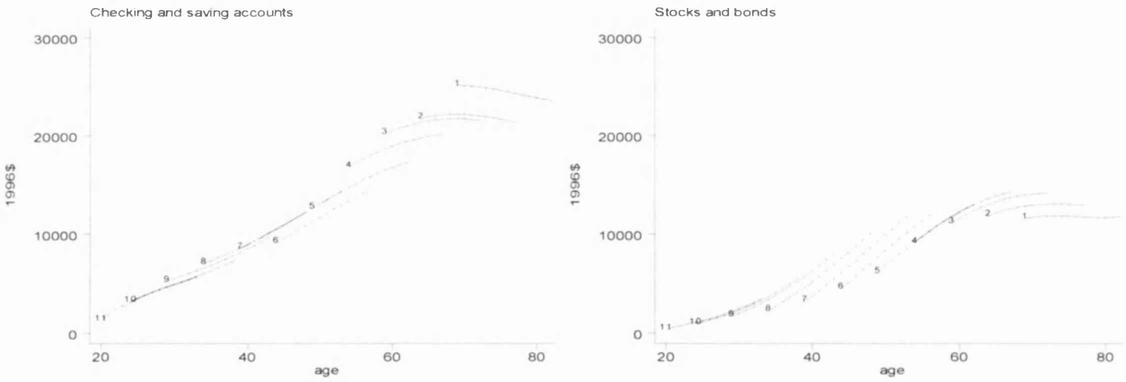


Figure 15: Share of Homeowners and of Homeowners with and without Mortgage by Cohorts

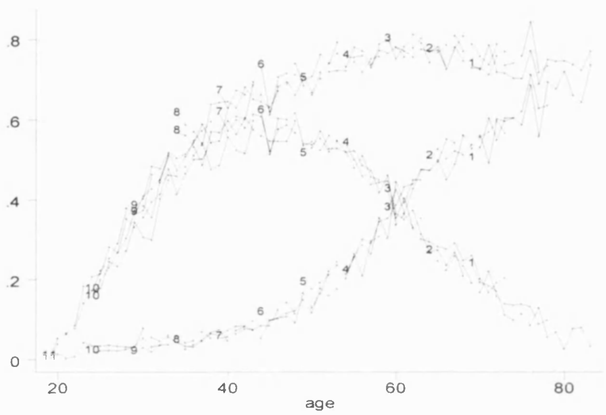


Figure 16: Total Retirement Contributions by Cohort

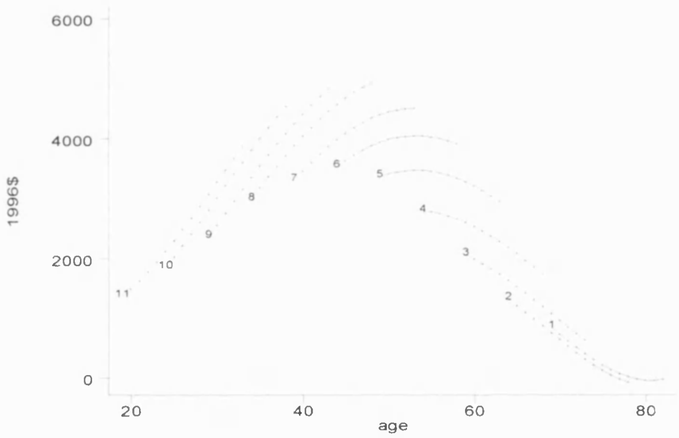


Figure 17: Share of Households with Private Pensions by Cohorts

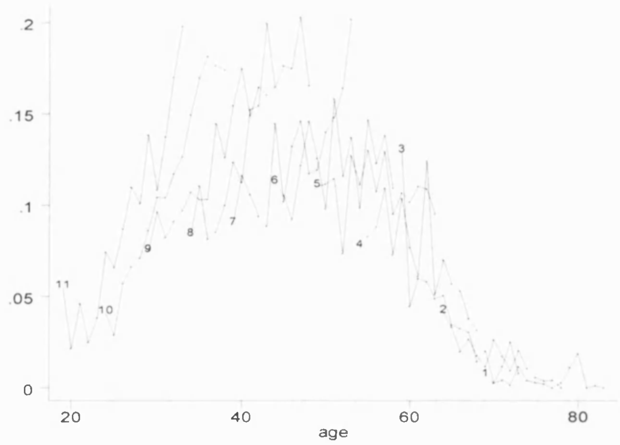


Figure 18: Total Gross Income and Total Disposable Income by Cohort

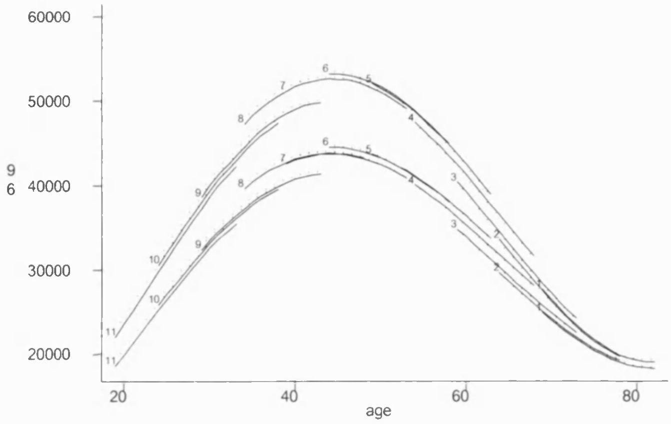


Figure 19: Social Security Benefits and Private Pensions by Cohort

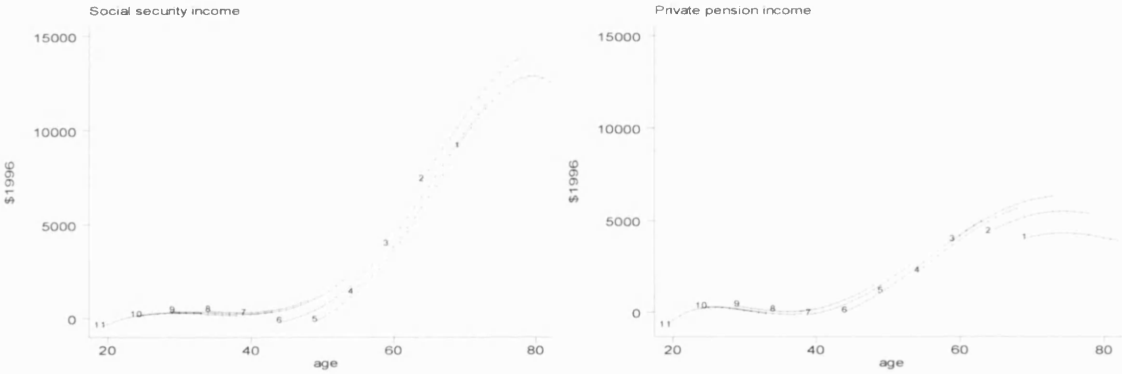


Figure 20: Total Expenditure by Cohort (median)

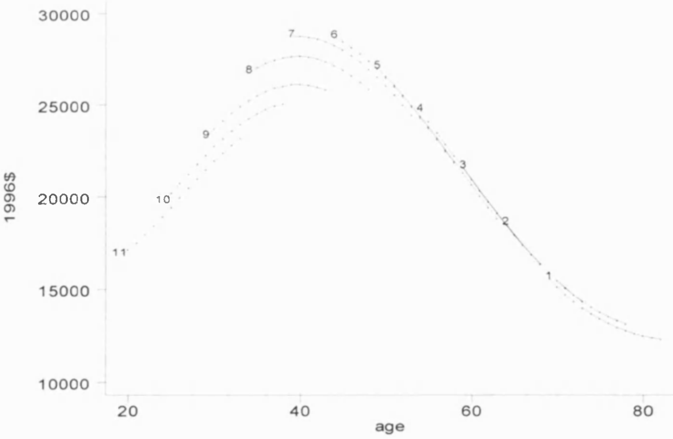


Figure 21: Total Savings by Cohort (median)

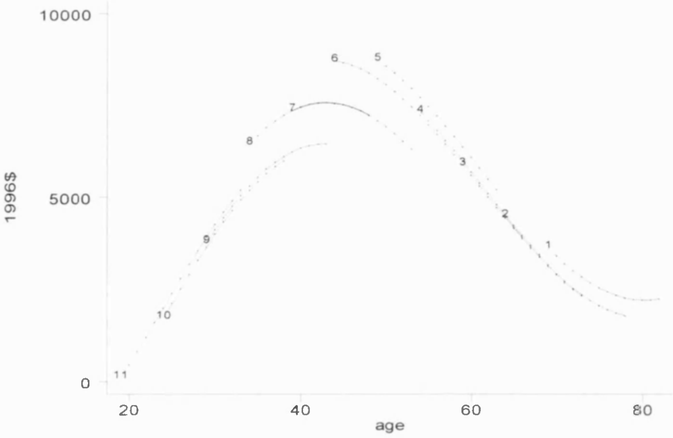


Figure 22: Median Saving Rate by Cohort (median)

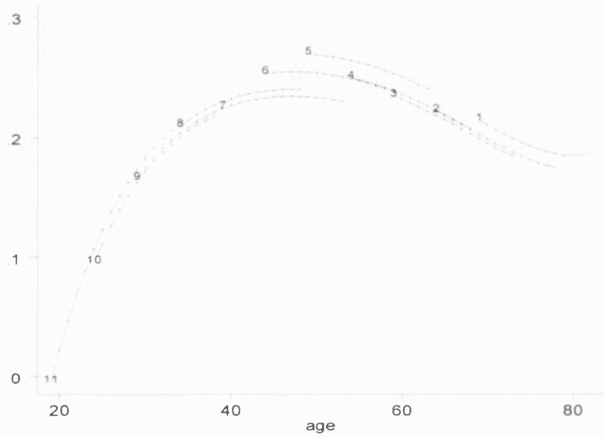
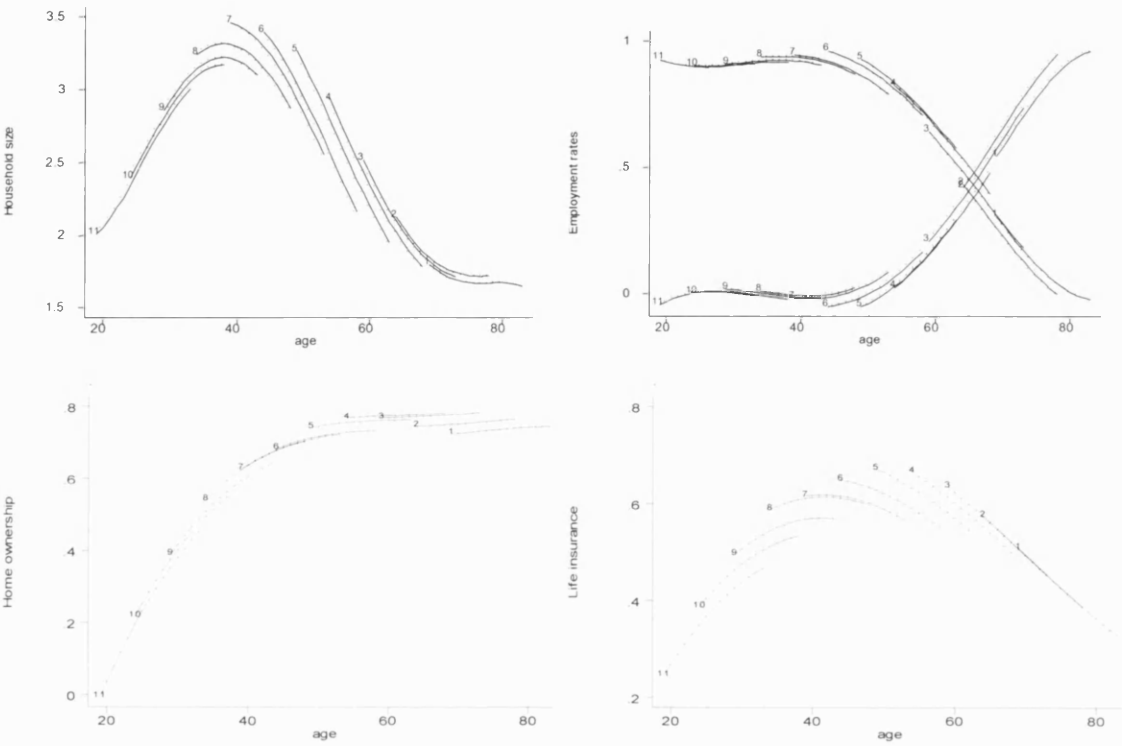


Figure 23: Household Size, Employment Rates, Home Ownership and Life Insurance Ownership by Cohort



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