

The copyright of this thesis vests in the author. No quotation from it or information derived from it is to be published without full acknowledgement of the source. The thesis is to be used for private study or non-commercial research purposes only.

Published by the University of Cape Town (UCT) in terms of the non-exclusive license granted to UCT by the author.

# **Three Essays on Retirement Date Expectations and Saving Behavior**

A thesis presented

by

**Aylit Tina Romm**

for the degree of

**DOCTOR OF PHILOSOPHY**

in the Department of

**Economics**

**UNIVERSITY OF CAPE TOWN**

January 2011

© 2011 by Aylit Tina Romm  
All rights reserved.

# Abstract

This thesis consists of three different essays—organized as different chapters—that deal with empirical as well as theoretical aspects of the economics of retirement. The first essay contributes to the theoretical life-cycle literature by analyzing in depth the role of retirement date expectations in determining saving behavior. As our main contribution, we demonstrate that the magnitude of the reaction of consumption and saving behavior of younger individuals to a change in the retirement date is largely determined by the degree to which utility is additively separable in consumption and leisure. The second essay is an econometric study that uses data from the US Health and Retirement Study to investigate whether Americans do, in fact, alter their saving behavior in response to changing retirement date expectations. Our obtained point estimates suggest that the responsiveness of households' saving behavior to retirement dates expectations is large. Finally, the third essay contributes to the literature on the formation and rationality of retirement expectations, with particular emphasis on the role of focal point responses. In this essay, we argue that the increased tendency with age to give a focal point answer of probability one to the question regarding the probability of working full time after age 62, is the primary cause for the failure of this subjective probability to converge to the corresponding objective probability over time. As our main contribution, we offer a novel interpretation of focal point responses in terms of ambiguous beliefs dynamics that arise in new developments of decision theory such as Choquet expected utility theory.

# **Acknowledgments**

I would like to thank my supervisor Professor Alexander Zimper for his guidance, support and intellectual mentorship throughout this process. I would also like to thank my co-supervisor, Professor Martin Wittenberg for his time and effort in providing me with invaluable insights.

# Contents

<b>Introduction .....</b>	<b>1</b>
<b>1 Retirement Date Effects on Consumption and Saving Behavior: The Case of Non-Separable Preferences in Consumption and Leisure .....</b>	<b>12</b>
1.1 Introduction .....	12
1.2 Separable preferences in consumption and leisure .....	16
1.3 Non-separable preferences in consumption and leisure .....	24
1.4 Effect on Saving Behavior .....	30
1.5 Simulations .....	32
1.6 Conclusion.....	34
1.A Appendix to Chapter 1 .....	35
<b>2 Retirement Date Effects on Pre-Retirement Wealth Accumulation: An Empirical Study .....</b>	<b>40</b>
2.1 Introduction .....	40
2.2 Data and Methodology .....	45
2.3 Regression Results .....	53
2.4 Conclusion.....	58

2.A Appendix to chapter 2 .....	69
<b>3 Focal Point Responses as Neo-Additive Capacities .....</b>	<b>71</b>
3.1 Introduction.....	71
3.2 The Literature on Focal Point Answers .....	74
3.3 Stylized Facts .....	75
3.3.1 Data and Methodology.....	75
3.3.2 Results.....	79
3.3.3 Results without Focal Point Answers .....	84
3.3.4 Results for Sample Giving Focal Point Responses .....	86
3.4 Theoretical Framework .....	92
3.5 Estimating Parameters for the model .....	96
3.6 Conclusion.....	104
3.A Appendix to Chapter 3 .....	106
<b>Concluding Remarks and Outlook .....</b>	<b>107</b>
<b>References .....</b>	<b>114</b>
<b>A Trends in Labor Force Participation Rates of Older Workers in the US.....</b>	<b>122</b>
<b>B A Brief Overview of the Structure of the Social Security Retirement System in the US .....</b>	<b>124</b>

## List of Figures

Figure 1.1	Relative Change in Consumption: Change in Retirement Age from 65 to 67.....	33
Figure 1.2	Relative Change in Saving: Change in Retirement Age from 65 to 67 .....	33
Figure 2.1	Distribution of p62 .....	61
Figure 2.2	Plot of P62 against L.P62 .....	62
Figure 3.1	Subjective and Objective Probabilities .....	81
Figure 3.2	Distribution of p62 between the ages of 51 and 55 inclusive .....	82
Figure 3.3	Distribution of p62 between the ages of 56 and 61 inclusive .....	83
Figure 3.4	No Focal Point Responses .....	85
Figure 3.5	100 from Precise .....	88
Figure 3.6	100 Consistently .....	89
Figure 3.7	Zero from Precise .....	90
Figure 3.8	Zero Consistently .....	91
Figure 3.9	Fitted Values-No Focal Points .....	99
Figure 3.10	Fitted Values- 100 from Precise .....	100
Figure 3.11	Fitted Values -Zero from Precise .....	101
Figure 3.12	Degree of Ambiguity: 100 Arising from Precise .....	102
Figure 3.13	Degree of Ambiguity: Zero Arising from Precise .....	102
Figure 3.14	Fitted Values -Whole Population .....	103

## List of Tables

Table 1.1	Retirement Date Dependent Human Capital Wealth from the perspective of $t < t_{ret}$ .....	19
Table 1.2	Parameters .....	32
Table 2.1	Summary Statistics for Wealth .....	63
Table 2.2	Summary Statistics for p62 .....	63
Table 2.3	Distribution of Wealth .....	63
Table 2.4	Mean and Median Wealth by p62 .....	63
Table 2.5	Mean p62 by Age and Pension Status.....	64
Table 2.6	Distribution of the variable -Usual.....	64
Table 2.7	Regression Results for Single Women .....	65
Table 2.8	Regression Results for Single Men .....	66
Table 2.9	Regression Results for Married Couples .....	67
Table 2.10	Regression Results for Married Couples- Continued.....	68
Table 2.11	Married Couples-More Results.....	68
Table 2.12	Effect of p62 on Wealth- by Pension Status .....	68
Table 2.13	Effect of p62 on Wealth-by Pension Status-Continued .....	68
Table 2.14	First Stage Estimates: Singles .....	69
Table 2.15	First Stage Estimates: Married Couples.....	70
Table 3.1	Percentage of End Point Focal Point Responses Arising from Precise Responses .....	88
Table 3.2	Parameter Estimates-Bayesian Learning .....	98

Table 3.3	Parameter Estimates- 100 Arising from Precise .....	98
Table 3.4	Parameter Estimates- Zero Arising from Precise .....	98
Table 3.5	Parameter Estimates- Whole Population .....	98

# Introduction

In the context of the life-cycle theory of consumption and saving, the most important parameter governing individuals' saving decisions is the expected length of retirement. This, in turn, is governed by two factors: First, the expected age of death; and second, the expected age of retirement. A later retirement age will, *ceteris paribus*, shorten the retirement horizon resulting in less of a need to save in younger years in order to maintain consumption levels in the years of retirement. In many developed countries, younger workers today can expect to retire later than their older counterparts.<sup>1</sup> This comes after a lengthy period, through the 1900's, up until the late 1980's, of a declining trend in the age of retirement.

The observed upward trend in the average retirement age can be attributed—to some extent—to government policies induced both by the aging of the baby boomers and by greater longevity in general. The aging of the baby boomers, together with increased longevity and lower birth rates, has significantly increased dependency ratios, rendering or threatening to render public pensions insolvent. For instance, the US government already reacted to these trends in 1983 through social security amendments that increased the Normal Retirement Age<sup>2</sup> from 65 for those born before 1938, increasing in two month increments for those born every year thereafter, reaching age 67 for those born in 1960. These amendments also increased the Delayed Retirement

---

<sup>1</sup> See appendix A for a more detailed discussion on historical and projected trends in labor force participation rates of older individuals in the United States.

<sup>2</sup> This refers to the age at which individuals are eligible for full social security benefits.

Credit, which rewards the delaying of retirement past Normal Retirement Age until age 70. To see that such retirement age increases may bear a huge potential for political and social conflict, just take France's 2010 increase in the Normal Retirement Age from 65 to 67, which has been met with much opposition by the French population, culminating in highly publicized strikes and violent protests.

While there appears to be a strong trend towards later retirement for the years to come, we also have a much spoken about global "savings crisis", i.e., a situation in which households saving rates are at dangerously low levels. For example, the US household saving rates in 2008 were at their lowest level in over 70 years<sup>3</sup>. Our proposition in this thesis is that while later retirement dates might serve to avert a pension crisis, they may at the same time exacerbate the private savings crisis. Thus, while the positive effects of later retirement dates might be well known, both in terms of decreasing dependency ratios, and in terms of increasing the labor capacity of the economy, there is also an adverse effect of later retirement on *household* savings caused by the individuals' consumption-smoothing behavior. This adverse effect of later retirement on household savings, and therefore on the capital-labour ratio, productivity and growth in the economy, has been so far mentioned in the literature only in passing (cf., e.g., Kotlikoff et al., 2001; Fougère et al., 2005).

---

<sup>3</sup> Since 2009 there has been an improvement in household saving levels in the wake of the recent financial crisis.

While Pingle (2006) and Mastrobuoni (2009) illustrate the importance of factors such as increases in the Delayed Retirement Credit and Normal Retirement Age respectively in increasing labor force participation rates of older workers, authors such as Blau and Goodstein (2010) show that these factors can account for only one quarter to one half of the trend in these rates. Since Mastroubini's model estimates "treatment effects", it is likely that changes in the Normal Retirement Age operate through non-economic channels such as changing social norms. Blau and Goodstein suggest that increasing labor force participation rates of older individuals is a result of changes in the composition of the older male population, away from high school dropouts and toward college graduates. Other factors cited by authors as influencing the increasing labor force participation of older individuals include the movement away from defined-benefit pension plans, which tend to incentivize early retirement, to defined contribution plans which are more age neutral. There is also a declining percentage of employers who offer retirees health insurance, and so employees may choose to remain employed until they are eligible for medicare. Schirle (2008) found that about one quarter of the increase in older male participation could be accounted for by the growth in the participation of older wives, since to a large extent working husbands and wives tend to retire at the same time.

Thus, while the factors contributing to later retirement dates are numerous, government policies have certainly endorsed this trend without much regard for potential

adverse effects on household saving behavior. While increased longevity on its own would have served to increase the savings of the young by lengthening their expected retirement horizons, increasing the age of retirement mitigates this effect. In light of this implication of later retirement, this thesis aims to analyze in greater depth the relationship between expected retirement dates and the saving behavior of the young. While it should be clear that certain factors contributing to later retirement are endogenous<sup>4</sup> to saving behavior, we expect that the anticipation of the later retirement date itself should also have a *direct* effect on pre-retirement saving behavior. It is mainly this direct effect that concerns us in this thesis. At the same time, we are also interested in the question of how individuals form such retirement date expectations. Since such expectations determine saving behavior, it is desirable to understand how these expectations evolve over time, and more so, how rational this process is. The accuracy of these expectations directly impacts an individual's ability to correctly assess the amount he will need to save for retirement.

We now proceed to give a brief summary of the contributions of each of the three chapters comprising this thesis.

---

<sup>4</sup> That is, such factors may cause a change in saving behavior apart from any effect on the retirement date.

## Chapter 1

Chapter 1 conducts a partial equilibrium analysis in which we theoretically analyze the direct effect of changing retirement dates on the consumption and saving behavior of younger individuals. Standard life-cycle models of saving (cf., Modigliani and Brumberg, 1954; Friedman, 1957) presume that individuals receive utility from consumption only. As a consequence, later retirement dates, and hence greater lifetime income, in these models will always lead to greater lifetime consumption of individuals, implying for utility maximizers greater consumption in every time period. The implication would be a reduction in savings at earlier stages of the life-cycle. Under the more realistic assumption, however, that an individual's utility is affected by consumption as well as leisure, the impact of a change in the retirement date is not as straightforward.

In this chapter, we study the effects of changes in retirement dates on pre-retirement consumption and saving behavior under the assumption that utility is a function of both consumption and leisure. As our main contribution, we demonstrate that the magnitude of the reaction of consumption and saving to a change in the retirement date is largely determined by the degree to which utility is additively separable in consumption and leisure.

As a first result, we show that while consumption of younger individuals increases in response to later retirement, the *relative* increase in consumption is *smaller*

in the case where utility is seen to be non-separable in consumption and leisure, and the cross-derivative of the utility function is negative, than in the case where they are separable. That is, for separable preferences our model implies an increase in consumption of younger age groups for later retirement dates analogous to the findings in standard models where utility is derived from consumption only. The situation is different, however, if preferences are non-separable in consumption and leisure. Key to our finding is that if preferences are non separable in consumption and leisure, and the cross-derivative of the utility function is negative, then the positive effect on consumption behavior of an increase in lifetime resources—induced by a later anticipated retirement date—is dampened by a negative effect on consumption caused by a decrease in the path of future leisure.

As a second result we show that while younger individuals save less in response to a later anticipated retirement date, the *relative* decrease in saving is *larger* when preferences are non-separable in consumption and leisure (and the cross-derivative of the utility function is negative) than when preferences are separable. This finding is particularly relevant because empirical evidence<sup>5</sup> supports the notion that preferences are non-separable in consumption and leisure, and more specifically, that the cross-derivative of the utility function is in fact negative.

---

<sup>5</sup> See Chapter 1.

## Chapter 2

In Chapter 2 we use data from the US Health and Retirement Study (HRS) to empirically verify whether Americans do, in fact, alter their saving behavior in response to changing retirement date expectations. Whether or not individuals take cognizance of their expected retirement date in saving decisions has implications for how recent and expected future trends towards later retirement in the United States will affect saving rates in the economy. In conducting our analysis we use data from seven waves of the Health and Retirement study, which is a nationally representative study of the elderly population in the United States. In particular, we look at the effect of the subjective probability—as reported in the HRS data—of working full time after age 62 (P62)<sup>6</sup> on wealth accumulation.

Central to our analysis is the issue of endogeneity between retirement date decisions and wealth. Two main difficulties arise in conducting our empirical analysis. Firstly, in cross-sectional analysis it is not possible to control for unobserved heterogeneity such as tastes, which might affect both the timing of retirement and wealth accumulation. The second issue is the direct endogeneity between retirement date expectations/decisions and wealth. While expectations regarding the timing of retirement are likely to have a direct effect on wealth accumulation prior to retirement, pre

---

<sup>6</sup> Age 62 is the early retirement age in the US. It is the earliest age at which individuals are eligible to receive social security retirement benefits, even though these benefits are permanently reduced. See appendix B for an overview of social security retirement system in the US.

retirement wealth is also likely to have an effect on retirement decisions. We attempt to correct for these problems as follows. In using panel data, we are able to conduct Fixed Effects regression analysis, which allows us to control for unobserved heterogeneity across individuals that might affect both wealth accumulation and retirement date decisions. We further attempt to correct for the direct endogeneity problem (between wealth and retirement expectations) by using Instrumental Variables estimation. We thus conduct an *Instrumental Variables Fixed Effects Regression* to analyze the effect of exogenous variation in P62 on wealth accumulation. To this end we use respondents' self reported responses regarding the usual retirement age in the job that the respondent is currently working in, as an instrument for the probability of working full time after age 62. The instrumental variable approach has the added advantage of dealing with measurement error and focal point responses (answers centred around 0, 50 or 100) that tend to plague subjective probability responses.

Similar to our approach is Bloom et al. (2007) who use the health and retirement study (HRS) to look at the effect of subjective survival probabilities on wealth accumulation decisions in the United States. Bloom et al find that an increase in the subjective probability of living to age 75 increases household wealth amongst couples only. Whether individuals respond to variation in subjective retirement expectations in a similar fashion as they do to variation in subjective survival expectations is a mat-

ter to be determined empirically. To date, there are no studies that include subjective retirement probabilities in wealth regressions.

On a whole, the point estimates suggest that the responsiveness of households' saving behavior to retirement dates expectations is large. A ten percentage point increase in the household subjective probability of working past age 62 results in a decrease in household wealth well in excess of 20% for most demographic groups. We are most confident in this result for single women households, in which case the standard errors are small. We also find that, in the case of married couples in particular, there is a threshold effect in this response.

### **Chapter 3**

Since individuals do not know their retirement date with certainty, they rely on their *expectation* about their retirement date in making life-cycle decisions. Thus, rationality of the process that leads to the formation of such expectations is crucial whenever individuals are to make correct saving decisions. In Chapter 3 we look at the rationality of individuals retirement date expectations by analyzing more closely the subjective probability of working past age 62. Our contribution in this chapter relates not only to the analysis of the data itself, but also to the decision-theoretic foundations of the literature on focal point answers.

As a first finding, we show that—with the exception of married men—the subjective probability of working past age 62 fails to converge to the corresponding objective probability as individuals approach age 62. In particular, there is an upward bias that is non-decreasing over time—an observation which represents an apparent violation of the Rational Bayesian Learning paradigm. Secondly, we show that there is an increased tendency at older ages to give a focal point response of 100 to the question regarding the probability of working full time after age 62. Moreover, we show that this phenomenon is the primary cause of the failure of the subjective probability of working past age 62 to converge to the corresponding objective (additive) probability over time.

More specifically, our analysis establishes that there are two different kinds of focal point responses given close to the event in question: Those that are more or less accurate, and those that are not. We show that focal point responses given consistently over the questioning horizon are quite accurate, while focal point responses given *only* closer to the event in question are biased.

These features of the data provide us with a new interpretation of focal point responses of 100 and zero that arise from precise responses. In particular, a focal point response of 100 or 0, can be represented by a *neo-additive capacity*—cf., Chateauneuf et al. (2007). A neo-additive capacity is a non-additive belief that represents a deviation from an additive belief such that the degree of ambiguity measures the lack of

confidence the agent has in some additive probability distribution. As this belief is updated over time according to the *Generalized Bayesian Update Rule*, the degree of ambiguity increases, in that the agent has decreasing confidence in the additive probability distribution. In our context, the agent, then, resolves this ambiguity by having complete confidence in the extreme belief that he/she will, or will not, with absolute certainty, continue to work full time after age 62.

# **Chapter 1**

## **Retirement Date Effects on Consumption and Saving Behavior: The Case of Non-Separable Preferences in Consumption and Leisure**

### **1.1 Introduction**

Labor force participation rates of older individuals in many OECD countries have been increasing since the late 1990's. For example, for US males in the age group between 65 and 69 labor force participation rates had reached levels of about 33% in March 2008, after having been at a low of 24% in 1985 and 27% in 1995. Similarly, labor force participation rates for US females were 27% in 2008 compared to 17% in 1995. Resulting from a gradual increase in the Normal retirement age, in combination with other factors, these trends in the US are expected to continue for sometime into the future. An important policy issue relates to the implication of these later retirement dates for wealth accumulation over the life-cycle, and hence aggregate saving rates in the economy. Saving rates are important in that they influence the accumulation of capital, and hence growth in the economy. Standard life-cycle models of saving (Modigliani and Brumberg, 1954; Friedman, 1957) presume that individu-

als receive utility from consumption only. As a consequence, later retirement dates, and hence greater lifetime income, in these models will always lead to greater lifetime consumption of individuals, and for utility maximizers, greater consumption in every time period. The implication would be a reduction in savings at earlier stages of the life-cycle. Under the more realistic assumption, however, that an individual's utility is affected by consumption as well as leisure, the impact of a change in the retirement date is not as straightforward.

In this chapter, we study the effects of changes in retirement date on pre-retirement consumption and saving behavior under the assumption that utility is a function of both consumption and leisure. As our main contribution, we demonstrate that the magnitude of the reaction of consumption and saving to a change in the retirement date is largely determined by the degree to which utility is additively separable in consumption and leisure.

Starting with Heckman (1974), many authors have suggested that preferences are non-separable in consumption and leisure. The testing of separability between consumption and leisure was first addressed by authors such as Jorgenson and Lau (1975), Ghez and Becker (1975), Abbot and Ashenfelter (1976, 1979), Blackorby et al. (1978), Barnett (1979, 1981), Atkinson et al. (1981), Deaton (1982), Browning et al. (1985), Murphy and Thom (1987), Browning and Meghir (1989), Kaiser (1993), and more recently by authors such as Basu and Kimball (2002), Ham and Reilly (2002), French (2005), Laitner and Silverman (2005), Ziliak and Kniesner (2005)

and Kiley (2007). All these studies conclude that preferences are non-separable in consumption and leisure, and in particular, that the marginal utility of consumption is negatively related to leisure. Given this empirical evidence, it is thus fitting that we analyze the effect of changing retirement dates in the case where preferences are non-separable in consumption and leisure.

As a first result, we show that while consumption of younger individuals increases in response to later retirement, the *relative* increase in consumption is *smaller* in the case where preferences are seen to be non-separable in consumption and leisure, and in particular when the cross-derivative of the utility function is negative, than in the case where they are separable. That is, for separable preferences our model implies an increase in consumption of younger age groups for later retirement dates analogous to the findings in standard models where utility is derived from consumption only. The situation is different, however, if preferences in consumption and leisure are non-separable. Key to our finding is that if preferences are non separable in consumption and leisure, and if the marginal utility of consumption is negatively related to leisure, the positive effect on consumption behavior of an increase in lifetime resources induced by a later anticipated retirement date, is dampened by a negative effect on consumption caused by a decrease in the path of future leisure. More specifically, if preferences are non-separable in consumption and leisure, the effect of a change in the retirement date can no longer be viewed as the same as that caused by a change in future income due to any other reason. For a given date of

retirement, an expected, say, capital gain or inheritance is not accompanied by a decrease in leisure. An increase in lifetime resources due to a later retirement date is, however, accompanied by a decrease in expected retirement leisure. We show that this nuance is not significant for preferences that are separable in consumption and leisure, and a change in the expected date of retirement will induce changes in consumption analogous to the case where utility is considered a function of consumption alone. If, however, preferences are non-separable in consumption and leisure, then our model shows that this nuance changes the analysis in a non-trivial manner.

As a second result we show that while younger individuals save less in response to a later anticipated retirement date, the *relative* decrease in saving is *larger* when preferences are non-separable in consumption and leisure, and the cross-derivative of the utility function is negative, than when preferences are separable.

While authors such as Heckman (1974), and more recently French (2005) and Hurd and Rohwedder (2005), have cited non-separable preferences as a possible explanation for the drop in consumption at retirement, our paper explicitly models the optimal consumption path under non-separable preferences, and then shows the effect of variation in the retirement date on *pre-retirement* consumption/saving behavior.

We proceed with this chapter as follows. In section 1.2 we start off with a model in which utility is an additively separable function of consumption and leisure. We show the response of consumption to a postponement in the anticipated retirement date. In section 1.3 we consider a model with non-separable preferences in con-

sumption and leisure, and show how the response of agents' consumption decisions differ from the separable case. Section 1.4 models the response of saving to a change in the retirement date, and shows how the response differs under separable and non-separable preferences. In section 1.5 we provide simulations to show how consumption and saving responses differ under the two different preference structures. We conclude in section 1.6.

## 1.2 Separable preferences in consumption and leisure

We consider a deterministic model in which we have a rational agent whose aim is to maximize lifetime utility. We assume the agent lives till (and including) period  $T$ . Within this period he will spend a certain amount of time working full time and the rest of the time in retirement, during which time he will live off savings accumulated during his working years and social security (and/or pension) income. We assume that in order to maintain his lifestyle post retirement, savings are necessary to supplement social security/pension income. Assuming that the agent does not face any liquidity constraints in that he is able to borrow against future income, we now proceed to analyze the effect of variation in the anticipated retirement date on pre-retirement consumption/saving decisions .

The agent's instantaneous utility at time  $t$  is given by  $\hat{u} = [u(c(t)) + v(l(t))]$ , where  $u(c(t))$  is the utility derived from consumption, and  $v(l(t))$  is the utility de-

rived from leisure. We define leisure,  $l_t$ , to be 1 before retirement, and equal to  $\bar{l} > 1$  every period after retirement.

Implicit in this specification is the assumption that preferences are separable in consumption and leisure. We further assume time separability. We also assume that the retirement date is determined exogenously to the model.

For a given anticipated date of retirement,  $t_{ret}$ , (and hence a given  $v(l(t))$  in every period), the agent's aim at time  $t$  is to maximize utility as follows:

$$\max_{(c_t \dots c_T)} \sum_{k=t}^T \beta^k (u(c_k)) \quad (1.1)$$

where  $\beta$  is the discount factor  $= \frac{1}{1+\rho}$ , where,  $\rho$ , is the rate of time preference.

The dynamic budget constraint at any time  $t$  is given by:

$$x_{t+1} = (x_t - c_t) \cdot R + y_{t+1} \quad (1.2)$$

$$x_t = a_t + y_t \quad (1.3)$$

where  $x_t$  is "cash on hand",  $R$  is the fixed gross return on assets, and is equal to  $(1 + r)$ , where  $r$  is the interest rate common to borrowing and lending, and  $y_t$  is non-capital income. We further assume that

$$y_t = \begin{cases} I_t & \text{if } t < t_{Ret} \\ i_t & \text{if } t \geq t_{Ret} \end{cases} \quad (1.4)$$

where  $I_t$  is labor income, and  $i_t$  is social security/pension income. We assume  $I_t > i_t$ .<sup>7</sup>

Human capital wealth,  $h_t$ , is given by

$$\begin{aligned} h_t &= \sum_{k=t+1}^T y_k R^{-(k-t)} = \frac{h_{t+1} + y_{t+1}}{R} \\ &= \sum_{k=t+1}^{t_{Ret}-1} I R^{-(k-t)} + \sum_{k=t_{Ret}}^T i R^{-(k-t)} \quad \text{for } t < t_{Ret} \end{aligned} \quad (1.5)$$

and is clearly the sum of total discounted non-capital income.

Finally

$$w_t = x_t + h_t \quad (1.6)$$

where  $w_t$  is total wealth at time  $t$ , and evolves according to the following equation:

$$w_{t+1} = (w_t - c_t) \cdot R \quad (1.7)$$

and

$$\sum_{k=t}^T \frac{c_k}{R^{k-t}} = w_t \quad (1.8)$$

with

$$w_{T+1} = 0 \quad (1.9)$$

---

<sup>7</sup> This assumption is certainly valid in the context of the US, as well as most other developed countries where the old age pension is earnings related ,i.e., the old age pension replaces a *percentage* of pre-retirement income.

That is, the present value of all future consumption must equal total wealth, and further, the binding constraint in equation 1.8 and terminal condition given by equation 1.9 imply that all wealth must be consumed by the time the agent dies. For the purpose of this model, we abstract from the bequest motive and assume that the agent does not intend to leave any bequests.

**Observation 1:**  $w_t$  is a strictly increasing function of  $t_{ret}$ .

Table 1.1 shows human capital wealth for different anticipated retirement dates. Clearly, an earlier retirement date results in less human capital wealth, and hence less total wealth,  $w_t$ .

RETIREMENT DATE, $t_{ret}$	HUMAN CAPITAL WEALTH AT TIME T
$t + 1$	$\sum_{k=t+1}^T i \cdot R^{-(k-t)}$
$t + 2$	$I \cdot R^{-1} + \sum_{k=t+2}^T i \cdot R^{-(k-t)}$
$t + 3$	$\sum_{k=t+1}^{t+2} I \cdot R^{-(k-t)} + \sum_{k=t+3}^T i \cdot R^{-(k-t)}$
....	
$T$	$\sum_{k=t+1}^T I \cdot R^{-(k-t)}$

Table 1.1: Retirement Date Dependent Human Capital Wealth from the perspective of  $t < t_{ret}$

In particular, the change in human capital as a result of increasing the retirement date from  $t_{ret}^1$  to  $t_{ret}^2$  is equal to

$$\left[ \sum_{k=t_{ret}^1}^{t_{ret}^2-1} (I - i) \right] \cdot R^{-(k-t)} \quad (1.10)$$

Thus, delaying the date of retirement allows the agent to substitute labor income for social security income between  $t_{ret}^1$  and  $t_{ret}^2$ , increasing human capital wealth<sup>8</sup>.

Writing the utility maximization problem, from the perspective of any time period,  $t$ , as a standard dynamic programming problem, we have

$$\begin{aligned}
 J(a_t, I, i, t_{ret}) &= \max_{(c_t \dots c_T)} \sum_{k=t}^T \beta^{k-t} (u(c_k)) & (1.11) \\
 &= \max_{(c_t \dots c_T)} [u(c_t) + \beta J(a_{t+1}, I, i, t_{ret})] \\
 &= \max_{(c_t \dots c_T)} [(u(c_t) + \beta u(c_{t+1}) + \beta^2 J(a_{t+2}, I, i, t_{ret}))] \\
 &\quad \text{etc}
 \end{aligned}$$

where  $J(a_t, I, i, t_{ret})$  is the value function, which depends on assets,  $a_t$ , pre retirement income,  $I$ , post retirement social security/pension income,  $i$ , and the date of retirement,  $t_{ret}$ . The first order conditions pertaining to consumption for the above maximization problem, conditioned on the budget constraint result in the following:

$$u'(c_t) = \beta R u'(c_{t+1}) = \dots \beta^{T-t} R^{T-t} u'(c_T) \quad (1.12)$$

$\Rightarrow$

$$\frac{u'(c_t)}{u'(c_{t+1})} = \beta R \quad (1.13)$$

---

<sup>8</sup> We assume that  $i_t$  is independent of the retirement date. This holds in the case where the increase in the retirement age is as a result of an increase in the Normal Retirement Age. If the Retirement age increased due to another factor, than  $i_t$  might increase with an increase in  $t_{ret}$ , in which case the increase in human capital wealth would be even greater than stated here.

Let us assume that the form of the utility function is of standard constant relative risk aversion (CRRA) form ,

$$u(c_k) = \frac{c_k^{1-\theta}}{1-\theta} \quad (1.14)$$

with  $\theta \neq 1$ . Now  $\theta$  reflects the curvature/concavity of the utility function with a higher value of  $\theta$  reflecting a more concave utility function.  $\frac{1}{\theta}$  reflects the intertemporal elasticity of substitution.

Now,

$$u'(c_k) = c_k^{-\theta} \quad (1.15)$$

and from 1.13

$\Rightarrow$

$$\left( \frac{c_t}{c_{t+1}} \right)^{-\theta} = \beta R \quad (1.16)$$

$\Rightarrow$

$$\left( \frac{c_t}{c_{t+1}} \right) = [\beta R]^{-\frac{1}{\theta}} \quad (1.17)$$

If the rate of time preference,  $\rho$ , is equal to the rate of return,  $r$ , then

$$\left( \frac{c_t}{c_{t+1}} \right)^{-\theta} = 1 \quad (1.18)$$

$\Rightarrow$

$$c_t = c_{t+1} \quad (1.19)$$

and, recursively

$$c_t = c_{t+1} = \dots = c_T \quad (1.20)$$

If, however, the rate of time preference is greater than the rate of return, consumption will tend to decrease over time. On the other hand, if the rate of return is greater than the rate of time preference, consumption will tend to increase over time. These effects, however, tend to be dampened, the more concave the utility function, i.e., the lower the intertemporal elasticity of substitution of the consumer. We illustrate in the following manner: We know from equations 1.18 and 1.19 that  $c_t \rightarrow c_{t+1} \rightarrow \dots \rightarrow c_T$  if  $[\beta R]^{-\frac{1}{\theta}} \rightarrow 1$ . Now  $[\beta R]^{-\frac{1}{\theta}} \rightarrow 1$  if  $[\beta R] \rightarrow 1$ , or if  $-\frac{1}{\theta} \rightarrow 0$  ( $\Rightarrow \theta \rightarrow \infty$ ). Thus, the more concave the utility function (the lower the intertemporal elasticity of substitution), the more an agent will tend to smooth consumption across time periods.

**Proposition 1.1**      *When preferences are separable in consumption and leisure, our solution for consumption in any time period  $t$  can be given as:*

$$c_t = \left( \frac{R^{T-t}}{\sum_{j=0}^{T-t} (\beta R)^{\frac{j}{\theta}} \cdot R^{T-t-j}} \right) \cdot w_t \quad (1.21)$$

*with the marginal propensity to consume out of total wealth equal to*  $\left( \frac{R^{T-t}}{\sum_{j=0}^{T-t} (\beta R)^{\frac{j}{\theta}} \cdot R^{T-t-j}} \right)$

**Proof:**      *See appendix to Chapter 1. ■*

Taking the natural log of expression 1.21, we have

$$\ln c_t = \ln \left( \frac{R^{T-t}}{\sum_{j=0}^{T-t} (\beta R)^{\frac{j}{b}} \cdot R^{T-t-j}} \right) + \ln w_t \quad (1.22)$$

Now,

$$\frac{\Delta \ln c_t}{\Delta t_{ret}} = \frac{\Delta \ln \left( \frac{R^{T-t}}{\sum_{j=0}^{T-t} (\beta R)^{\frac{j}{b}} \cdot R^{T-t-j}} \right)}{\Delta t_{ret}} + \frac{\Delta \ln w_t}{\Delta t_{ret}} \quad (1.23)$$

gives the *relative change* in consumption for a unit change in the retirement date.

Now since  $\ln \left( \frac{R^{T-t}}{\sum_{j=0}^{T-t} (\beta R)^{\frac{j}{b}} \cdot R^{T-t-j}} \right)$  is constant with respect to  $t_{ret}$ , we have the following proposition:

**Proposition 1.2**

$$\frac{\Delta \ln c_t}{\Delta t_{ret}} = \frac{\Delta \ln w_t}{\Delta t_{ret}} \quad (1.24)$$

*That is, when preferences are separable in consumption and leisure, the relative change in consumption at time  $t$  with respect to a unit change in the anticipated retirement date, is equal to the relative change in total wealth at time  $t$  for a unit change in the anticipated retirement date.*

### 1.3 Non-separable preferences in consumption and leisure

So far we have restricted our utility function to being additively separable in consumption and leisure. If we relax this assumption, and instead assume that preferences are non-separable in consumption and leisure, then the optimal consumption path does not necessarily involve consumption smoothing over time. To show this, assume the same budget and leisure constraints as in the separable case, but now assume that instantaneous utility at time  $t$  is given by the following cobb douglas isoelastic utility function:<sup>9</sup>

$$\begin{aligned}
 u(c, l) &= \frac{(c_t^\eta (l_t)^{1-\eta})^{1-\theta}}{1-\theta} \\
 &= \begin{cases} \frac{(c_t^\eta)^{1-\theta}}{1-\theta} & \text{for } t < t_{ret} \\ \frac{(c_t^\eta (l_t)^{1-\eta})^{1-\theta}}{1-\theta} & \text{for } t \geq t_{ret} \end{cases} \quad (1.25)
 \end{aligned}$$

where  $0 < \eta < 1$ , and represents the share of consumption in utility (of course  $1 - \eta$  represents the share of leisure in utility), and  $\theta \neq 1$ <sup>10</sup> will influence whether the cross-derivative of the utility function is positive or negative, with  $\frac{1}{\theta}$  being the intratemporal elasticity of substitution between consumption and leisure.

Now,

---

<sup>9</sup> Examples of authors who have used such a utility function are: French (2005), Hurd and Rohwedder (2003), Low (2005), and Laitner and Silverman (2005).

<sup>10</sup> If  $\theta = 1$ , then the function reduces to a log utility function which is additively separable in consumption and leisure.

$$\begin{aligned}\frac{\partial u}{\partial c_t} &= \eta (c_t^\eta (l_t)^{1-\eta})^{-\theta} c_t^{\eta-1} (l_t)^{1-\eta} \\ &= \eta c_t^{\eta(1-\theta)-1} (l_t)^{(1-\eta)(1-\theta)}\end{aligned}\quad (1.26)$$

and

$$u_{cl} = (1 - \theta)(1 - \eta)c_t^{\eta(1-\theta)-1} l_t^{(1-\eta)(1-\theta)-1} \quad (1.27)$$

If  $\theta > 1$  ( $\frac{1}{\theta} < 1$ ), then  $u_{cl} < 0$ , i.e. the marginal utility of consumption decreases as leisure increases. Since marginal utility of consumption is lower at times when leisure is high, consumption will also be lower. Conversely, if  $\theta < 1$ , then  $u_{cl} > 0$ <sup>11</sup>.

Most empirical estimates suggest that  $\theta > 1$ . Ghez and Becker (1975) report a value of  $\frac{1}{\theta} = 0.83$  ( $\theta = 1.20$ ). Auerbach and Kotlikoff (1987) report values of  $\frac{1}{\theta}$  between 0.3 and 1.5 ( $\theta$  between 0.8 and 3.33), but select a value of 0.8 ( $\theta = 1.25$ ) as their base value in simulations. Attanasio and Weber (1995) report an estimate of  $\theta = 2.2$ , while Barsky et al. (1997) estimate that most people have a value of  $\theta$  greater than 2, and many have a value greater than 4. Altig et al. (2001) select a parameter value for  $\frac{1}{\theta}$  of 0.8 ( $\theta = 1.25$ ) for their simulations, while Diamond and Zodrow (2007, 2008) use a value of 0.6 ( $\theta = 1.67$ ) in their benchmark simulation. French's (2005) estimates imply an intratemporal elasticity of substitution between 0.18 and 0.45 ( $\theta$  between 2.2 and 5.6), and Ziliak and Kniesner (2005) report values

---

<sup>11</sup> Authors such as Hurd and Rohwedder (2003), Low (2005), and Laitner and Silverman (2005) refer to consumption and leisure being *Frisch* substitutes if  $\theta > 1$ . They refer to Frisch complements if  $\theta < 1$ .

ranging from 0.09 to 0.23 ( $\theta$  between 4.34 and 11.11). We thus proceed with our model, concentrating on the case where  $\theta > 1$ .

For a given retirement date, and hence a given value of  $l_t$  in every period, our maximization problem at time  $t$  is given by:

$$J(a_t, I, i, t_{ret}) = \max_{(c_t \dots c_T)} U = \sum_{k=t}^T \frac{(c_k^\eta (l_k)^{1-\eta})^{1-\theta}}{1-\theta} \quad (1.28)$$

Now, maximization gives rise to the same first order condition as in the separable case—

$$u'(c_t) = \beta R u'(c_{t+1})$$

From 1.26, we have

$$c_t = (\beta R)^{\frac{1}{\eta(1-\theta)-1}} \cdot \left( \frac{l_{t+1}}{l_t} \right)^{\frac{(1-\eta)(1-\theta)}{\eta(1-\theta)-1}} \cdot c_{t+1} \quad (1.29)$$

which for  $t < t_{ret} - 1$ , and  $t \geq t_{ret} \Rightarrow$

$$c_t = (\beta R)^{\frac{1}{\eta(1-\theta)-1}} \cdot c_{t+1} \quad (1.30)$$

and between  $t_{ret} - 1$  and  $t_{ret}$

$$c_{t_{ret}-1} = (\beta R)^{\frac{1}{\eta(1-\theta)-1}} \cdot (\bar{l})^{\frac{(1-\eta)(1-\theta)}{\eta(1-\theta)-1}} \cdot c_{t_{ret}} \quad (1.31)$$

Thus, even if  $\beta R$  was equal to unity, for  $\theta > 1$ , consumption before retirement is greater than consumption after retirement. This indeed affirms authors such as French (2005) and Hurd and Rohwedder (2005) who have indicated that the observed fall in consumption at retirement can be attributed to non-separable preferences.

**Proposition 1.3** *In the case where preferences are non-separable in consumption and leisure, at any point in time,  $t$*

$$c_t = \left( \frac{R^{T-t}}{\sum_{j=0}^{T-t} \left[ R^{T-t-j} \cdot (\beta R)^{-\frac{j}{\eta(1-\theta)-1}} \cdot \left( \frac{l_t}{l_{t+j}} \right)^{\frac{(1-\eta)(1-\theta)}{\eta(1-\theta)-1}} \right]} \right) \cdot w_t \quad (1.32)$$

*With the marginal propensity to consume out of total wealth equal to:*

$$\left( \frac{R^{T-t}}{\sum_{j=0}^{T-t} \left[ R^{T-t-j} \cdot (\beta R)^{-\frac{j}{\eta(1-\theta)-1}} \cdot \left( \frac{l_t}{l_{t+j}} \right)^{\frac{(1-\eta)(1-\theta)}{\eta(1-\theta)-1}} \right]} \right)$$

**Proof** See Appendix to chapter 1. ■

**Observation 1.2:** We see that the *mpc* in the non-separable case is a function of the retirement date.

**Observation 1.3:** For  $\theta > 1$ , the marginal propensity to consume out of total wealth is higher when the agent is working, than when the agent is retired.

**Proof** See Appendix to Chapter 1. ■

**Observation 1.4:** An agent working in time period  $t$  will experience a higher marginal propensity to consume out of total wealth in the non-separable case where  $\theta > 1$ , than he would in the separable case.

**Proof** This should be obvious simply by comparing the *mpc* in the separable and non-separable cases. ■

**Observation 1.5:** *An agent who is working in time period  $t$ , whose marginal utility of consumption is negatively related to leisure, and who anticipates a postponement in his retirement date, will experience a decrease in the marginal propensity to consume out of total wealth at time  $t$ .*

**Proof** See appendix to chapter 1. ■

Now, taking the natural log of expression 1.32 we have

$$\ln c_t = \ln \left( \frac{R^{T-t}}{\sum_{j=0}^{T-t} \left[ R^{T-t-j} \cdot (\beta R)^{-\frac{j}{\eta(1-\theta)-1}} \cdot \left( \frac{l_t}{l_{t+j}} \right)^{\frac{(1-\eta)(1-\theta)}{\eta(1-\theta)-1}} \right]} \right) + \ln w_t \quad (1.33)$$

and

$$\frac{\Delta \ln c_t}{\Delta t_{ret}} = \frac{\Delta \ln \left( \frac{R^{T-t}}{\sum_{j=0}^{T-t} \left[ R^{T-t-j} \cdot (\beta R)^{-\frac{j}{\eta(1-\theta)-1}} \cdot \left( \frac{l_t}{l_{t+j}} \right)^{\frac{(1-\eta)(1-\theta)}{\eta(1-\theta)-1}} \right]} \right)}{\Delta t_{ret}} + \frac{\Delta \ln w_t}{\Delta t_{ret}} \quad (1.34)$$

Since  $\left( \frac{R^{T-t}}{\sum_{j=0}^{T-t} \left[ R^{T-t-j} \cdot (\beta R)^{-\frac{j}{\eta(1-\theta)-1}} \cdot \left( \frac{l_t}{l_{t+j}} \right)^{\frac{(1-\eta)(1-\theta)}{\eta(1-\theta)-1}} \right]} \right)$  is a function of the retirement date (see Observation 1.5), we have Proposition 1.4.

**Proposition 1.4** Denoting  $\left( \frac{R^{T-t}}{\sum_{j=0}^{T-t} \left[ R^{T-t-j} \cdot (\beta R)^{-\frac{j}{\eta(1-\theta)-1}} \cdot \left( \frac{l_t}{l_{t+j}} \right)^{\frac{(1-\eta)(1-\theta)}{\eta(1-\theta)-1}} \right]} \right)$  by  $mpc$ , we have

$$\frac{\Delta \ln c_t}{\Delta t_{ret}} = \frac{\Delta \ln w_t}{\Delta t_{ret}} + \frac{\Delta \ln mpc}{\Delta t_{ret}} \quad (1.35)$$

*where the first term is positive, and the second term is negative. That is, when preferences are non-separable in consumption and leisure, the relative change in consumption for a unit change in the retirement date is equal to the relative change in total wealth, plus the relative change in the marginal propensity to consume, for this unit change in the anticipated retirement date.*

Thus, when preferences are non-separable in consumption and leisure, the effect of later retirement dates on consumption is twofold. The positive effect on consumption caused by an increase in total wealth, is dampened by a second negative effect on consumption caused by a decrease in the path of future leisure, and hence the marginal propensity to consume out of total wealth. Thus, the relative increase in consumption is smaller than in the separable case.

**Corollary 1.1**      *The effect of later retirement dates on consumption approaches the separable case as  $\theta \rightarrow 1$ , or as  $\bar{l} \rightarrow 1$ . This is since the magnitude of the second effect diminishes under such conditions.*

**Proof**      See appendix to chapter 1. ■

**Corollary 1.2**      *The effect of later retirement dates on consumption deviates to a larger extent from the separable case as  $\bar{l}$  gets larger. This is since the magnitude of the second effect increases under such conditions.*

The proof of this corollary is very simple and simply results from the fact that  $\left| \frac{\Delta \ln mpc}{\Delta t_{ret}} \right|$  is larger if  $\bar{l}$  is larger. Note that for this effect to dominate the wealth effect, would require an unrealistically high value of  $\bar{l}$ , and it is thus unreasonable to expect that an increase in the retirement date would ever lead to a decrease in consumption.

## 1.4 Effect on Saving Behavior

Saving at any point in time,  $t$ , is given by:

$$s_t = y_t - c_t \quad (1.36)$$

Taking the natural log on both sides

$$\ln s_t = \ln(y_t - c_t) \quad (1.37)$$

and using the law for the log of a summation/subtraction,

$$\ln s_t = \ln y_t + \ln(1 - e^{(\ln c_t - \ln y_t)}) \quad (1.38)$$

Now, as the change in  $t_{ret}$  gets very small,

$$\frac{\Delta \ln s_t}{\Delta t_{ret}} \approx \left( -\frac{1}{(1 - e^{(\ln c_t - \ln y_t)})} \cdot e^{(\ln c_t - \ln y_t)} \cdot \frac{\Delta \ln c_t}{\Delta t_{ret}} \right)^{12} \quad (1.39)$$

While it is clear that saving decreases in response to an increase in the anticipated retirement date, we are interested in how the magnitude of this effect differs

<sup>12</sup> Note that this expression is the derivative of the expression  $\ln y + \ln(1 - e^{(\ln c - \ln y)})$  with respect to  $t_{ret}$  ( $\ln y$  is independent of  $t_{ret}$ ).  $\frac{\Delta \ln s_t}{\Delta t_{ret}}$  approximates this expression as  $\Delta t_{ret}$  gets very small and tends to the continuous time situation, where the derivative expression is appropriate.

between the separable and non-separable cases. We know that  $\frac{\Delta \ln c_t}{\Delta t_{ret}}$  is smaller in the non-separable case than it is in the separable case (from Proposition 1.4). We also know that  $\ln c_t$  is larger in the non-separable case than it is in the separable case (see Observation 1.4), so that  $\frac{1}{(1-e^{(\ln c_t - \ln y_t)})} \cdot e^{(\ln c_t - \ln y_t)}$  is larger in the non-separable case than it is in the separable case. Which effect is dominant? It is easy to show that the relative *increase* in  $\frac{1}{(1-e^{(\ln c_t - \ln y_t)})} \cdot e^{(\ln c_t - \ln y_t)}$  from the separable to non-separable case, is greater than the relative *decrease* in  $\frac{\Delta \ln c_t}{\Delta t_{ret}}$  from the separable to non-separable cases. Thus  $\frac{\Delta \ln s_t}{\Delta t_{ret}}$  is greater in absolute value in the non-separable case than in the separable case.

**Proposition 1.5**      *The relative decrease in savings of an agent at time  $t$ , in response to a later anticipated retirement date, is greater in magnitude in the non-separable case, where the cross-derivative of the utility function is negative, than in the separable case.*

**Corollary 1.3**      *The effect of later retirement dates on saving approaches the separable case as  $\theta \rightarrow 1$ , or as  $\bar{l} \rightarrow 1$ .*

**Corollary 1.4**      *The effect of later retirement dates on saving deviates to a larger extent from the separable case as  $\bar{l}$  gets larger.*

## 1.5 Simulations

In this section we define parameters for the models described above in order to quantitatively simulate the effect of later anticipated retirement dates on consumption and saving behavior at time  $t$ , in both the separable and non-separable cases.

$I$	1000
$i$	600
$a$	0
$T$	90
$t$	25
$\bar{l}$	2
$\eta$	0.6
$\rho = r$	0

Table 1.2: Parameters

Note that for the sake of simplicity we abstract from the interest rate and rate of time preference and set  $\rho = r = 0 \Rightarrow \beta = R = 1$ . We also normalize income, with  $I = 1000$  and  $i = 600$ , so that the pension income replacement rate is 0.6. Figures 1.1 and 1.2 show the relative changes in consumption and saving in both the separable and non-separable cases for varying values of  $\theta$ . It is evident that the relative increase in consumption is smaller in the non-separable case than in the separable case. It is also clear that the relative decrease in saving is greater in the non-separable case than in the separable case. In both the case of consumption and saving, the effect in the non-separable case approaches that of the separable case as  $\theta \rightarrow 1$ .

Figure 1.1: Relative Change in Consumption: Change in Retirement Age from 65 to 67

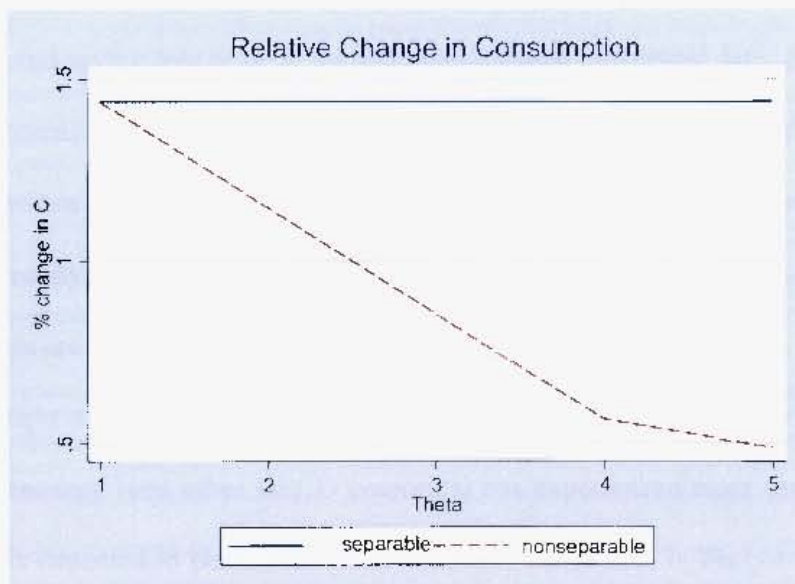
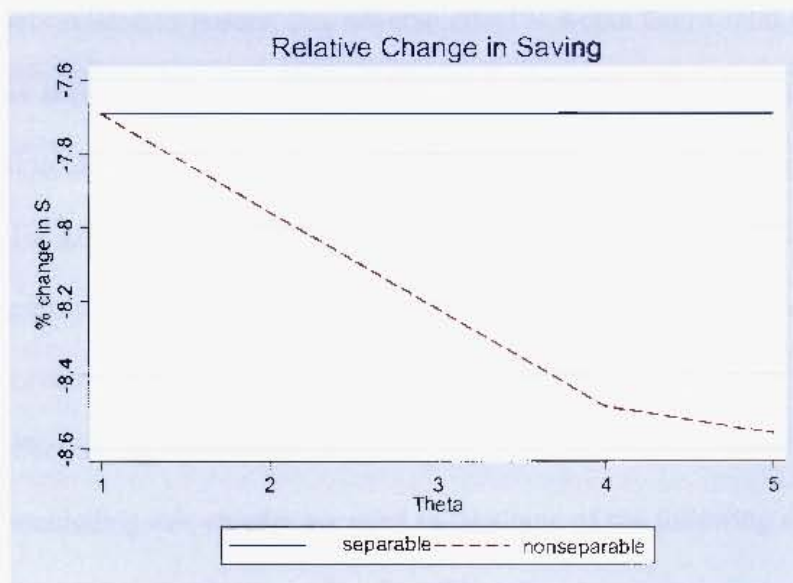


Figure 1.2: Relative Change in Saving: Change in Retirement Age from 65 to 67



## 1.6 Conclusion

A postponement in the date of retirement will result in younger individuals consuming more and saving less prior to the initial anticipated retirement date. Further, the relative increase in consumption is smaller, and relative decrease in saving larger in the case where preferences are non-separable in consumption and leisure—and the marginal utility of consumption is negatively related to leisure, than in the case where preferences are separable.

In light of this theoretical outcome, the upward trend in retirement dates that the US economy (and other OECD countries) has experienced since the mid 90's, and that is expected to persist for some time into the future, is likely to have had, and continue to have an adverse effect on the saving behavior of the young. More so, in light of evidence supporting the view that the marginal utility of consumption is negatively related to leisure, this adverse effect is worse than would be the case if utility is seen as a function of consumption only, or if utility were separable in consumption and leisure. Policies in OECD countries promoting later retirement ages are for good reason. The burden on the social security system of the baby boomers entering retirement, as well as increasing life expectancy, are amongst the most important of these. Cognizance, however, needs to be taken of the unintended adverse effect on saving behavior.

In concluding this chapter we need to take note of the following caveat. It is important to realize that in analyzing the effect of an exogenous change in the re-

retirement date, we are analyzing the direct effect on consumption/saving behavior of a change in the retirement date. In reality, it is likely that some of the factors influencing later retirement dates are endogenous to the consumption/saving decision, and that there are multiple effects at play. We do not, in this paper, attempt to analyze the general equilibrium relationship between retirement dates and savings in the economy. The point of this paper is merely to analyze one effect— the direct effect of later retirement dates on pre-retirement saving behavior — under varying preference structures. While this effect is one of many at play in the complex relationship between retirement dates and savings behavior, it is none the less very relevant to the overall dynamics.

## 1.A Appendix to Chapter 1

### Proof of Proposition 1.1.

We use recursive methods, as illustrated by Stockey et al. (1989).

From condition 1.9, we know that all worth should be exhausted by the end of time  $T$ . Thus

$$c_T = w_T \tag{1.40}$$

In general, we can write:

$$c_T = m_T \cdot w_T \tag{1.41}$$

where  $m_T$  is the marginal propensity to consume out of total worth in period  $T$ , with  $m_T = 1$ .

Now, by equation 1.17 we have  $c_{T-1} = (\beta R)^{-\frac{1}{\theta}} c_T$ , and by equation 1.7

$$(\beta R)^{\frac{1}{\theta}} \cdot c_{T-1} = (w_{T-1} - c_{T-1}) \cdot R \quad (1.42)$$

$\Rightarrow$

$$c_{T-1} = \left( \frac{R}{(\beta R)^{\frac{1}{\theta}} + R} \right) \cdot w_{T-1}$$

i.e.

$$m_{T-1} = \left( \frac{R}{(\beta R)^{\frac{1}{\theta}} + R} \right) \cdot m_T$$

and by continuing recursively, we have in general

$$c_{T-k} = \left( \frac{R^k}{\sum_{j=0}^k (\beta R)^{\frac{j}{\theta}} R^{k-j}} \right) \cdot w_{T-k} \quad (1.43)$$

and

$$m_{T-k} = \left( \frac{R^k}{\sum_{j=0}^k (\beta R)^{\frac{j}{\theta}} R^{k-j}} \right) \cdot m_T \quad (1.44)$$

with  $m_T = 1$ .

### Proof of Proposition 1.3

Again we have

$$c_T = w_T$$

which now implies by 1.7 and 1.29

$$c_{T-1} \cdot \left[ (\beta R)^{-\frac{1}{\eta(1-\theta)-1}} \left( \frac{l_{T-1}}{l_T} \right)^{\frac{(1-\eta)(1-\theta)}{\eta(1-\theta)-1}} \right] = (w_{T-1} - c_{T-1}) \cdot R \quad (1.45)$$

and

$$c_{T-1} = \left( \frac{R}{R + (\beta R)^{-\frac{1}{\eta(1-\theta)-1}} \left( \frac{l_{T-1}}{l_T} \right)^{\frac{(1-\eta)(1-\theta)}{\eta(1-\theta)-1}}} \right) \cdot w_{T-1} \quad (1.46)$$

and in general

$$c_{T-k} = \left( \frac{R^k}{\sum_{j=0}^k \left[ R^{k-j} (\beta R)^{-\frac{j}{\eta(1-\theta)-1}} \left( \frac{l_{T-k}}{l_{T-k+j}} \right)^{\frac{(1-\eta)(1-\theta)}{\eta(1-\theta)-1}} \right]} \right) \cdot w_{T-k} \quad (1.47)$$

**Proof of Observation 1.3:**

Suppose the agent is retired in period  $t + j$  for some  $j \neq 0$ .

$$\text{Then } \frac{l_t}{l_{t+j}} = \begin{cases} 1 & \text{if } t \geq t_{ret} \text{ (agent is retired in } t) \\ \frac{1}{i} < 1 & \text{if } t < t_{ret} \text{ (agent still working in } t) \end{cases}$$

Now for  $\theta > 1$ ,

$$\frac{\Delta mpc}{\Delta \frac{l_t}{l_{t+j}}} < 0 \quad (1.48)$$

Thus, if the agent is retired in period  $t$ , the  $mpc$  will be smaller than if the agent is working in period  $t$ .

**Proof of Observation 1.5:**

Suppose that the agent is *not* retired in period  $t$ . Then the  $mpc$  can be expressed

as

$$\left( \frac{R^{T-t}}{\sum_{j=0}^{t_{ret}-1} \left[ R^{T-t-j} \cdot (\beta R)^{-\frac{j}{\eta(1-\theta)-1}} \right] + \sum_{j=t_{ret}}^{T-t} \left[ R^{T-t-j} \cdot (\beta R)^{-\frac{j}{\eta(1-\theta)-1}} \cdot \left(\frac{1}{i}\right)^{\frac{(1-\eta)(1-\theta)}{\eta(1-\theta)-1}} \right]} \right) \quad (1.49)$$

since

$$\frac{l_t}{l_{t+j}} = \begin{cases} 1 & \text{if } t+j < t_{ret} \text{ (agent still working in } t+j) \\ \frac{1}{i} < 1 & \text{if } t+j \geq t_{ret} \text{ (agent retired in } t+j) \end{cases}$$

Now, for  $\theta > 1$ ,

$$\left[ R^{T-t-j} \cdot (\beta R)^{-\frac{j}{\eta(1-\theta)-1}} \right] > \left[ R^{T-t-j} \cdot (\beta R)^{-\frac{j}{\eta(1-\theta)-1}} \cdot \left(\frac{1}{i}\right)^{\frac{(1-\eta)(1-\theta)}{\eta(1-\theta)-1}} \right]$$

Therefore,

$$\frac{\Delta \left( \sum_{j=0}^{t_{ret}-1} \left[ R^{T-t-j} \cdot (\beta R)^{-\frac{j}{\eta(1-\theta)-1}} \cdot \right] + \sum_{j=t_{ret}}^{T-t} \left[ R^{T-t-j} \cdot (\beta R)^{-\frac{j}{\eta(1-\theta)-1}} \cdot \left(\frac{1}{\bar{l}}\right)^{\frac{(1-\eta)(1-\theta)}{\eta(1-\theta)-1}} \cdot \right] \right)}{\Delta t_{ret}} > 0$$

and hence

$$\frac{\Delta mpc}{\Delta t_{ret}} < 0 \tag{1.50}$$

**Proof of Corollary 1.1:**

If  $\theta \rightarrow 1$  or  $\bar{l} \rightarrow 1$ , the term  $\left(\frac{l_t}{l_{t+j}}\right)^{\frac{(1-\eta)(1-\theta)}{\eta(1-\theta)-1}} \rightarrow 1$ .

The mpc then becomes independent of  $\left(\frac{l_t}{l_{t+j}}\right)^{\frac{(1-\eta)(1-\theta)}{\eta(1-\theta)-1}}$ , and hence the retirement date. Therefore, the effect of a change in the retirement date on consumption tends to the separable case, i.e.,

$$\frac{\Delta \ln c_t}{\Delta t_{ret}} \rightarrow \frac{\Delta \ln w_t}{\Delta t_{ret}} \tag{1.51}$$

## Chapter 2

# Retirement Date Effects on Pre-Retirement Wealth Accumulation: An Empirical Study

### 2.1 Introduction

The responsiveness of saving decisions to agents' expectations regarding the length of their work lives is important from a policy perspective. Whether, or not, individuals take cognizance of their expected retirement date in saving decisions, has implications for how recent and expected future trends towards later retirement in the United States will affect the savings rate in the economy. Do individuals take account of necessary parameters, such as retirement date expectations, when making consumption-saving decisions? The now common notion of *the retirement-consumption puzzle*, where consumption levels are shown to drop at retirement, might indicate not. The retirement-consumption puzzle is indicative of saving shortfalls at retirement, and seriously threatens the life-cycle hypothesis, in which rational, risk averse agents maximize lifetime utility by smoothing the marginal utility of consumption across different time periods. Various explanations have been offered in order to explain the retirement-consumption puzzle. For example, Banks et al. (1998) show how the drop in consumption at retirement can be attributed to unanticipated shocks causing

individuals to retire earlier than expected. Haider and Stephens (2007) confirm the importance of such unanticipated shocks in the timing of retirement, but maintain that not all of the drop in consumption at retirement can be attributed to such shocks. Bernheim et al. (2001) suggest that prior to retirement individuals incorrectly perceive themselves to have enough retirement resources. When they reach retirement they may realize this is not the case, and are forced to reduce their consumption. French (2005) and Laitner and Silverman (2005) show that a drop in consumption at retirement is consistent with the life-cycle hypothesis when preferences are seen to be non-separable in consumption and leisure. In such a case, smoothing the marginal utility of consumption over time does not necessarily imply the smoothing of consumption over time, and the drop in consumption at retirement may thus be planned.<sup>13</sup> Alternatively, the fact may remain that individuals are myopic in that they don't plan properly in order to ensure that consumption does not drop at retirement. They may simply not be taking into account the relevant life-cycle parameters, such as the expected timing of retirement, when making saving decisions.

In this chapter we look directly at individuals' intentions *ex ante* to retirement by investigating whether agents' decisions to accumulate wealth are responsive to their subjective expectations regarding their retirement date. In conducting our analysis, we use data from seven waves of the Health and Retirement study, a nationally

---

<sup>13</sup> Other explanations have been offered by various authors. For example, Hurd and Rohwedder (2003) suggest that after retirement individuals substitute home production for bought goods, so that a drop in consumption expenditure does not necessarily imply a drop in consumption. Laibson (1998) and Angeletos et al. (2001) suggest that the retirement-consumption puzzle is due to hyperbolic discounting.

representative study of the elderly population in the United States, and look at the effect of the subjective probability of working full time after age 62 (P62) on wealth accumulation. Further, we analyze whether this effect differs amongst married women, single women, married men and single men, and whether the effect varies with pension status.

Central to our analysis is the issue of endogeneity between retirement decisions and wealth. The problem in such models arises due to two main issues. In cross-sectional analysis it is not possible to control for unobserved heterogeneity such as tastes, which might effect both the timing of retirement and wealth accumulation. The second issue is the direct endogeneity between retirement date expectations/decisions and wealth. While expectations regarding the timing of retirement are likely to have a direct effect on wealth accumulation prior to retirement, pre retirement wealth is also likely to have an effect on retirement decisions. We attempt to correct for these problems as follows. In using panel data we are able to conduct Fixed Effects regression analysis, which allows us to control for unobserved heterogeneity across individuals that might affect both wealth accumulation and retirement date decisions. We further attempt to correct for the direct endogeneity problem (between wealth and retirement expectations) by using Instrumental Variables estimation. We thus conduct an *Instrumental Variables Fixed Effects Regression* to analyze the effect of exogenous variation in P62 on wealth accumulation. We use respondents' self reported responses regarding the usual retirement age in the job that he/she

is currently working in, as an instrument for the probability of working full time after age 62.

The instrumental variable approach has the added advantage of dealing with measurement error and focal point responses (answers centred around 0, 50 or 100) that tend to plague subjective probability responses. A lot of the literature interprets focal point answers as an indication of the agent being uncertain as to the probability of the event, which in turn leads to him reporting biased estimates (cf., e.g., Lillard and Willis, 2001; Hill et al., 2004; Hurd et al., 2005). To the extent that these probabilities still reflect an individual's *perception* of the probability, they reflect exactly what we want them to in our analysis, and there is no problem. As discussed by Smith et al. (2001) and Khawaja et al. (2006), these focal point answers contain a lot of information regarding an agent's belief, in that a subjective probability of working full time after age 62 of one indicates a very high belief of the probability of the event occurring, while a subjective probability of zero indicates a very low belief of the probability of the event occurring, even to the extent that these estimates are biased. However, Basset and Lumsdaine (2001), say focal point answers and general inconsistencies in the answering of probabilistic questions are indicative of low cognition and inadequate understanding of the nature of probabilities. From this point of view, responses can be regarded as implausible estimates of the relevant subjective probability. To the extent that focal point answers and general inconsistencies in responses imply that the question was not fully understood, and are thus

implausible estimates of the individual's subjective probability, the problem needs to be corrected. Since ignoring observations with these focal point answers is implausible, firstly due to the large number of observations reflecting these responses, and secondly due to the possible (and in my view, likely) information content displayed in them, instrumenting for these probabilities with other non-probabilistic variables mitigates any possible problem<sup>14</sup>.

Similar to our approach is Bloom et al. (2007), who use the health and retirement study (HRS) to look at the effect of subjective survival probabilities on wealth accumulation decisions in the United States. Bloom et al find that an increase in the subjective probability of living to age 75 increases household wealth amongst couples only. They do not, however, control for retirement date expectations in the wealth regressions. Whether individuals respond to variation in subjective retirement expectations in a similar fashion as they do to variation in subjective survival expectations, is a matter to be determined empirically. To date, there are no studies that include subjective retirement probabilities in wealth regressions.

The remainder of this chapter proceeds as follows. In section 2.2 we discuss our data and methodology, also looking at various descriptive statistics. In section 2.3 we discuss our regression results. We end with a discussion and conclusion in section 2.4.

---

<sup>14</sup> See Bloom et al. (2007) who instrument for survival probabilities to eliminate any focal point, or inconsistency problem.

## 2.2 Data and Methodology

We draw on data using seven waves (1992- 2004) of the Health and Retirement study (HRS). Conducted by the Institute for Social Research (ISR) at the University of Michigan, the HRS is a nationally representative survey of the elderly population in the United states. The initial survey was conducted in 1992 and the sample consisted of individuals born between 1931-1941 (aged 51-61 in 1992), and their spouses of any age. This initial wave consisted of 12 652 individuals. These respondents were reinterviewed in 1994 and 1996. In 1993, another survey (Assets and Health Dynamics amongst the Oldest-old, AHEAD) interviewed respondents born in or before 1923. They were reinterviewed in 1995. In 1998, the two cohorts were merged into a single sample, and another cohort of respondents born between 1924 and 1930 was added to this sample. The sample was again representative of American individuals aged 51 and above. The 1998 sample was reinterviewed in 2000 and 2002, and in 2004 a new cohort (1948-53) was added. The HRS includes extensive data on wealth, retirement and subjective expectations, making it ideally suited for the purpose of our study. We look at married households, single male households and single female households separately, since we feel that the behavioral foundations governing wealth accumulation, and in particular in response to retirement expectations, will differ across these groups of individuals.

The dependent variable used in this analysis is net household wealth (WEALTH). It is calculated as the net value of all household wealth less all debt, exclusive of so-

cial security and work sponsored pension wealth. In particular, it is calculated as the sum of: Net value of primary residence; net value of vehicles; net value of businesses; net value of IRA, Keogh accounts; net value of stocks, mutual funds and investment trusts; value of checking, savings and money market accounts; value of CD, government saving bonds, and T-bills; net value of bonds and bond funds; net value of all other savings; less all other debt.

The problem when dealing with wealth as a variable is both one of scale, where very large absolute values dominate a regression, and one of very skewed distribution. For both reasons, a log transformation would be desirable. The difficulty with a direct log transformation, is that the wealth variable takes on both zero and negative values, for which the log transformation is not defined. Authors have dealt with the issue of non positive wealth values in various ways. Some authors have taken a log transformation, dropping households with non-positive wealth values (cf., e.g., Diamond and Hausman, 1984; Kings and Dicks-Mireaux, 1982). However, restricting a sample in this sense can create a significant selection problem. Other authors have replaced the non-positive values with a small positive number before applying the log transformation (cf., e.g., Engen and Gale, 2000, Carol and Samwick, 1997, 1998; Lundberg and Ward-Batts, 2000). The problem with this method is that it does not account for variation between observations with different negative values, and between negative values and zero values. An alternative approach is to use the Inverse Hyperbolic Sine function (IHS). This approach, first suggested by Johnson (1949),

and first applied to wealth equations by Burbridge et al. (1988), has subsequently been used in wealth regressions by numerous authors (cf., Carroll et al., 2003; Cobb-Clark and Hildebrand, 2003; Kapteyn and Panis, 2003; Wenzlow et al., 2004; Pence, 2006). The Inverse Hyperbolic Sine function is given by

$$h(x) = \log(\sqrt{x^2 + 1} + x) \quad (2.1)$$

and takes care of non-positive values of  $x$ <sup>15</sup>. We apply this transformation to the wealth variable in our regression analysis.

The explanatory variable of interest is the probability of working full time after age 62 (P62). The question asked in the HRS is “Thinking about work generally and not just your present job, what do you think are the chances that you will be working full- time after you reach age 62?” The question is asked only to individuals who are working for pay at the time of the interview. We therefore think of the answer as a conditional probability– the probability of working full time after reaching age 62, given working at age  $x < 62$ . The variable is calibrated on a scale of 0-100. Since P62 is an individual variable, and WEALTH is a household variable, it is necessarily to control for spouse characteristics in the regressions when we have married individuals. Figure 2.1 shows the distribution of P62 for all individuals. We have a clear case of focal point answers, with probabilities centering around 0, 50 and 100. We also show, in figure 2.2, how the P62 variable tends to follow a random walk over time.

---

<sup>15</sup> Some studies insert a dampening factor,  $\theta$ , such that the function is given by  $g(x, \theta) = \log(\sqrt{\theta x^2 + 1} + \theta x)/\theta$ . We follow studies such as Kapteyn and Panis (2003) and others, and set  $\theta = 1$ .

We include control variables in the regressions which may be correlated with both WEALTH and P62 .We include the hourly wage rate (WGHR), and the number of hours worked per week (HOURS), to control for current labor/self-employment income. The hourly wage rate is an *effective* hourly wage rate in that it takes into account labor earnings, whether as a result of a set salary, or, whether derived from profit sharing. We control for various other sources of income (OTHERINC) which includes lump sum payments from insurance, pension or inheritance, plus alimony and any other source of income, excluding labor/self employed income, capital income, and any pension or social security income. We include three pension dummy variables: PENSION<=62 is a dummy variable taking on the value 1 if an individual has a work sponsored pension and is eligible for full benefits at age 62 or younger (This is our base category). PENSION>62 is a dummy variable taking on the value 1 if the individual has a work sponsored pension and is eligible for full benefits after age 62. NOPENSION is a dummy variable taking on the value 1 if the individual does not have a work sponsored pension. If the individual's planning horizon is longer than 10 years, the variable (FINPLAN) takes on the value 1. This variable is a proxy for the effective time rate of preference. (HEALTH) is the individuals self reported health which takes on the value 1 if the individual reports his/her health to be fair or poor, and takes on the value zero if health is reported to be excellent, very good or good. (HCOV) takes on a value of 1 if the individual does not have employer sponsored health cover that extends into retirement. Mortality expectations are controlled

for by looking at the respondent's self reported probability of living till age 75 (P75), while the respondent's self reported probability of leaving a large bequest ( $\geq \$100,000$ ) is given by (PBEQUEST). Both mortality expectations and bequest intentions are likely to be correlated with saving decisions and retirement expectations. Other variables controlled for are: age of individual (AGE); marital status for single individuals, i.e., whether (DIVORCED) or (WIDOWED), with the base category being people who have never been married; and number of children in the household (HCHILD). Controlling for marital history and number of children is important in controlling for the structure of the single household. A divorced single would behave very differently from a single person who has never been married, or is widowed. In the case of non fixed effects regressions we control for (RACE) and (EDUCD). RACE takes on a value of 1 if the individual is white and zero otherwise. EDUCD takes on the value 1 if the individual has a college education and zero otherwise. Time dummies are included in all regressions.

As an instrument for P62, we use the individual's response to a question asking what the usual retirement age is for people in their kind of job. USUALD is a dummy variable taking on a value 1 if the age given is 62 or younger. We transform the variable into a dummy variable in this fashion, since what is likely to matter for the probability of working past age 62, is whether the usual retirement age is past age 62. The first stage regressions in Tables 2.14 and 2.15 confirm the appropriateness of constructing the dummy variable in this manner.

We provide a brief intuitive argument for the validity of the instrument. It might be argued that there are certain job characteristics such as pension and health coverage characteristics that might effect both the usual age of retirement on the job and individual saving behavior. Hurd and McGarry (1993a, 1993b) show that the pension characteristic that most determines the age of retirement, is the age at which an individual can start receiving full benefits (usually referred to as the *normal retirement age* of the pension). Since we have controlled for this pension characteristic in the regression, variation in the usual retirement age should not reflect variation in the normal retirement age of the pension. Hurd and McGarry (1993a) also show that whether or not retirees are covered by employee health insurance also influences the probability of working past age 62. This is since individuals only become eligible for medicare at age 65. Since we have controlled for this in the regression, variation in the usual retirement age does not reflect variation in health care of retirees of the firm. The *effective* hourly wage controls for earning characteristics of the job that might simultaneously effect the individual's saving behavior and the usual retirement age on the job. It is thus likely, that any variation in the usual retirement age on the job, is a reflection of job characteristics such as physical and mental demands, stress levels, and convention in decision making— characteristics that are all likely to be exogenous to the individual saving decision.

In the context of married couples we control for the characteristics of both spouses. All variables referring to the husband will be prefixed with an H, and those referring to the wife prefixed with a W.

In Tables 2.1 to 2.5, we present various summary/descriptive statistics concerning the WEALTH and P62 variables. In Table 2.6 we present some summary statistics on the instrument. Table 2.1 illustrates the fact that on average married households have the most wealth, followed by single men. Single women have the least wealth. This makes sense in that a lot of married households have two potential earners. It could also be the case that even if the wife does not earn an income, married men may tend to accumulate more wealth since they feel a greater sense of responsibility than single men. In terms of single men and women, men tend to be better educated, have higher earning jobs and uninterrupted careers, allowing them to accumulate more wealth than women. It is also true that if a single woman has children, to the extent that the father does not take enough responsibility for the financial well-being of the children, this becomes the mother's primary responsibility, thereby draining her resources. Table 2.2 illustrates that married women have a substantially lower probability of working full time past age 62 than any other group. Table 2.3 shows the percentage of individuals in each group having wealth less than, equal to, and greater than zero. Probably for the same reasons as mentioned above, single women have the least amount of positive wealth, followed by single men, and then by married couples. Single women also incur the most debt. Table 2.4 shows the mean and median

wealth levels, for P62 greater than, and smaller than its median. With the exception of single men, higher probabilities of working full time after age 62 are associated with lower wealth levels. Of course the question to be answered is which way the direction of association runs. Table 2.5 shows how the mean of P62 changes with age, and pension characteristics. We see that for all groups, the subjective probability of working after age 62 increases as the individual approaches age 62. We notice too, that the average probability of working full time past age 62 is lower for individuals who can receive full pension benefits at 62 or younger, relative to individuals who can receive full pension benefits only after age 62, or individuals who have no pension at all. Table 2.6 shows the distribution of the usual retirement age on the job. We note that only about 20% of people perceive the usual retirement age as being 62 or below.

As indicated in the introduction, we conduct a Fixed Effects regression to control for unobserved heterogeneity that may affect both the expected retirement dates and wealth levels. We further attempt to correct for the direct endogeneity problem (between wealth and retirement expectations) by using Instrumental Variables estimation. We thus conduct an Instrumental Variables Fixed Effects regression to analyze the effect of exogenous variation in P62 on wealth accumulation.

## 2.3 Regression Results

For wealth values not too close to zero, the inverse hyperbolic sine function (IHS),

$$h(\text{WEALTH}) \approx \begin{cases} \log(2\text{WEALTH}) & \text{for } \text{WEALTH} > 0 \\ -\log(2\text{WEALTH}) & \text{for } \text{WEALTH} < 0 \end{cases} \quad (2.2)$$

The IHS is anti-symmetric so that

$$h(\text{WEALTH}) = -h(-\text{WEALTH}) \quad (2.3)$$

Thus, interpreting the regression coefficients of the IHS regression, is essentially the same as interpreting a regression with the dependent variable logged in the usual manner. Multiplying the coefficient by 100, simply shows a *percentage* change in wealth for a one unit change in any of the explanatory variables,  $x$ .

For all groups, we report the results of the OLS, Fixed Effects and IV Fixed Effects regressions. First stage regressions for IV Fixed Effects are given in the appendix as tables 2.14 and 2.15. Table 2.7 reports the regression results for single females, Table 2.8 for single males, and Tables 2.9 and 2.10 for married couples. The reported hausman statistics for the IV regressions indicate that the IV fixed effects regression is most appropriate in all cases, and the significance of the `USUALD` variable in the first stage regressions indicates that it is certainly legitimate.

When looking at the point estimates of the IV Fixed Effects regressions, we notice that single individuals tend to behave differently from married individuals with regards to how they respond to an increase in the subjective probability of working past age 62. The point estimates for both single women and single men indicate a

large negative causal effect running from P62 to WEALTH. In particular, for single women, the estimate implies that a 10 percentage point increase in the subjective probability of working past age 62, results in a 28% decrease in wealth<sup>16</sup>, while for single men, the same increase in this probability results in a 25% decrease in wealth. However, while these point estimates are very similar, the estimate for single women is significant at the 10% level, while that for single men is not. There is thus a large amount of variability around the point estimate for single men. While this probably has something to do with the fact that in the case of single men, the variable USUALD is a weak instrument for P62 ( F-stat –t-stat squared- on USUALD in first stage regression is less than ten), we still are inclined to have less confidence in this estimate than in that for single women. The fact, however, remains that the difference in the magnitude of the effect between single individuals and married individuals is stark, and suggests that single individuals on a whole behave very differently from married individuals in this respect. The point estimates for married individuals suggests that a ten percentage point increase in the husband’s subjective probability of working past age 62, decreases household wealth by only 4%, while a ten percentage point increase in the wife’s subjective probability of working past age 62 increases household wealth by 1%. Neither estimate is significantly different from zero.

---

<sup>16</sup> Or, equivalently, a one percentage point increase in the subjective probability of working past age 62 results in a 2.8% decrease in household wealth. We interpret our estimates in terms of a 10 percentage point increase in P62, since it more plausible to expect a change in this variable of the magnitude from 50 to 60%, say, then from 50 to 51%.

How can we explain the fact that married individuals seem less likely to take cognizance of their retirement date expectations when making saving decisions? It is important to note that the sample of married couples we have in our regression are those where both partners are currently working (This is because they will only enter the regression sample if neither the value for HP62 or WP62 is missing. This will only occur if they are both working). Thus, a change in one partner's probability of working past age 62, keeping the other's constant might not translate into a significant enough change in future *household* income to induce changes in household saving. Further, it is probable that one partner's unchanged P62 will allow a certain threshold of consumption to be maintained, even if the other partner retires earlier. Thus, smoothing consumption completely may not be as important as simply maintaining consumption above a certain minimum threshold. We attempt to verify this hypothesis in two different ways. First, we add an interaction term of HP62 with WP62. The instrument for this interaction term is simply the interaction of HUSUALD with WUSUALD. This interaction term will show the effect of variation at the same time in both partners' P62. As a second check, we take a sample of married men whose wives are not currently working, and check whether they are more inclined to take cognizance of HP62 in saving decisions. We do the same for a sample of married women whose husbands are not currently working. The results are presented in Table 2.11. Looking at the point estimates, the interaction term presents an effect almost identical to that in the case of single women and single men. A ten percentage

point increase in both the husband and wife's probabilities of working past age 62, results in 29% less household wealth, than if just one spouse's probability increased by the same amount (in which instance there was a negligible effect). Looking at the case where the husband is the sole earner, we see a massive effect. A ten percentage point increase in the husbands probability of working past age 62, results in a 70% decrease in household wealth. Again, however, we need to take cognizance of the large standard errors around these point estimates, probably due to the relative weakness of the instrument for married individuals. While there probably is a large effect for married men who are sole earners, 70% is most likely an overestimate.

In the case of the wife being the sole earner, the magnitude of the effect is very small, i.e., an increase in such a woman's probability of working past age 62 does not have much of an effect on household wealth. This sample of women (whose husbands are most likely unable to work), are probably less able to save for retirement, due to more pressing and immediate responsibilities.

We have thus far established that married couples where both partners are working, are the least likely to alter their savings behavior in response to a change in the probability of working full time after age 62 of just one partner. Apart from sole earning married women, all other individuals seem to take cognizance of this probability in wealth accumulation decisions. Further, due to the small standard errors around the point estimate for single women, we are most confident in this effect for this group. The results seem to suggest that there is a threshold effect in terms

of how responsive household wealth is to changes in the *household* probability of working past age 62. While (with the exception of sole earning married women) a 10 percentage point increase in the *household* probability of working past age 62 results in a decrease in household wealth of 25% or more, the same percentage point change for just one member of a two person working household results in a change in wealth of far less than 10%. It thus seems that it is not so much complete consumption smoothing that is important, as it is to maintain a certain minimum level of consumption, when this can be achieved by the spouse who anticipates no change in his/her retirement date.

It is interesting to note that in all instances (for single women, single men, married men) the age at which one is eligible for full pension benefits is not significant in the wealth equation, but is significant in determining P62 (see first-stage regressions in appendix). Thus, whether individuals have a pension, and the age of pension eligibility, affects their retirement expectations, rather than their saving decisions. However, if retirement expectations change for reasons other than a change in pension status, pension status might affect the manner in which individuals' savings behavior reacts to such a change in retirement expectations. Thus, as a last measure, we analyze whether pension characteristics, and in particular, the earliest age at which one is eligible to receive full benefits, is significant in determining whether individuals take cognizance of retirement date expectations in wealth accumulation decisions. We would expect individuals who expect to retire earlier to save more,

if retiring early imposes a significant wealth or liquidity effect. An individual who expects to retire at or before age 62 and is eligible for full pension benefits at or before age 62, is in a far better position than someone who expects to retire at or before age 62, but is only eligible for full pension benefits after age 62, or does not have a pension at all. We thus run separate IV Fixed Effects regressions for the sample of individuals with  $\text{NOPENSION}=1$  or  $\text{PENSION}>62=1$  (no pension, or eligibility for full pension benefits after age 62), and for those with  $\text{PENSION}\leq 62=1$  (pension with eligibility for full benefits at age 62 or earlier).

Tables 2.12 and 2.13 show the coefficient on P62 by pension characteristics. Married individuals here are those from the original sample of a two person working household. We notice that on a whole (with the exception of single men), the negative causal relationship running from P62 to wealth is far more predominant if individuals have no pension, or are only eligible for full benefits after age 62.

## **2.4 Conclusion**

This chapter investigates the impact of subjective expectations regarding the timing of retirement on pre-retirement wealth accumulation. More specifically, we analyze the effect of the agent's subjective belief that he will work full time after age 62 (P62) on his current level of wealth. We use Instrumental Variables Fixed Effects regression to correct for any endogeneity between P62 and wealth. The individual's perception of the usual retirement age on the job acts as an instrument for P62.

On a whole, the point estimates suggest that the responsiveness of individuals' saving behavior to retirement dates expectations is large. A ten percentage point increase in the probability of working past age 62 results in a decrease in household wealth well in excess of 20% for most demographic groups. There are two notable exceptions. One is married women who are the sole earners. The other is when there is a change in the probability of working past age 62 for just one member of a two person (married) working household. While a simultaneous ten percentage point increase in this probability for both partners results in a 29% decrease in household wealth, the same percentage point increase in this probability for just one partner has a negligible effect on household wealth. It is, thus, probable that the household is happy to rely on one partner's unchanged P62 to maintain a certain consumption threshold, in the event that the other partner retires earlier. It thus seems that it is not so much complete consumption smoothing that is important, as it is to maintain a certain minimum level of consumption.

We note that the responsiveness of saving decisions to retirement date expectations is generally more predominant, the more a change in retirement expectations imposes a wealth or liquidity effect, as measured by pension status. In particular, the negative causal relationship running from P62 to wealth is far more predominant if individuals have no pension, or are only eligible for full benefits after age 62.

It is important to take cognizance of the fact that except for the case of single women, in which case the instrument is strong, the standard errors around the other point estimates are large. We are thus most confident in our results for single women.

In that —on a whole— the point estimates suggest that individuals do seem to take cognizance of retirement date expectations in decisions to accumulate wealth, the *retirement-consumption- puzzle* is not due to complete myopic behavior. We have however shown that —in certain instances— it is likely that complete consumption smoothing is not as important as maintaining a certain minimum threshold level of consumption, in which instance consumption would drop to a degree at retirement. Either way, from a policy perspective, to the extent that individuals do— in the large— alter their saving behavior in response to changes in the expected timing of retirement, changing trends in retirement dates is likely to have an effect on savings in the economy as a whole.

Figure 2.1: Distribution of p62

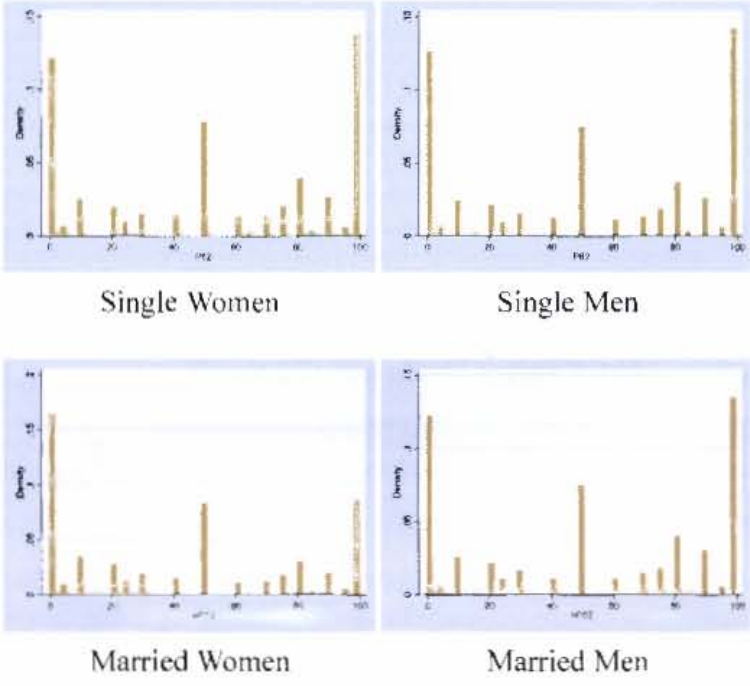
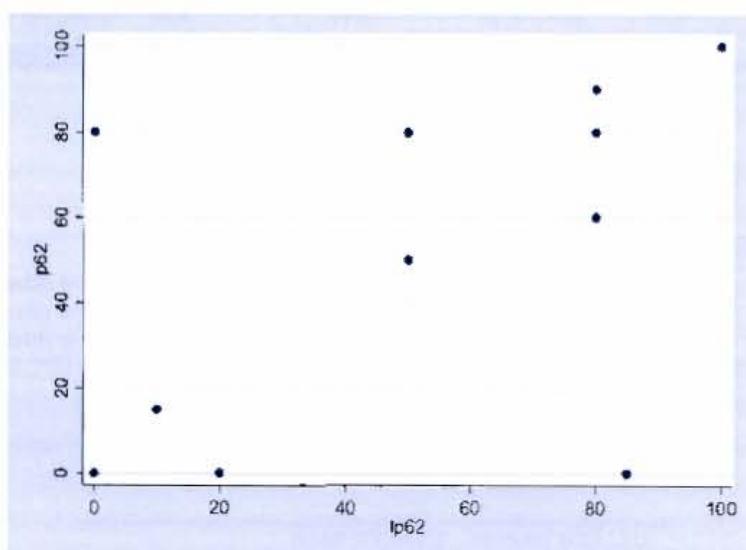


Figure 2.2: Plot of P62 against L.P62



	WEALTH (in levels)		
	Single Women	Single Men	Married Couples
mean	149 001	225 079.7	372 970.6
median	50 000	57 700	166 000
standard Deviation	502 152.2	1049 573	1033 032
no of observations	32 662	12 159	42 319

Table 2.1: Summary Statistics for Wealth

	P62			
	Single Women	Single Men	Married Men	Married Women
mean	53.2	52.7	52.8	40
median	50	50	50	41.5
standard deviation	39.4	39.6	39.3	37.9
no of observations	6342	2921	12 843	14 953

Table 2.2: Summary Statistics for p62

	Single Women	Single Men	Married Households
% with WEALTH <0	5.4	5.1	2.3
% with WEALTH=0	10	8	1
% with WEALTH >0	84.6	87	96.7

Table 2.3: Distribution of Wealth

	mean WEALTH	median WEALTH
<b>Single Women</b>		
P62>50	128 743	51 500
P62<50	144 765	55 300
<b>Single Men</b>		
P62> 50	313 156	65 250
P62< 50	186 768	65 100
<b>Married Couples</b>		
HP62>50	300 500	115 800
HP62< 50	342 300	168 000
WP62 >40	305 740	136 000
WP62<40	349 555	175 000

Table 2.4: Mean and Median Wealth by p62

AGE	mean P62	pension status	mean p62
<b>Single Women</b>		<b>Single Women</b>	
AGE <56	50.1	PENSION<=62=1	39.8
AGE>= 56	55.7	PENSION>62=1 OR NOPENSION=1	54.2
<b>Single Men</b>		<b>Single Men</b>	
AGE<56	51.4	PENSION<=62=1	37.5
AGE >=56	53.9	PENSION>62=1 OR NOPENSION=1	54.1
<b>Married Men</b>		<b>Married Men</b>	
HAGE <56	50.84	HPENSION<=62=1	35.8
HAGE>=56	54.2	HPENSION>62=1 OR HNOPENSION=1	54.8
<b>Married Women</b>		<b>Married Women</b>	
WAGE <56	30	WPENSION<=62=1	31.0
WAGE>=56	50	WPENSION>62=1 OR WNOPENSION=1	42.3

Table 2.5: Mean p62 by Age and Pension Status

	Single Women	Single Men	Married Women	Married Men
% with USUAL <=62	18	19	22.4	22
% with USUAL >62	25.1	27.6	24.2	30.86
% with no usual or otherwise	56.9	53.4	53.4	47.1
no observations	9094	4378	18 199	20 872

Table 2.6: Distribution of the variable -Usual

	OLS	FIXED EFFECTS	IV FIXED EFFECTS
	IHS(WEALTH)	IHS(WEALTH)	IHS(WEALTH)
P62	-0.005*** (-2.97)	-0.002 (-1.10)	-0.028* (-1.67)
WGHR	0.002* (1.89)	0.001 (0.54)	-0.001 (0.79)
LNOTHERINC	0.038*** (2.69)	0.037** (2.42)	0.038*** (2.35)
PENSION>62	0.026 (0.10)	-0.051 (-0.19)	0.091 (0.31)
NOPENSION	-0.510* (-1.90)	-0.107 (-0.34)	0.019 (0.06)
FINPLN	0.669*** (4.55)	0.200 (1.14)	0.211 (1.17)
HEALTH	-1.329*** (-7.97)	-0.190 (-0.86)	-0.327 (-1.34)
HCOV	0.608*** (3.84)	-0.418* (-1.87)	-0.282 (-1.15)
P75	-0.001 (-0.56)	-0.003 (-1.08)	-0.0002 (-0.06)
PBEQUEST	0.031*** (19.28)	0.007*** (2.45)	0.006** (2.38)
HOURS	0.009 (1.60)	0.016*** (2.10)	0.023** (2.54)
AGE	0.037*** (2.79)	-0.234 (-1.24)	0.006** (2.38)
DIVORCED	0.658*** (4.07)	0.702** (2.09)	0.606* (1.72)
WIDOWED	1.081*** (6.02)	0.324 (0.69)	0.049 (0.10)
HCHILD	-0.046 (-1.55)	0.108 (1.07)	0.104 (1.00)
RACED	1.363*** (10.10)		
EDUCD	0.580*** (3.63)		
CONS	5.301*** (6.37)	22.703*** (3.33)	
no of obs	4730	4730	4730
hausman stat for IV regression			46.50**

Notes: Time/ wave dummies are included in all regressions.  
\* denotes significance at the 10% level; \*\* at the 5% level, and \*\*\* at the 1% level.  
Figures in parentheses are t values.

Table 2.7: Regression Results for Single Women

	OLS	FIXED EFFECTS	IV FIXED EFFECTS
	IHS(WEALTH)	IHS(WEALTH)	IHS(WEALTH)
P62	-0.001 (-0.15)	0.004 (1.27)	-0.025 (-0.67)
WGHR	0.005*** (3.45)	0.001 (0.30)	0.001 (0.30)
LNOTHERINC	0.053** (2.31)	0.040 (1.49)	0.023 (0.83)
PENSION>62	0.028 (0.09)	-0.369 (-1.03)	-0.110 (-0.22)
NOPENSION	0.070 (0.21)	0.367 (0.87)	0.661 (1.14)
FINPLN	0.040 (0.18)	-0.316 (-1.26)	-0.212 (-0.72)
HEALTH	-0.344 (-1.42)	-0.406 (-1.22)	-0.483 (-1.34)
HCOV	1.178*** (5.63)	0.207 (0.72)	0.192 (0.64)
P75	0.004 (1.59)	0.003 (0.68)	0.004 (0.97)
PBEQUEST	0.031*** (12.43)	-0.001 (0.32)	-0.001 (-0.05)
HOURS	0.013** (1.96)	0.020 (1.16)	0.020 (1.33)
AGE	0.036* (1.74)	0.488* (1.90)	0.401 (1.39)
DIVORCED	0.265 (1.42)	-0.432 (-1.11)	-0.503 (-1.21)
WIDOWED	-0.465 (-1.54)	-0.671 (-0.77)	0.661 (1.14)
HCHILD	-0.013 (-0.33)	-0.052 (-0.45)	-0.064 (-0.52)
RACED	1.280*** (6.49)		
EDUCD	0.830*** (4.02)		
CONS	4.54*** (3.67)	-15.311 (-1.17)	-10.16 (-0.67)
no of obs	1980	1980	1980
hausman stat for IV regression			50.82**

Notes: Time/ wave dummies are included in all regressions..  
\* denotes significance at the 10% level; \*\* at the 5% level, and \*\*\* at the 1% level.  
Figures in parentheses are t values.

Table 2.8: Regression Results for Single Men

	OLS	FIXED EFFECTS	IV FIXED EFFECTS
	IHS(WEALTH)	IHS(WEALTH)	IHS(WEALTH)
HP62	-0.002*** (-4.25)	0.001* (1.71)	-0.004 (-0.58)
WP62	-0.004*** (-8.14)	-0.003*** (-4.43)	0.001 (0.11)
HWGHR	0.001*** (5.42)	-0.0001 (-0.22)	-0.00001 (-0.10)
WWGHR	0.003*** (5.11)	0.0001 (0.05)	0.00007 (0.11)
LNOTHERINC	0.009** (1.99)	0.007 (1.53)	0.007 (1.56)
HPENSION>62	-0.126* (-1.77)	-0.085 (-1.26)	-0.071 (-0.92)
HNOPENSION	-0.006 (-0.09)	0.051 (0.66)	0.054 (0.62)
WPENSION>62	0.032 (0.45)	0.053 (0.74)	0.026 (0.31)
WNOOPENSION	-0.120 (-1.66)	0.140* (1.72)	0.135* (1.73)
HFINPLN	-0.006 (-0.08)	0.090 (1.01)	0.061 (0.57)
WFINPLN	0.247*** (3.43)	-0.138 (-1.60)	-0.138 (-1.49)
HHEALTH	-0.452*** (-7.19)	-0.132* (-1.69)	-0.153* (-1.76)
WHEALTH	-0.544*** (-8.24)	0.058 (0.67)	0.071 (0.73)
HHC0V	0.047 (1.04)	0.041 (0.65)	0.034 (0.52)
WHC0V	0.013 (0.33)	0.005 (0.10)	0.010 (0.19)
HP75	-0.002** (-2.16)	-0.001 (-1.37)	-0.001 (-0.34)
WP75	0.002** (1.98)	-0.0002 (-0.23)	-0.001 (-0.39)
HPBEQUEST	0.011*** (21.79)	0.0004 (0.64)	0.001 (0.70)
WPBEQUEST	0.010*** (19.66)	0.0005 (0.67)	0.0004 (0.52)
HAGE	0.047*** (9.42)	-0.0003 (-0.01)	-0.0004 (-0.01)
WAGE	0.024*** (6.29)	0.054* (1.91)	0.051 (1.59)
HCHILD	-0.179 (-1.42)	-0.463* (-1.88)	-0.456* (-1.77)
HHOURS	0.007*** (4.33)	-0.003 (-1.53)	-0.003 (-1.16)
WHOURS	-0.005*** (-2.91)	0.004 (1.60)	0.003 (0.76)

Table 2.9: Regression Results for Married Couples

	OLS	FIXED EFFECTS	2SLS FIXED EFFECTS
HEDUCD	0.173*** (3.36)		
WEDUCD	0.122** (2.26)		
HRACED	0.148*** (3.38)		
WRACED	0.227*** (5.22)		
CONS	7.405*** (21.51)	9.859*** (5.16)	10.130*** (4.67)
no of obs	11932	11932	11932
hausman stat for IV regression			216.77***

Notes: Time/ wave dummies are included in all regressions.  
\* denotes significance at the 10% level; \*\* at the 5% level, and \*\*\* at the 1% level.  
Figures in parentheses are t values.

Table 2.10: Regression Results for Married Couples- Continued

	with interaction term	husband sole earner	wife sole earner
HP62*WP62	-0.029 (-0.08)		
HP62		-0.070 (-1.09)	
WP62			0.009 (0.39)
no of observations	11 684	5245	5234

Table 2.11: Married Couples-More Results

	Single Women		Single Men	
	PENSION<=62	PENSION>62 OR NOPENSION	PENSION<=62	PENSION>62 OR NOPENSION
p62	0.005 (0.06)	-0.040* (-1.82)	-0.030 (-0.50)	-0.025 (-0.59)
no of observations	328	4402	884	1096

Table 2.12: Effect of p62 on Wealth- by Pension Status

	Married Men		Married Women	
	HPENSION<=62	HPENSION>62 OR HNOPENSION	WPENSION<=62	WPENSION>62 OR WNOPENSION
P62	0.040 (1.18)	-0.016 (-0.90)	0.087 (0.81)	-0.011 (-0.64)
no of observations	2508	8400	2161	8652

Table 2.13: Effect of p62 on Wealth-by Pension Status-Continued

## 2.A Appendix to chapter 2

..

P62	Single Women	Single men
WGHR	0.02 (1.15)	0.001 (0.04)
LNOTHERINC	- 0.02 (-0.11)	-0.404 (-1.63)
PENSION>62	4.82* (1.87)	8.37** (2.23)
NOPENSION	3.50 (1.16)	9.36** (2.12)
FINPLN	0.30 (0.18)	3.66 (1.39)
HEALTH	-4.99** (-2.35)	-3.13 (-0.90)
HCOV	5.37** (2.50)	-0.53 (-0.18)
P75	0.11*** (3.94)	0.07* (1.79)
PBEQUEST	0.005 (0.23)	0.04 (0.97)
AGE	3.091* (1.71)	-2.54 (-0.95)
DIVORCED	4.81* (1.87)	-2.66 (-0.65)
WIDOWED	3.500 (1.16)	-15.99* (-1.75)
HCHILD	-0.283 (-0.29)	-0.34 (-0.29)
HOURS	0.298*** (4.10)	0.294*** (2.75)
USUALD	-10.405*** (-6.37)	-6.70*** (-2.72)
CONS	-122.67 (-1.34)	159.40 (1.16)
Time dummies are also included		

Table 2.14: First Stage Estimates: Singles

WP62/HP62	Married Women	Married Men
HOURS	0.002 (0.05)	0.13*** (3.05)
WHOURS	0.25*** (5.57)	0.03 (0.66)
HWGHR	-0.004* (-1.77)	-0.0001 (-0.03)
WWGHR	-0.003 (-0.31)	0.004 (0.36)
LNOTHERINC	-0.12 (-1.50)	0.05 (0.59)
HPENSION>62	2.86** (2.33)	4.69*** (3.68)
WPENSION>62	1.30 (0.99)	-3.64 (-2.68)
HNOPENSION	3.30** (2.31)	2.77 (1.48)
WNOPENSION	-0.04 (-0.03)	-0.69 (-0.45)
HFINPLN	3.75** (2.30)	-2.46 (-1.45)
WFINPLN	2.92* (1.85)	1.97 (1.20)
HHEALTH	-1.90 (-1.34)	-5.25*** (-3.57)
WHEALTH	-3.56** (-2.26)	-0.57 (-0.35)
HHC0V	-0.75 (-0.65)	-1.83 (-1.53)
WHC0V	-0.46 (-0.46)	0.5 (0.48)
HP75	-0.07*** (-4.40)	0.07*** (4.01)
WP75	0.08*** (4.88)	0.01 (0.67)
HPBEQUEST	-0.02 (-1.63)	-0.001 (-0.03)
WPBEQUEST	0.01 (1.07)	-0.003 (-0.23)
HAGE	1.06** (2.09)	0.75 (1.41)
WAGE	1.16** (2.24)	0.36 (0.65)
HCHILD	-6.07 (-1.35)	-2.82 (-0.60)
HUSUALD	-0.58 (-0.67)	-6.68*** (-4.96)
WUSUALD	-4.08*** (-4.81)	-1.84** (-2.09)
CONS	-77.06** (-2.22)	-9.43 (-0.26)
Time Dummies are included		

Table 2.15: First Stage Estimates: Married Couples

## Chapter 3

# Focal Point Responses as Neo-Additive Capacities

### 3.1 Introduction

Economic decisions typically rely on agents' expectations regarding uncertain events in the future. These expectations, in turn, are formed by the agent using his subjective beliefs regarding the probability distributions of such events. In surveys, such subjective probability distributions are often elicited through the responses agents give to questions regarding probabilities of certain events occurring. Concern, however, has been expressed in the literature about the pattern of responses given to such questions (cf., e.g., Hurd and McGarry, 1995; Hurd et al., 1998; and Basset and Lumsdaine, 2001). While general inconsistencies in such answers have been noted, the concentration of answers around focal points (0, 50 and 100 percent)<sup>17</sup> has been of notable concern. While the bunching of answers at 50 is at worst questionable, it can be argued that focal point answers of 0 and 100 are not sensible, in that it is unreasonable that an agent should know with complete certainty whether an uncertain future event will occur or not. Focal point responses are generally distinguished in the liter-

---

<sup>17</sup> Corresponding to 0, 0.5 and 1 on a 0-1 scale.

ature from *precise* answers, implying that these focal point responses are imprecise, or inaccurate.

In this chapter, we use certain dynamic elements of the data to show that there are two different kinds of focal point responses given close to the event in question. On the one hand, those that are more or less accurate, and, on the other hand, those that are not. We show that focal point responses given consistently over the questioning horizon are quite accurate, whereas focal point responses given *only* closer to the event in question are biased. Thus, what is of interest is the dynamic process that leads the agent to form such focal point belief patterns over time. While the literature seems to concur that focal point responses of 0 and 100 are a reflection of uncertainty, we provide a formal decision theoretic approach that explains the dynamics of the agents' responses. More specifically, we represent a focal point response of 100 or 0 (or 1,0 on a 0-1 scale) as a *neo-additive capacity* in the sense of Chateauneuf et al. (2007). A neo-additive capacity is a non-additive belief that represents a deviation from an additive belief, such that the degree of ambiguity measures the lack of confidence the agent has in some additive probability distribution. Whenever this belief is updated over time according to the *Generalized Bayesian Update Rule*, the degree of ambiguity increases, in that the agent has decreasing confidence in the additive probability distribution. In our context, the agent then resolves this ambiguity by having complete confidence in the extreme belief that he/she will, or will not, with absolute certainty, continue to work full time after age 62.

Our formal interpretation is consistent with focal point responses nearer age 62 that arise from precise answers given at younger ages. In particular, our interpretation is consistent with the data according to which focal point responses given consistently over the questioning horizon are quite accurate, whereas focal point responses given *only* closer to the event in question (and that have arisen from precise answers) are biased.

Our contribution in this chapter relates both to the data itself, and in using the data to make a theoretical contribution. Firstly, we show that, with the exception of married men, the subjective probability of working past age 62 fails to converge to the corresponding objective probability as individuals approach age 62. In particular, there is an upward bias that is non-decreasing over time—an observation which represents an apparent violation of the Rational Bayesian Learning paradigm. Secondly, we show that there is an increased tendency, at older ages to give a focal point response of 100 to the question regarding the probability of working full time after age 62. More so, we show that it is this phenomenon that is the primary cause of the failure of the subjective probability of working past age 62 to converge to the corresponding objective (additive) probability over time. It is these initial observations that lead us to study focal point responses more closely, culminating in our formal interpretation of such focal point responses within a decision theoretic framework.

We proceed as follows. Section 3.2 briefly reviews the existing literature on focal point answers. Section 3.3 illustrates the stylized facts in the data. Section 3.4

provides the theoretical framework used to explain the observations in the data. In section 3.5, we estimate the relevant parameters for the suggested model. Section 3.6 concludes.

## 3.2 The Literature on Focal Point Answers

Our interpretation of focal point responses as neo-additive capacities stands for a new approach to the existing literature on focal point responses. This literature thus far tends to agree that focal point answers of 0 and 100 are a reflection of the agent's uncertainty regarding the relevant probability distribution. According to Lillard and Willis (2001) and Hill et al. (2004), this uncertainty results in agents reporting the modal (most likely) probability in response to subjective probability questions. Basset and Lumsdaine (2001) and Huynh and Jung (2010) show that individuals who give answers of zero and 100 are less educated and have lower income levels than other individuals. This suggests that answers of zero and 100 demonstrates low cognition and lack of understanding of the question or concept of a probability. Such agents are, in this sense, *uncertain* as to how to respond.

The opinion on answers of 50 is different. While Bruine de Bruin et al. (2000) say answers of 50 are a reflection of epistemic uncertainty, most other authors say answers of 50 reflect genuine probabilities not far from 50 that are simply rounded to 50 (cf., Borsch-Supan, 1998; Kleinjans and Van Soest, 2010; Huynh and Jung, 2010; Manski and Molinari, 2010). Indeed Kleinjans and Van Soest show that while an-

swers of 0 and 100 are related to uncertainty, the probability of giving an answer of 50 that is not related to a genuine underlying probability is small. Huynh and Jung show that while individuals giving answers of zero and 100 are less educated and have less income and assets to the rest of the sample, individuals giving answers of 50 look essentially the same as the rest of the sample (giving more precise probabilities). Manski and Molinari actually ask respondents whether their answers are precise probabilities. Of those that said their answers were precise, nearly a quarter gave answers of 50 percent. It thus seems that we should view answers of 50 differently to answers of 0 and 100.

Thus, while the literature tends to agree that focal point responses of 0 and 100 are a reflection of uncertainty, our interpretation provides a mechanism, other than the modal choice hypothesis, through which such uncertainty gives rise to these focal point responses.

### **3.3 Stylized Facts**

#### **3.3.1 Data and Methodology**

We use 7 waves of the Health and retirement study (every two years from 1992-2004) to assess how subjective probabilities of working past age 62 deviate from objective probabilities. We look at individuals aged 51 to 61. We separate these individuals into four demographic groups: single women, married women, single men, and married

men. We separate individuals in this manner since we feel that it is likely that gender and marital status would influence retirement expectations, and *possible* that they would influence rationality of such<sup>18</sup>. In order to avoid macroeconomic effects, we analyze several cohorts. For each cohort we find the average subjective probability at each age. For each age we then find the average subjective probability across all cohorts.

The objective probabilities are calculated by observing the cohorts over time. In particular, the objective probability of working full time after age 62 for an individual who is, say, 52 in 1992, will be based on what 62 year olds were doing in 2002. Thus, for this cohort we would include only individuals that are still in the sample in 2002 so that we can observe them at age 62. Similarly, the objective probability for a 52 year old in 2002 will be based on what 62 year olds are expected to be doing in 2012. The objective probability for a 52 year old single working male in 1992, say, is calculated by looking at the proportion of this group who is working full time in 2002 when they are age 62. For a 54 year old individual in 1992, we look at the proportion working full time in 2000. This is easily done for ages that are even numbers, not so easily done for ages that are odd numbers. For example, a 53 year old individual in 1992 was 62 in the year 2001. However, there is no HRS survey in

---

<sup>18</sup> While it is possible that other factors would influence such, for relative simplicity, we consider only heterogeneity in gender and marital status.

2001, so we cannot ascertain what this person was doing at age 62. Thus, for the odd ages we interpolate (linearly) from the even ages.<sup>19</sup>

In order to calculate the objective probabilities for 62 year olds after 2004, we use predicted growth rates of labor force participation rates at age 62, calculated by the Bureau of labour statistics, in order to predict the HRS proportions up till 2016. Since the growth rates of the proportion of 62 year olds working full time in the HRS data has greatly followed the growth trends calculated by the BLS for the population as a whole, we assume that at the time the HRS was carried out, it would be rational to assume that barring any shocks, the growth rates in the HRS proportions would be expected to follow the growth trends predicted by the BLS.

A complication arises from the fact that there is ambiguity in the question “What is the probability that you will be working full time after age 62?”. Does this imply after the individual’s 62nd birthday, or does it imply after the individual is no longer 62? The method used to calculate the objective probability discussed above assumes the first interpretation. However, as noted by Hurd and McGarry (1993b), some individuals assume the first interpretation, others the second. We thus also calculate the objective probability under the second interpretation. In doing this we calculate the proportion of a certain cohort working at time  $t$ , that is working full

---

<sup>19</sup> Except for age 61 where we suspect there might be some discontinuity. For this age we use information about what happens at age 63, to infer (by interpolating) what happens at age 62 for this age group. We can calculate the objective probability of working at age 63 for 51, 53, 55, 57, 59 and 61 year olds. By looking at the change in this probability between the ages of 59 and 61, we can infer the same change for the probability of working full time at age 62. We discuss shortly why we are interested in the proportion working at age 63 anyway.

time at age 63. Here of course we have information on the odd ages, and need to interpolate for the even ages.

Our final objective probability for each cohort that we use in our analysis is the average of those calculated under the first and second interpretations. Once we have calculated the objective probabilities in this way for every age group of every cohort, we combine the information to find the average objective probability for every age group as a whole. In this way we can track how deviations between subjective and objective probabilities change over the years between 51 and 61 for a *representative* agent. Thus, by having seven observations for each age group we can eliminate macroeconomic effects, and by looking at cohorts over time we eliminate cohort effects.

Most similar to this approach is that of Hurd et al. (2009)<sup>20</sup>. They studied 4 cohorts (of the population as a whole<sup>21</sup>) separately, reaching age 62 in 1996, 1998, 2000 and 2002 respectively. They compared the average subjective probability of the cohort of working after age 62 in previous waves (starting at wave 2) to actual outcomes at age 62 (and age 63 to allow for different interpretations of the question). They show that individuals tend to overestimate this probability. The disadvantage of looking at a particular cohort is that one cannot account for macroeconomic effects affecting a specific cohort. However, in looking at the 4 cohorts, while the magnitude

---

<sup>20</sup> Hurd et al. (2009) specifically analyze the probability of working past age 62, as did Hurd and McGarry (1993). Other authors analyzing the rationality of retirement date expectations as a whole include Bernheim (1989), Disney and Tanner (1998), Forni (1999), and Benitez-Silva and Dwyer (2005), but their approaches are less relevant to our approach in this paper.

<sup>21</sup> Not separated into different demographic groups, as in our approach.

of the overestimation differed, the general tendency to overestimate was present. The problem with looking at biases at different ages is that there is only one cohort with 53-54 year olds, and no cohorts with those younger. A large observed overestimation for this age group may have been specific to a macroeconomic effect specific to that cohort.

### **3.3.2 Results**

Looking at figure 3.1, we find that, with the exception of married men whose subjective probabilities seem to correspond to the objective probabilities, all other groups tend to overestimate the probability of working full time after age 62. The effect seems most pronounced for single women, and least pronounced for married women. More so, for all groups, the subjective probabilities do not seem to converge to the objective probabilities over time, with the average deviation remaining approximately constant between the ages of 51 and 61. This is in contrast to what would be predicted by the theory of Rational Bayesian Learning.

In order to try and ascertain the cause of this phenomenon, we look at the distribution of subjective probabilities at different ages for our different subgroups. Figures 3.2 and 3.3 display these distributions. There are two important observations. Firstly, there is a definite bunching of responses at 0, 50 and 100 percent for all of our four subgroups at both younger and older ages. Secondly, while the proportion of responses at 0 and 50 remains approximately constant at both younger and

older ages, the proportion of responses at 100 increases for all our four groups as individuals get closer to age 62. This leads us to the question—Are these increasing number of responses at 100 responsible for the lack of convergence of the subjective probabilities to the objective probabilities as individuals approach age 62? In order to answer this question, we omit all observations with extreme focal point responses (0 and 100). We only omit focal values of 0 and 100, not 50, since there is enough evidence in the literature to suggest that it is individuals giving answers of 0 and 100, specifically, that demonstrate different attributes and greater uncertainty than the rest of the sample. The literature is generally more concerned about answers of 0 and 100, than about answers of 50. We then carry out the same methodology outlined above for this sample. In addition to recalculating average subjective probabilities for this group, we recalculate objective probabilities for this group. We do this since the literature has stressed the fact that individuals providing these focal point answers have different attributes (such as being less educated and having lower assets) to the rest of the population. Since these attributes are correlated with retirement timing, it is likely that the objective probability of working past age 62 is also different to the rest of the population. Thus, the objective probability of working past age 62 is likely to be different in the sample excluding focal point responses to a sample including focal point responses.

Figure 3.1: Subjective and Objective Probabilities

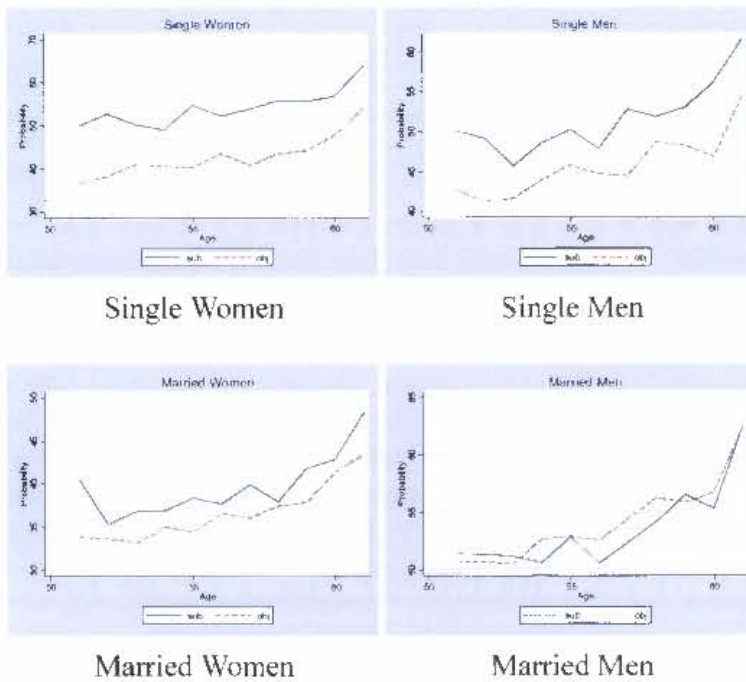


Figure 3.2: Distribution of p62 between the ages of 51 and 55 inclusive

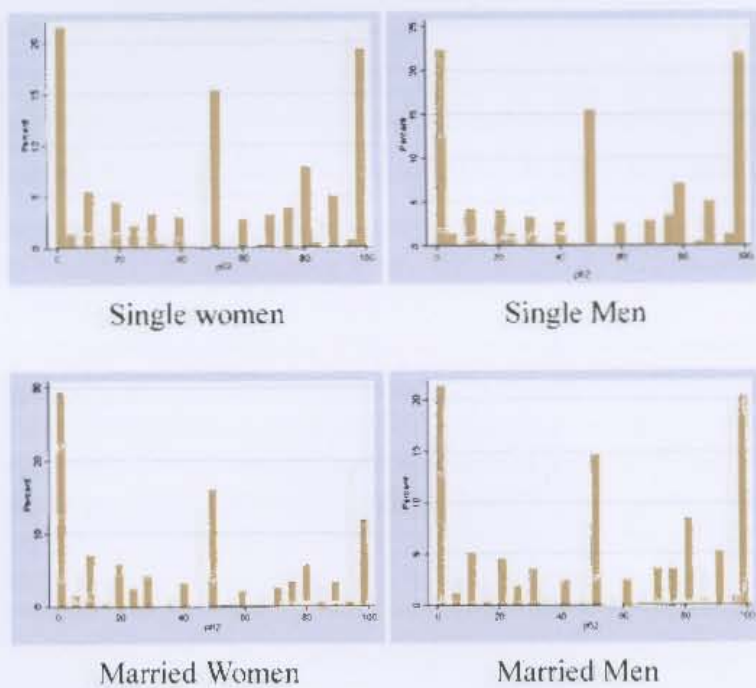
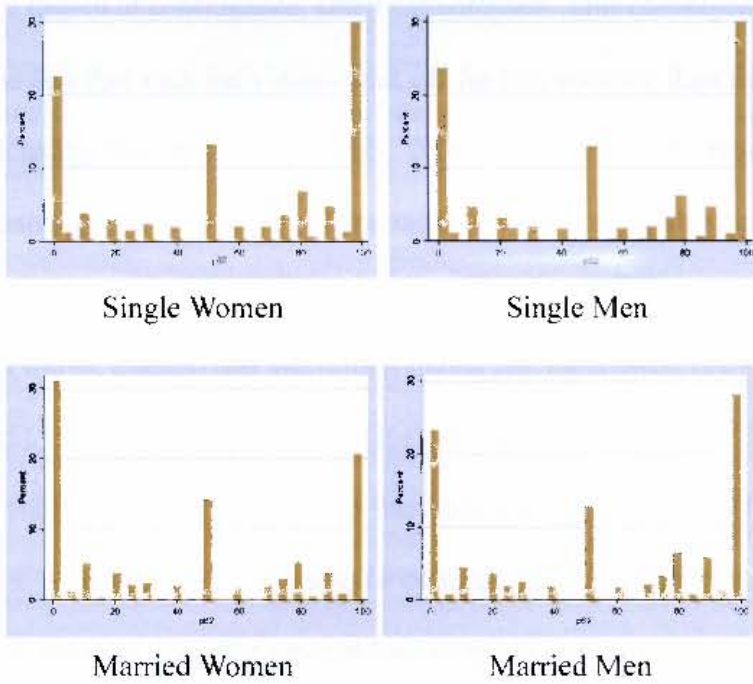


Figure 3.3: Distribution of p62 between the ages of 56 and 61 inclusive



### 3.3.3 Results without Focal Point Answers

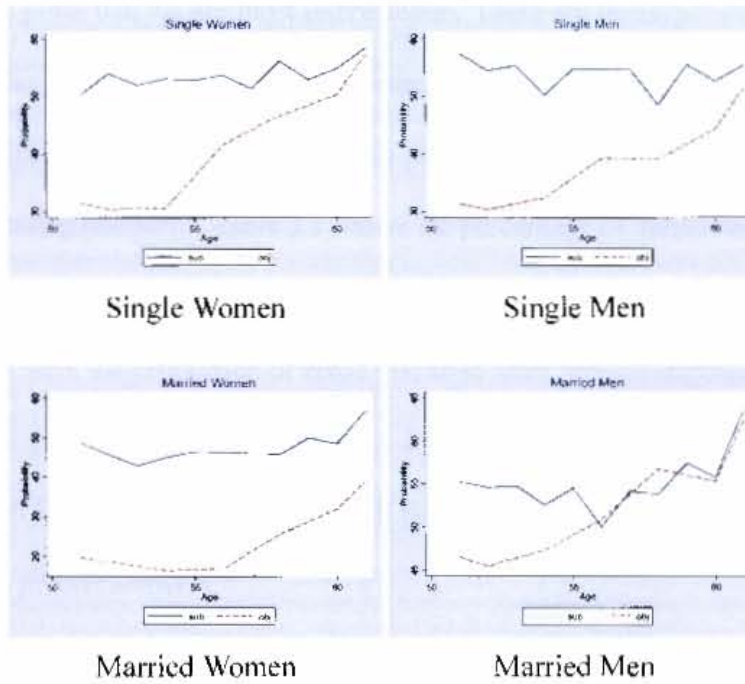
Figure 3.4 shows the relevant subjective and objective probabilities for this sample. A different picture emerges. There is definitely evidence that this sample of individuals are rational Bayesian learners. This is especially the case with single men, single women and married men, where by age 61, the subjective probability almost completely coincides with the objective probability. In the case of married women, we do notice a degree of convergence, albeit not complete. This convergence is the case, despite the fact that such individuals start off far less accurate than the those in the sample including focal point respondents. What is important in the rational Bayesian learning paradigm, is not the size of the initial bias, but rather the fact that the bias decreases over time.

As a whole, it seems that individuals giving *precise* answers (including answers at 50) tend to subscribe to the rational Bayesian learning paradigm, while the population as a whole (including those giving focal point answers of 0 and 100) does not<sup>22</sup>. More so, it is apparent that the presence of focal point responses results in greater accuracy at younger ages (the upward bias is smaller at younger ages in the entire sample than in that minus focal points), but induces an upward bias at older ages. Thus, we are interested in the nature of focal point responses given nearer to age 62.

---

<sup>22</sup> With the exception of married men, who seem to be rational even with the inclusion of focal points.

Figure 3.4: No Focal Point Responses



throughout the questioning horizon. We see that as age 62 approaches, the focal point answer of 100 now becomes relatively accurate.

Figure 3.7 shows individuals who give focal point responses of zero that arise from precise responses. Here we notice an increasing *downward* bias as age 62 approaches. Figure 3.8 shows individuals who give a focal point response of zero consistently throughout the questioning horizon. These individuals are remarkably accurate from the outset. Even at younger ages, the objective probability is equal to, or very close to zero.

It is clear that it is focal point responses that arise from precise responses that induce a bias at ages closer to 62. However, with the exception of married men, since the proportion of zeros that arise from precise responses is small relative to the proportion of 100's that arise from precise answers<sup>24</sup>, we observe an upward bias as age 62 approaches. In the case of married men, it is the fact that these proportions are essentially equal, that the upward and downward biases cancel, and that they thus appear "rational" at this point.

In the next section, we provide a theoretical framework that can explain the mechanism whereby bias is created as precise responses become focal points.

---

<sup>24</sup> See table 3.1.

Focal Response	Single Women	Single Men	Married Women	Married Men
100	39	32	60	36
0	25	10	39	35

Table 3.1: Percentage of End Point Focal Point Responses Arising from Precise Responses

Figure 3.5: 100 from Precise

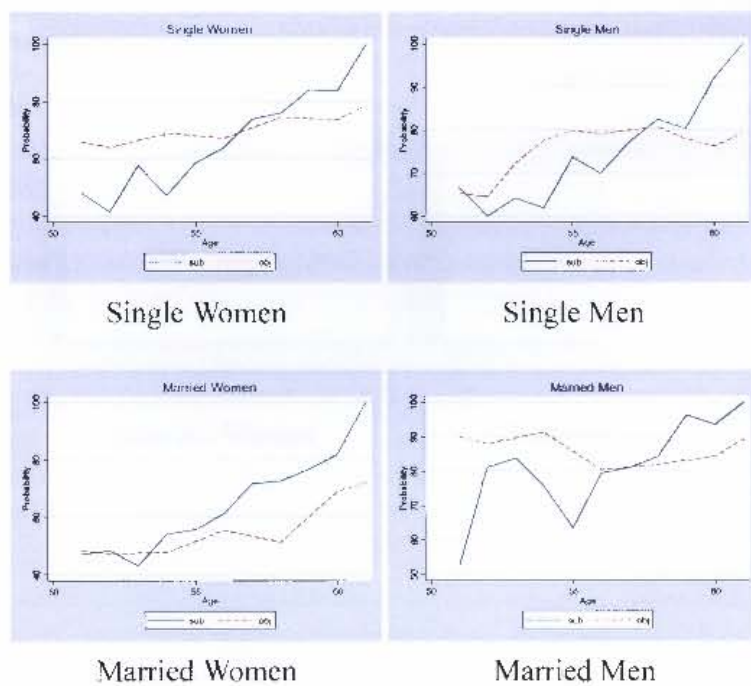


Figure 3.6: 100 Consistently

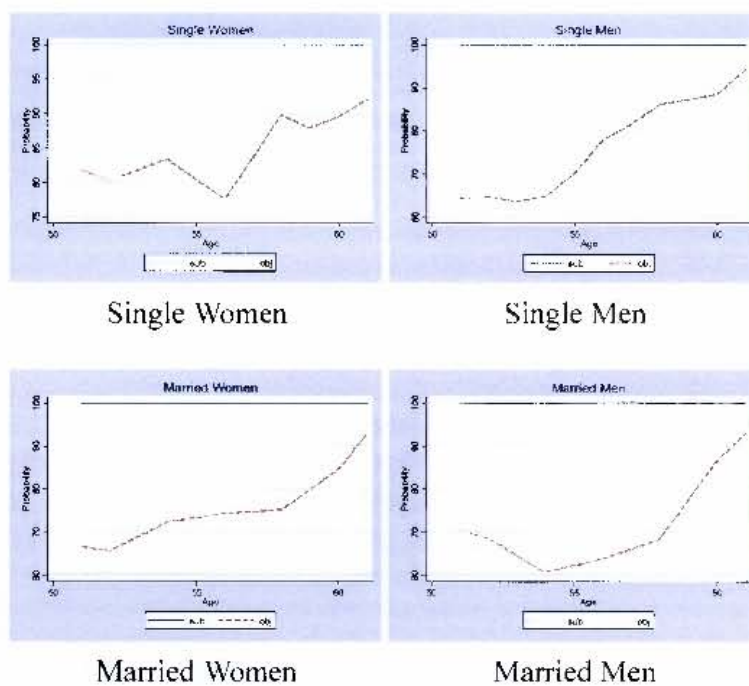


Figure 3.7: Zero from Precise

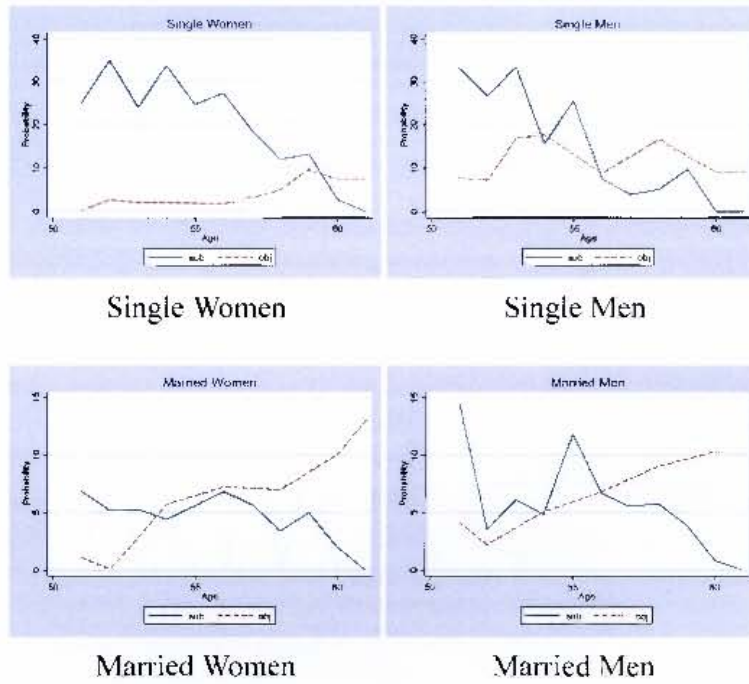
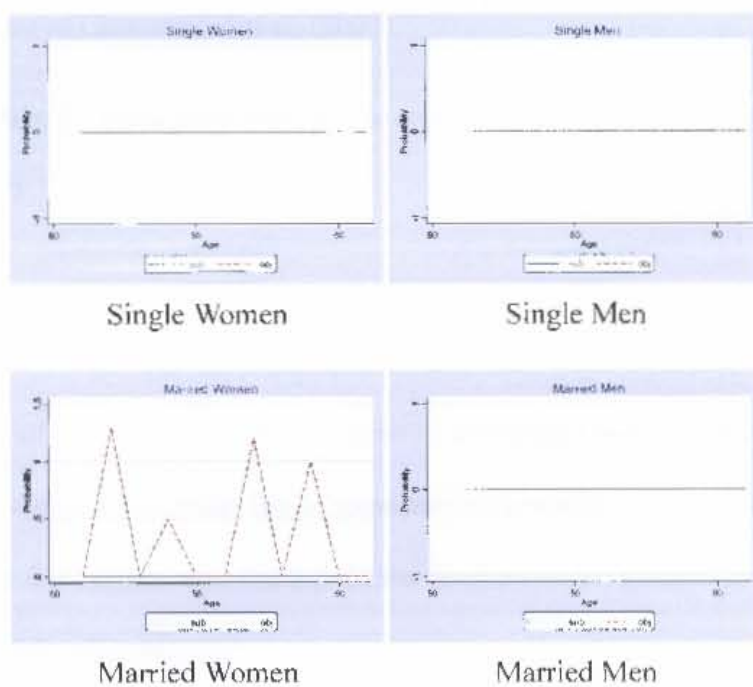


Figure 3.8: Zero Consistently



### 3.4 Theoretical Framework

We assume that subjective probabilities are *non-additive beliefs*. Non-additive beliefs account for individuals exhibiting *ambiguity attitudes* in the sense of Schmeidler (1989). Individuals displaying such non-additive beliefs can be described as Choquet Expected Utility (CEU) decision makers, in that they maximize utility with respect to non-additive beliefs. In particular, the non-additive belief is a *neo-additive capacity* in the sense of Chateauneuf et al. (2007).

**Definition 1** For a given measurable space  $(S, \Sigma, \nu)$ , the neo-additive capacity,  $v$ , is given by

$$v(E) = \delta \cdot (\lambda \cdot w^0(E) + (1 - \lambda) \cdot w^1(E)) + (1 - \delta) \cdot \mu(E) \quad (3.1)$$

for all  $E \in \Sigma$ , where  $\delta \in [0, 1]$  (degree of ambiguity) measures the lack of confidence the decision maker has in some *subjective* additive probability distribution,  $\mu$ , and  $\lambda \in [0, 1]$  measures the weight the decision maker gives to the belief  $w^0(E)$  in the face of ambiguity<sup>25</sup>.

Now

$$w^0(E) = \begin{cases} 100 & \text{if } E \neq \emptyset \\ 0 & \text{if } E = \emptyset \end{cases} \quad (3.2)$$

and

---

<sup>25</sup> In general, the literature terms  $\lambda$ , the degree of optimism. In our context, however, we do not use the terminologies, optimism and pessimism, since, while some individuals might consider working after age 62 a good thing, others might see it a bad thing.

$$w^1(E) = \begin{cases} 0 & \text{if } E \neq S \\ 100 & \text{if } E = S \end{cases} \quad (3.3)$$

Let us write the event that the agent works past age 62 as  $w_{62}$ . If  $w_{62}$  is always possible, then  $w^0(E) = 100$ .<sup>26</sup> If it is also possible not to work past age 62, then  $w^1(E) = 0$ . The neo-additive capacity then reduces to

$$v(62) = 100 \cdot (\delta \cdot \lambda) + (1 - \delta) \cdot \mu(62) \quad (3.4)$$

Now, the greater is  $\lambda$ , the more weight will be given to the belief  $w^0(w_{62}) = 100$ , for a given level of ambiguity. If  $\lambda = 0$ , no weight is given to the belief  $w^0(w_{62}) = 100$ . In other words, the greater is  $\lambda$ , the more weight will be placed on the belief that the agent will, with absolute certainty, work past age 62. If  $\lambda=1$ , a weight of  $\delta$  will be placed on the belief that the agent will, with absolute certainty, work past age 62. If  $\lambda=0$ , a weight of  $\delta$  will be placed on the belief that an agent will with absolute certainty, *not* work past age 62. In both instances, a weight  $(1 - \delta)$  will be placed on the additive probability,  $\mu(62)$ , as it is perceived by the agent. At the same time, as the level of ambiguity,  $\delta$ , increases for a given level of  $\lambda$ , less weight is placed on the additive probability,  $\mu(62)$ . If  $\delta = 0$ , the capacity reduces to the additive probability, and the agent is “rational”. If  $\lambda = 1$ , the neo-additive capacity displays an upward bias from the additive probability, while if  $\lambda = 0$ , it displays a downward bias.

---

<sup>26</sup> Note that we use a scale of 0 to 100, since this is the scale used in the data. A belief  $w^0(E) = 100$  corresponds to  $w^0(E) = 1$  on a 0-1 scale.

Now using the notation of Ludwig and Zimmer (2008), let  $\pi_{j,62}$  denote the true probability of an agent of age  $j$  working past age 62. The agent's subjective belief about this probability is denoted  $\tilde{\pi}_{j,62}$ . His estimator about  $\pi_{j,62}$  is then the choquet expected value of  $\tilde{\pi}_{j,62}$  (referred to from now simply as  $\tilde{\pi}$ ) with respect to the neo-additive capacity  $v$ .

$$E[\tilde{\pi}, v] = 100 \cdot (\delta \cdot \lambda) + (1 - \delta) \cdot E(\tilde{\pi}, \mu) \quad (3.5)$$

where

$$E(\tilde{\pi}_{j,62}, \mu) = \phi^{62-j} \cdot \pi_{j,62} \quad (3.6)$$

We can interpret a focal point answer of 100, as a neo-additive capacity in the extreme case where  $\lambda = 1$ , and  $\delta = 1$ , and a focal point answer of 0, as a neo-additive capacity with  $\lambda = 0$ , and  $\delta = 1$ .

How do we account for precise responses becoming focal point responses as age 62 approaches? Gilboa and Schmeidler (1993) and Eichberger et al. (2006) present various update rules for non-additive measures. Applying *The Generalized Bayesian Update Rule* to our neo-additive capacity, we have,

$$E[\tilde{\pi}, v(\cdot|I_h)] = 100 \cdot (\delta_{I_h} \cdot \lambda) + (1 - \delta_{I_h}) \cdot E[\tilde{\pi}, \mu(\cdot|I_h)] \quad (3.7)$$

such that

$$\delta_{I_h} = \frac{\delta}{\delta + (1 - \delta) \cdot \mu(I_h)} \quad (3.8)$$

$$= \frac{\delta}{\delta + (1 - \delta) \cdot \left(\frac{1}{1+h}\right)} \quad (3.9)$$

and

$$E[\tilde{\pi}, \mu(\cdot|I_h)] = \left( \frac{2\phi^{62-j} + h}{2 + h} \right) \cdot \pi_{j,62} \quad (3.10)$$

where  $E[\tilde{\pi}, v(\cdot|I_h)]$  represents the agent's posterior belief that he will work full time after age 62 given the information he has after  $h$  years experience. Following Ludwig and Zimmer, we assume that  $I_h$  is more specifically represented by  $I_{n(h)}^k$ . That is, we assume that after  $h$  years experience, the agent observes that  $k$  out of  $n$  people have worked past age 62. We assume for simplicity that the agent starts learning at age 51, such that age 51 corresponds to  $h = 1$ . Further, following Ludwig and Zimmer (2008), we assume,  $\mu(I_h) = \left( \frac{1}{1+h} \right)$ . The proof of this can be seen in that paper. Proof of equation 3.8 is derived by Ludwig and Zimmer (2008, 2009), and is replicated in the appendix to this chapter.

It should be clear that  $\delta_{I_h} > \delta$ , so that  $\delta_h > \delta_{h-1}$ . Thus, as time goes on, and the agent gathers more and more information,  $\delta \rightarrow 1$ , such that the capacities of individuals with  $\lambda = 1$  tend to 100. Thus, individuals in our sample who have  $\lambda = 1$  will be inclined to give focal point answer of 100 as time goes on<sup>27</sup>. Similarly, the capacities of individuals with  $\lambda = 0$  tend to 0. Thus, individuals in our sample who have  $\lambda = 0$  will be inclined to give focal point answer of 0 as time goes on.

However, we have noted that in the sample of individuals who only ever give precise responses, as well as those giving an answer of 100 consistently, there is generally convergence of the subjective probability to the objective probability. In the

---

<sup>27</sup> Note that even if the capacity is very close to 100, there would probably be some tendency to round to 100.

sample of individuals giving an answer of zero consistently, the subjective and objective measures coincide from the outset. It is, thus, likely that the subjective probabilities of these groups are additive measures. We have rational Bayesian learning as individuals' perception of the additive probability,  $\tilde{\pi}_{j,62}$ , converges to the true additive probability,  $\pi_{j,62}$ , with increasing information and experience. That is, if  $\delta = 0$ , then after  $h$  years experience

$$E[\tilde{\pi}, v(\cdot)|I_h] = \left( \frac{2\phi^{62-j} + h}{2 + h} \right) \cdot \pi_{j,62} \quad (3.11)$$

As a whole the population tends to behave like the *representative agent* discussed in Ludwig and Zimmer (2008). This agent displays rational Bayesian learning, together with increasing psychological bias as time goes on.

### 3.5 Estimating Parameters for the model

We now estimate parameters for the model/s proposed above. We estimate the parameters based on the average subjective probabilities in each age group— that is, we attempt to fit the curves in the various diagrams above. We estimate parameters for three different samples. First, we estimate the parameters of a rational Bayesian learning model for the sample of individuals not giving focal point responses. We then estimate a “rational Bayesian learning, with psychological bias” model for individuals who give focal point responses that arise from precise responses. Lastly, we estimate a “rational Bayesian learning, with psychological bias” model for the

sample representative of the population as a whole. We use non-linear regression analysis, trying different starting values to make sure we have unique convergence.

Table 3.2 presents our estimates of  $\phi$  for our sample of Bayesian learners, while figure 3.9, diagrammatically shows the actual and predicted values of the subjective probabilities. In all instances we have an initial overestimation ( $\phi > 1$ ), with the fit of the model being very good—Note the high  $\bar{R}^2$  values, as well as the fitted curves in figure 3.9. Table 3.3 presents our estimates for the sample of individuals who give focal point responses of 100 that arise from precise responses. We restrict  $\lambda$  to be equal to 1 and estimate  $\delta$  and  $\phi$ . Here we have an initial underestimation in all cases ( $\phi < 1$ ). The  $\bar{R}^2$  values, as well as the fitted curves in figure 3.10 show a very good fit. In Table 3.4 we show our estimates of  $\phi$  and  $\delta$  for the sample of individuals who give focal point responses of zero that arise from precise answers. Here we restrict  $\lambda$  to be equal to zero. We have an initial overestimation. The  $\bar{R}^2$  values and figure 3.11 show that the fit is better for men than for women. In figures 3.12 and 3.13, we show the path of the estimated  $\delta$  for these focal point responses that arise from precise responses. Finally, in Table 3.5 we estimate  $\phi$ ,  $\delta$ , and  $\lambda$  for the sample representative of the population as a whole. The  $\bar{R}^2$  values and figure 3.14 show an excellent fit.

	SINGLE WOMEN	SINGLE MEN	MARRIED WOMEN	MARRIED MEN
$\phi$	1.06 (278)	1.06 (294)	1.12 (73.15)	1.01 (376)
$\overline{R}^2$	0.99	0.99	0.92	0.99

Table 3.2: Parameter Estimates-Bayesian Learning

	SINGLE WOMEN	SINGLE MEN	MARRIED WOMEN	MARRIED MEN
$\phi$	0.66 (7.72)	0.31 (0.61)	0.94 (32.49)	0.94 (35.10)
$\delta$	0.2 (2.49)	0.33 (11.08)	0.28 (3.44)	0.3 (1.49)
$\overline{R}^2$	0.99	0.99	0.99	0.93

Table 3.3: Parameter Estimates- 100 Arising from Precise

	SINGLE WOMEN	SINGLE MEN	MARRIED WOMEN	MARRIED MEN
$\phi$	1.22 (32.87)	1.23 (29.72)	1.22 (16.48)	1.17 (43.84)
$\delta$	0.2 (1.9)	0.30 (2.91)	0.3 (2.47)	0.2 (3.31)
$\overline{R}^2$	0.64	0.92	0.73	0.90

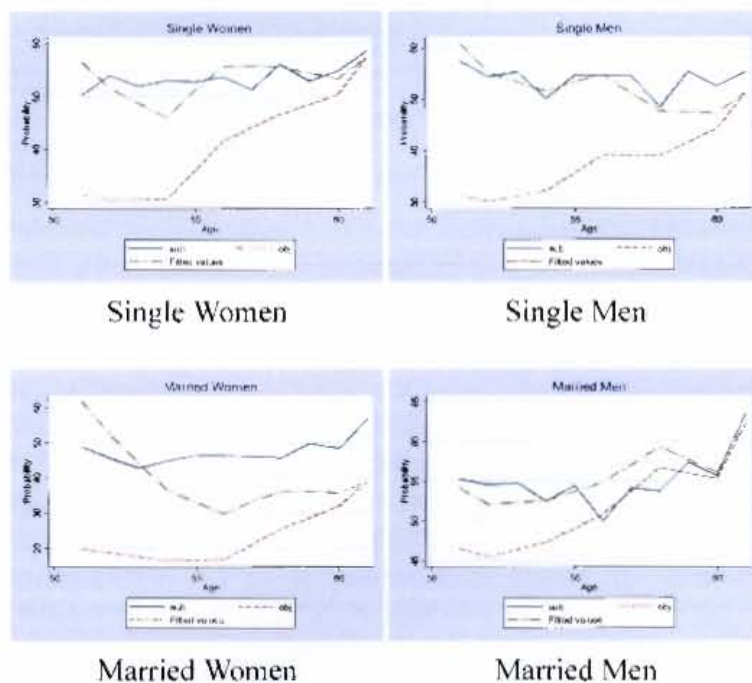
Table 3.4: Parameter Estimates- Zero Arising from Precise

	SINGLE WOMEN	SINGLE MEN	MARRIED WOMEN	MARRIED MEN
$\phi$	1.02 (205)	0.38 (0.8)	0.362 (0.5)	0.28 (0.5)
$\delta$	0.03 (0.9)	0.67 (6.03)	0.69 (5.12)	0.72 (8.29)
$\lambda$	0.88 (1.98)	0.56 (18.47)	0.48 (16.05)	0.57 (28)
$\overline{R}^2$	0.99	0.99	0.99	0.99

Table 3.5: Parameter Estimates- Whole Population

For all tables, t values are in parentheses.

Figure 3.9: Fitted Values-No Focal Points



Single Women

Single Men

Married Women

Married Men

Figure 3.10: Fitted Values- 100 from Precise

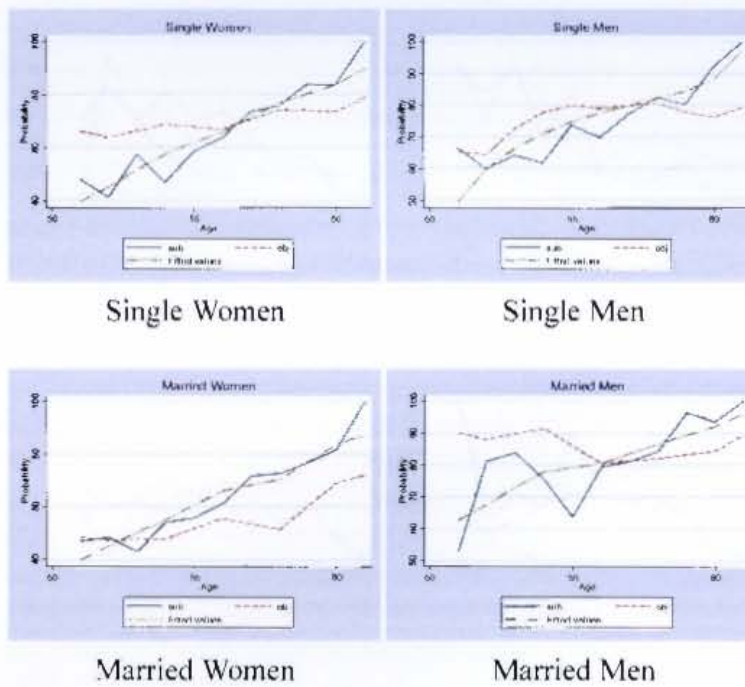


Figure 3.11: Fitted Values -Zero from Precise

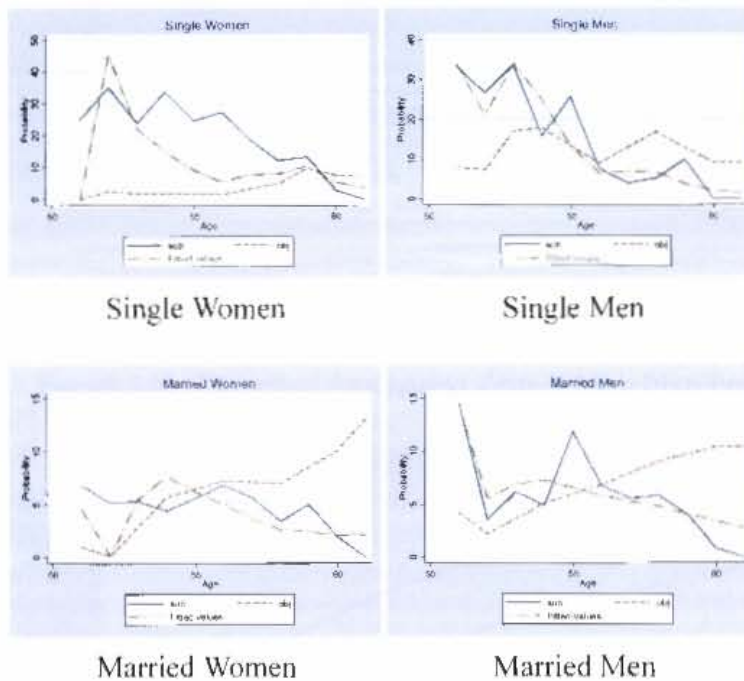


Figure 3.12: Degree of Ambiguity: 100 Arising from Precise

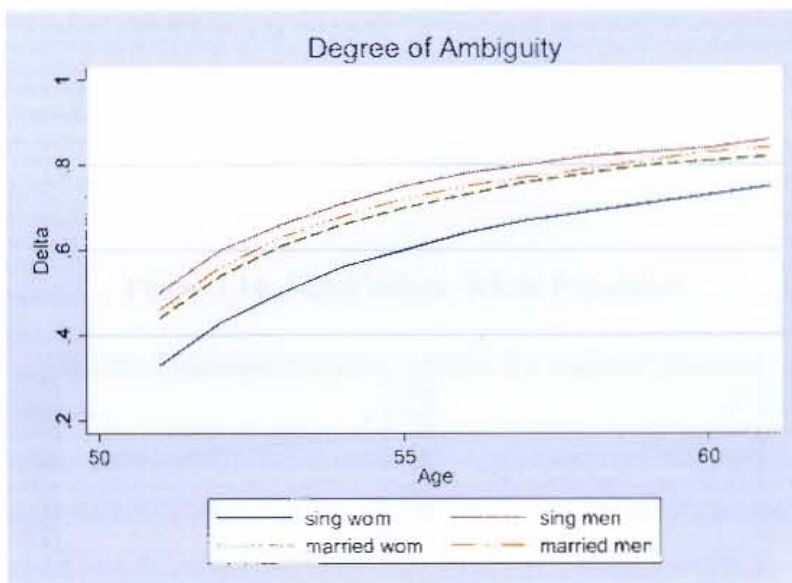


Figure 3.13: Degree of Ambiguity: Zero Arising from Precise

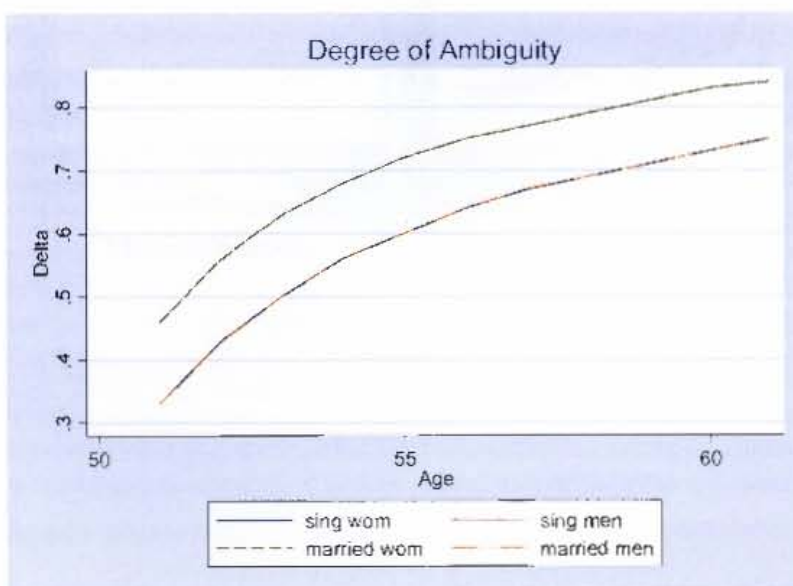
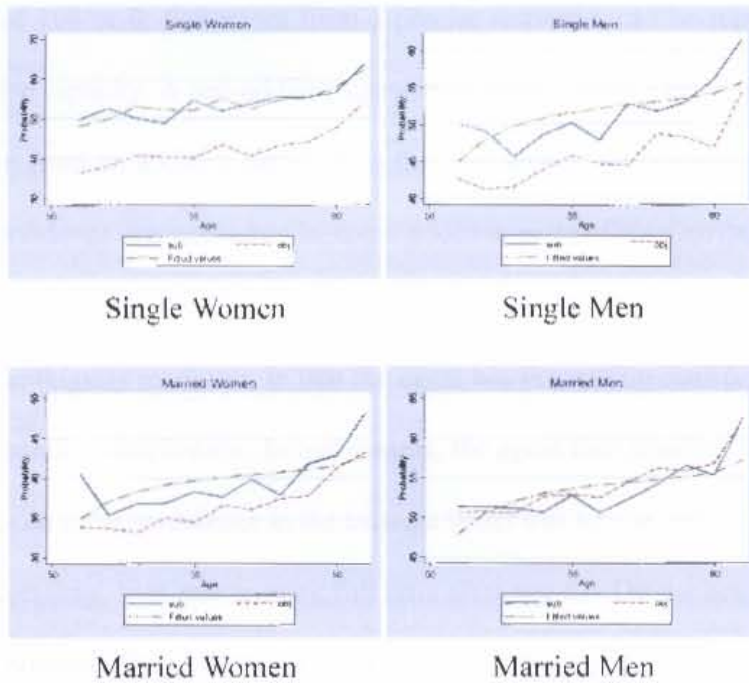


Figure 3.14: Fitted Values -Whole Population



### 3.6 Conclusion

The aim of this chapter is to show that our formal interpretation of focal point answers as neo-additive capacities is consistent with the features of the data. In fact, the fit of the data to our model is very good.

Focal point responses of 100 or 0 closer to age 62, that arise from precise responses, are biased upwards and downwards respectively. In particular, a focal point response of 100 or 0, that arises from a precise response, can be represented by a neo-additive capacity. A neo-additive capacity is a non-additive belief that represents a deviation from an additive belief, such that the degree of ambiguity measures the lack of confidence the agent has in some additive probability distribution. As this belief is updated over time according to the *Generalized Bayesian Update Rule*, the degree of ambiguity increases, in that the agent has decreasing confidence in the additive probability distribution. In our context, the agent then resolves this ambiguity by having complete confidence in the extreme belief that he/she will, or will not, with absolute certainty, continue to work full time after age 62. On the contrary, individuals who consistently give precise responses, or, who consistently give focal point responses over the questioning horizon, are rational, in the sense that their subjective probabilities coincide with the objective probabilities, at least by the time they are close to age 62. These responses can be represented by additive probabilities.

This, together with the observation that, with the exception of married men, the proportion of zeros that arise from precise responses is small relative to the proportion

of 100's that arise from precise answers, explains the persistence of the upward bias in the sample of the population as a whole, even as age 62 approaches.

As a final point, we note that while it appeared at the outset that married men were more rational than other individuals, after decomposing the data further we see that this is not the case. While heterogeneity in gender and marital status might influence the level of retirement expectations, it does not influence the rationality of such. The absence of an upward bias in the subjective probability of working past age 62 close to age 62 for married men, is not due to them being more rational, but rather due to the positive and negative biases of focal points of 100 and 0 respectively cancelling each other out .

### 3.A Appendix to Chapter 3

Let the event  $E$  be such that the agent works full time after age 62. Applying the generalized Bayesian update rule to the neo-additive capacity,  $\nu$ , we have<sup>28</sup>:

$$\begin{aligned}
 v_{I_h}(E) &= \frac{\delta \cdot \lambda + (1 - \delta) \cdot \mu(E \cap I_h)}{\delta \cdot \lambda + (1 - \delta) \cdot \mu((E \cap I_h)) + 1 - (\delta \cdot \lambda + (1 - \delta) \cdot \mu(E \cup \neg I_h))} \\
 &= \frac{\delta \cdot \lambda + (1 - \delta) \cdot \mu(E \cap I_h)}{1 + (1 - \delta) \cdot (\mu(E \cap I_h) - \mu(E \cup \neg I_h))} \\
 &= \frac{\delta \cdot \lambda + (1 - \delta) \cdot \mu(E \cap I_h)}{1 + (1 - \delta) \cdot (\mu(E \cap I_h) - \mu(E) - \mu(\neg I_h) + \mu(E \cap \neg I_h))} \\
 &= \frac{\delta \cdot \lambda + (1 - \delta) \cdot \mu(E \cap I_h)}{1 + (1 - \delta) \cdot (-\mu(\neg I_h))} \\
 &= \frac{\delta \cdot \lambda + (1 - \delta) \cdot \mu(E \cap I_h)}{1 + (1 - \delta) \cdot (\mu(I_h) - 1)} \\
 &= \frac{\delta \cdot \lambda + (1 - \delta) \cdot \mu(E \cap I_h)}{1 + (1 - \delta) \cdot \mu(I_h) - (1 - \delta)} \\
 &= \frac{\delta \cdot \lambda + (1 - \delta) \cdot \mu(E \cap I_h)}{\delta + (1 - \delta) \cdot \mu(I_h)} \\
 &= \frac{\delta \cdot \lambda}{\delta + (1 - \delta) \cdot \mu(I_h)} + \frac{(1 - \delta) \cdot \mu(I_h)}{\delta + (1 - \delta) \cdot \mu(I_h)} \cdot \mu(E | I_h) \\
 &= \delta_{I_h} \cdot \lambda + (1 - \delta_{I_h}) \cdot \mu(E | I_h)
 \end{aligned}$$

where

$$\delta_{I_h} = \frac{\delta}{\delta + (1 - \delta) \cdot \mu(I_h)}.$$

---

<sup>28</sup> We assume, for simplicity, a 0-1 scale for the purpose of this proof.

## Concluding Remarks and Outlook

In the context of the life-cycle theory of consumption and saving, the most important parameter governing an individual's saving decision is the expected length of his retirement horizon. This, in turn, is governed by both his expected longevity, and his expected date of retirement. The focus of this thesis has been on theoretical and empirical questions concerning the expected date of retirement. In the wake of the aging of the baby boomers and greater longevity in general, governments are desperately attempting to keep their public pension funds solvent by instituting policies to increase average retirement ages. As we argue in Chapter 1, however, these governments need to be aware of the adverse effects these policies have on private savings behavior. In fact, due to the tendency for retirement date expectations to be biased upwards, the population is likely to overreact to such policies. In an attempt to avert a pension crisis, governments might be, inadvertently, exacerbating the savings crisis.

From a theoretical perspective, we show that later retirement dates should induce younger individuals to save less, whereby this relative effect is greater when preferences are non-separable in consumption and leisure, and in particular, when the cross-derivative of the utility function is negative. From an empirical perspective, the point estimates suggest that the responsiveness of Americans' saving decisions to retirement date expectations is large. A ten percentage point increase in the household subjective probability of working past age 62, results—in most cases—in a decrease

in household wealth well in excess of 20%. At the same time, we know that greater longevity should induce younger individuals to save more in the face of a longer expected retirement horizon. However, the Bloom et al (2007) study showed that only couples respond to survival expectations when making saving decisions. In contrast, single individuals seem unresponsive to such survival expectations in their wealth accumulation decisions. Our study provides a stronger result. Our regressions in Chapter 2 show that when retirement expectations are controlled for, neither single nor married couples seem to respond to survival expectations in wealth accumulation decisions. In light of this, individuals responding to later expected retirement dates, but not to their increased longevity, are likely to save far less over the life-cycle than predicted by standard models of consumption smoothing. That is, individuals are likely to reach retirement with inadequate savings, to the extent that they are forced to drop their consumption levels at this point.

In addition, Chapter 3 demonstrates that retirement date expectations are biased upwards, that is, individuals expect to work longer than they actually do. This, coupled with the empirical fact that survival probabilities are biased downwards at *pre-retirement* ages (cf., Ludwig and Zimmer, 2008), implies that individuals are grossly underestimating their retirement horizons. Of course, this once again implies that individuals will be undersaving for retirement. In fact, we show that there is a subset

of the population for which the upward bias in the probability of working past age 62 gets larger and larger as age 62 approaches. These are individuals who give focal point answers of 100 close to age 62, but precise responses at younger ages. Such individuals are likely to exhibit dynamically inconsistent saving behavior, in the sense that they perceive an increasingly lesser need to save as retirement approaches. An interesting avenue for future research would be to follow the consumption/ saving behavior of such individuals over the panel in order to empirically verify the existence of such dynamically inconsistent saving behavior. It would also be interesting to observe how these individuals react when they reach retirement. Do they experience a greater drop in consumption at this point than do “rational” individuals?

In concluding this thesis, we take note of three caveats. Firstly, we need to acknowledge that we are *not* analyzing *aggregate* saving. Aggregate saving is determined by the aggregation of the saving of the young and the dissaving of the old. In addition to the behavioral effects of individual saving behavior addressed in this thesis, there is a compositional element at the aggregate level which is induced by a change in retirement dates. That is, with later retirement dates there is an increase in the percentage of the working population relative to the non-working population. This compositional effect implies that there is also a greater percentage of savers. Thus, while the aim of this thesis is to study how later retirement dates affect the saving behavior of the individual,

we also need to be aware that at the aggregate level there is a positive compositional effect in addition to this negative behavioral effect.

However, to the extent that the later retirement date remains an expectation, there is a behavioral effect that has not yet translated into a compositional effect. Policies to raise the retirement age are implemented gradually, with retirees at the time of the passing of the laws not being effected at all. While current US retirees are now retiring later than did their older counterparts a few years back, younger Americans can expect to retire even later than those retiring today. In some other OECD countries, individuals of retirement age are yet to experience the effect of such policies. In addition, there is talk to raise the Normal Retirement Age even further. Thus, to a large degree, these later retirement dates are still to come into effect and have not yet translated into a compositional effect. It is the *expectation* of later retirement that induces a negative behavioral effect on saving, and there is no doubt that such expectation is certainly present.

Preliminary research (cf., Romm and Wolny, 2010), looking at the effect of later retirement on aggregate savings, suggests that even once later retirement has come into effect, the behavioral effect dominates the compositional effect. By looking at countries where average retirement ages have already started rising, we establish a negative causal relationship between later retirement ages and aggregate savings, suggesting a very strong negative behavioral effect. Future research, however, might differentiate

between those countries where there is an expectation that the retirement age will increase further, and those where there is less of an expectation. This would allow us to compare the relative strengths of the behavioral effect in these different cases.

As a second caveat, we acknowledge that within the Choquet Expected Utility paradigm, biases in expectations are usually thought about in terms of *optimism* and *pessimism*. In this thesis, however, we deliberately omit this terminology, since it is our view that whether retiring later is considered a good or bad event, is a matter of preference. In future research we plan to look more closely at the characteristics of those individuals giving focal point responses of 100 and zero close to retirement, in an attempt to ascertain which of these individuals are displaying optimism, and which, pessimism. For example, are individuals giving focal point responses of zero close to retirement in bad health, or, do they simply perceive themselves to be very wealthy? While, in the first instance such individuals would be displaying pessimism, in the second instance they would be displaying optimism. In addition, it would be interesting to address the question as to whether the propensity to give a focal point response in this domain, translates into a propensity to give focal point responses in other domains. That is, do individuals have a general tendency to be optimistic or pessimistic, or is such psychological bias restricted to a particular issue, or perhaps to a few related issues? For Example, do individuals who give a zero response to the question regarding the probability of working past age 62, also give such a zero

response to the question regarding the probability of living till age 75? Do they give focal point responses to all subjective probability questions?

As a final caveat, we note that preferences for retirement are likely to be a cultural issue that differs between countries. For example, various estimates for the US suggest that—on average— individuals display a preference for leisure. Laitner and Silverman (2005), and Mazzocco (2005) show that leisure is more heavily weighted in individuals' utility functions than consumption, with Mazzocco showing this weighting to be higher for females than males. Van Soest et al (2006), and Vaňková and Van Soest (2009) use stated preferences data to analyze preferences for retirement in The Netherlands. While preferences for different retirement trajectories are analyzed, in general it seems that the Dutch do *not* display a preference for later retirement. Further, Van Soest et al (2006) show that while better educated individuals prefer relatively later retirement, women and those in poor health display a preference for earlier retirement. Vaňková and Van Soest (2009) recommend that later retirement be encouraged by providing financial incentives for phased retirement. Esser (2006) analyzes preferred retirement dates for twelve European countries. In all cases, preferred retirement dates are lower than both expected retirement dates, and statutory retirement dates. Furthermore, in the UK, Ireland, Italy, France and Belgium, the preference for earlier retirement is greater than in Germany, Sweden and Finland, with latest retirement being preferred in Denmark. Knowledge and understanding of such differences

in national retirement preferences is vital in implementing appropriate policies aimed at increasing average retirement ages, whereby such policies should be fine-tuned to meet the preferences of each particular country.

## References

- [1] Abbot, M., and O. Ashenfelter (1976). "Labor supply, Commodity Demand and the Allocation of Time," *Review of Economic Studies*, 43(3), 389-411.
- [2] Abbot, M., and O. Ashenfelter (1979). "Labor supply, Commodity Demand and the Allocation of Time: Correction," *Review of Economic Studies*, 46(3), 567-69.
- [3] Altig, D., A.J. Auerbach, L.J. Kotlikoff, K.Smetters, and J.Walliser (2001). "Simulating Fundamental Tax Reform in the United States," *American Economic Review*, 91(3), 574-95.
- [4] Angeletos, G.M., D. Laibson, A. Repetto, J. Tobacman, and S. Weinberg (2001). "The Hyperbolic Consumption Model: Calibration, Simulation, and Empirical Evaluation," *Journal of Economic Perspectives* 15(3), 47-68.
- [5] Atkinson, A., N.H. Stern, and J. Gomulka (1981). "On Labour Supply and Commodity Demands," in *Essays in the Theory and Measurement of Consumer Behavior in Honour of Sir Richard Stone* (ed A.S Deaton), Cambridge University Press.
- [6] Attanasio, O.P., and G. Webber (1995). "Is Consumption Growth Consistent with Intertemporal Optimization? Evidence from the Consumer Expenditure Survey," *Journal of Political Economy*, 103(6), 1121-57.
- [7] Auerbach, A.J., and L.J. Kotlikoff (1987). "Evaluating Fiscal Policy with a Dynamic Simulation Model," *American Economic Review*, 77(2), 49-55.
- [8] Banks, J., R. Blundell, and R.Tanner (1998). "Is there a Retirement-Savings Puzzle?" *American Economic Review*, 88(4), 769-788.
- [9] Barnett, W.A. (1979). "Theoretical Foundations for the Rotterdam Model," *Review of Economic Studies*, 46(1), 109-130.
- [10] Barnett, W.A. (1981). "Consumer Demand and Labor Supply," North Holland, Amsterdam.

- [11] Barsky, R., M. Kimball, F.T. Juster, and M. Shapiro (1997). "Preference Parameters and Behavioral Heterogeneity: An Experimental Approach in the Health and Retirement Study," *Quarterly Journal of Economics*, 112, 537-579.
- [12] Basset, W.F., and R.L. Lumsdaine (2001). "Probability Limits," *Journal of Human Resources*, 36(2), 327-363.
- [13] Basu, S., and M. Kimball (2002). "Long Run Labour Supply and the Elasticity of Intertemporal Substitution for Consumption," Working Paper, University of Michigan at Ann Arbor.
- [14] Benitez-Silva, H., and D.S. Dwyer, (2005). "The Rationality of Retirement Expectations and the Role of New Information," *Review of Economics and Statistics*, 87(3), 587-592.
- [15] Bernheim, D.B., J. Skinner, and S. Weinberg (2001). "What Accounts for the Variation in Retirement Wealth among U.S Households?" *American Economic Review*, 91(4), 832-857.
- [16] Blackorby, C., D. Primont, and R.R. Russel (1978). "Duality, Separability and Functional Structure: Theory and Economic Applications," New York, North Holland.
- [17] Blau, D.M., and R.M.. Goodstein (2010). "Can Social Security Explain Trends in Labor Force Participation of Older Men in the United States?" *Journal of Human Resources*, 45(2), 328-363.
- [18] Bloom, D., D. Canning, M. Moore, and Y. Song (2007). "The Effect of Subjective Survival Probabilities on Retirement and Wealth in the US," In Robert Clark, Andrew Mason and Naohiro Ogawa (eds), *Population Aging, Intergenerational Transfers and the Macroeconomy*.
- [19] Börsch-Supan, A. (1998). "Subjective Survival Curves and Life Cycle Behavior," In D.A Wise (Ed), *Inquiries in the Economics of Aging*, 306-309, Chicago University Press.
- [20] Browning, M., A. Deaton, and M. Irish (1985). "A profitable Approach to Labor Supply and Commodity Demands over the Life-cycle," *Econometrica*, 53(3), 503-543.

- [21] Browning, M., and C. Meghir (1989). "Testing for Separability of Commodity Demands from Male and Female Labor Supply," IFS-Working Paper Series, 89/4, Institute of Fiscal Studies, London.
- [22] Bruine de Bruin, W., B. Fischhoff, S.G. Millstein, and B.C. Halpern-Felsher (2000). "Verbal and Numerical Expressions of Probability: Its a Fifty-Fifty Chance," *Organizational Behavior and Human Decision Processes*, 81, 115-131.
- [23] Burbidge, J.B., L. Magee, and A.L. Robb (1988). "Alternative Transformations to Handle Extreme Values of the Dependent Variable," *Journal of the American Statistical Association*, 83(401), 123-127.
- [24] Chateauneuf, A., J. Eichberger and S. Grant (2007). "Choice Under Uncertainty with the Best and Worst in Mind: Neo-Additive Capacities," *Journal of Economic Theory*, 127, 538-567.
- [25] Carroll, C.D., and A.A. Samwick (1997). "The Nature of Precautionary Wealth," *Journal of Monetary Economics*, 40(1), 41-71.
- [26] Carroll, C.D., and A.A. Samwick (1998). "How important is Precautionary Saving," *The Review of Economic and Statistics*, 80(3), 410-419.
- [27] Carroll, C.D., K.E. Dynan, and S.D. Krane (2003). "Unemployment Risk and Precautionary Wealth: Evidence from Households' Balance Sheets," *Review of Economics and Statistics*, 85(3), 586-604.
- [28] Cobb-Clark, D.A., and V.A. Hildebrand (2006). "The Wealth and Asset Holdings of U.S Born and Foreign Born Households: Evidence from SIPP data," *Review of Income and Wealth*. 52(1), 17-42.
- [29] Deaton, A. (1982). "Model Selection Procedures, or Does the Consumption Function Exist," in G.C Chow and P.Corsi (eds) *Evaluating the Reliability of Macroeconomic Models*, Wiley, New York.
- [30] Diamond, P.A., and J.A. Hausman (1984). "Individual Retirement and Saving Behavior," *Journal of Public Economics*, 23(1-2), 81-114.
- [31] Diamond, J.W., and G.R. Zodrow (2007). "Economic Effects of a Personal Capital-Income Tax Add On to a Flat Tax," *FinanzArchiv: Public Finance Analysis*, Mohr Siebeck, Tübingen, 63(3), 374-395.

- [32] Diamond, J.W., and G.R. Zodrow (2008). "Fundamental Tax Reform: Issues, Choices and Implications," MIT Press Books.
- [33] Disney, R., and S. Tanner (1998). "What can we Learn from Retirement Expectations Data?" IFS working Paper Series No W99/17.
- [34] Eichberger, J., S. Grant and D. Kelsey (2006). "Updating Choquet Beliefs," *Journal of Mathematical Economics*, 43, 888-899.
- [35] Engen, E.M., and W. Gale (2000). "The effects of 401(k) plans on Household Wealth: Differences Across Earnings Groups," NBER Working Paper 8032.
- [36] Esser, I. (2006). "Continued Work or Retirement: Preferred Exit Age in Western European Countries," Ch 2 in *Ageing and the Labour Market: Issues and Solutions. Or are there?*, Vol 12, FISS Series of International Studies on Social Security, edited by H. Emanuel.
- [37] Forni, L. (2003). "An Analysis of Retirement Expectations and Realizations: Evidence from the US Health and Retirement Survey," in *Recherche Quantitative per la Politica Economica*, Bank of Italy.
- [38] Fougère, M., S. Harvey, J. Mercenier, and M. Mérette (2005). "Economic Benefits of Working Longer, and the Financing of Social Security in Canada," Working Paper, Département de Science Économique et Thema, Université Cergy-Pontoise, Paris.
- [39] French, E. (2005). "The Effect of Health, Wealth and Wages on Labor Supply and Retirement Behavior," *Review of Economic Studies*, 72(2), 395-427.
- [40] Friedman, M. (1957). "A Theory of the Consumption Function," NBER, Princeton.
- [41] Ghez, G., and G.S. Becker (1975). "The Allocation of time and Goods over the Life-cycle," New York, Columbia University Press.
- [42] Gilboa, I., and D. Schmeidler (1993). "Updating Ambiguous Beliefs," *Journal of Economic Theory*, 59, 33-49.
- [43] Haider, S.J., and M. Stephens (2007). "Is there a Retirement-Consumption Puzzle? Evidence Using Subjective Retirement Expectations," *Review of Economics and Statistics*, 89(2), 247-264.

- [44] Ham, J.C., and K.T. Reilly (2002). "Testing Intertemporal substitution, Implicit Contracts and Hours Restriction Models of the Labor Market Using Micro Data," *American Economic Review*, 92(4), 905-927.
- [45] Heckman, J. (1974). "Life Cycle Consumption and Labor Supply: An Explanation of the Relationship between Income and Consumption over the Life-cycle," *American Economic Review*, 64(1), 188-94.
- [46] Hill, D., M. Perry, and R. Willis (2004). "Estimating Knightian Uncertainty from Survival Probability Questions on the HRS," Unpublished Manuscript, University of Michigan.
- [47] Hurd, M.D., and K. McGarry (1993a). "The Relationship between Job Characteristics and Retirement," Working Paper 4558, National Bureau of Economic Research, Cambridge, MA.
- [48] Hurd, M.D., and K. McGarry (1993b). "Evaluation of Subjective Probability Distributions in the HRS," Working Paper 4560, National Bureau of Economic Research, Cambridge, MA.
- [49] Hurd, M.D., and K. McGarry (1995). "Evaluation of the Subjective Probabilities of Survival," *Journal of Human Resources*, 30 (supplement), 268-92.
- [50] Hurd, M.D., D.McFadden, and L. Gan (1998). "Subjective Survival Curves and Life Cycle Behavior," in David Wise (ed), *Inquiries in the Economics of Aging*, Chicago: University of Chicago Press.
- [51] Hurd, M.D., and S. Rohwedder (2003). "The Retirement-Consumption Puzzle: Anticipated and Actual Declines in Spending at Retirement," Working Paper 9586, National Bureau of Economic Research, Cambridge, MA.
- [52] Hurd, M.D., and S Rohwedder (2005). "Changes in Consumption and Activities at Retirement," Working Paper 096, University of Michigan, Michigan Retirement Research Centre.
- [53] Hurd, M.D., M. Reti, and S. Rohwedder (2009). "The Effect of Large Capital Gains or Losses on Retirement," in David Wise (ed), *Developments in the Economics of Aging*, NBER Chapters.
- [54] Huynh, K.P., and .J. Jung (2010). "Correcting Focal Point Biases in Subjective Health Expectations," Working Paper, Towson University.

- [55] Johnson, N.L. (1949). "Systems of Frequency Curves Generated by Methods of Translation," *Biometrika*, 36, 149-176.
- [56] Jorgenson, D.W., and L.J. Lau (1975). "The Structure of Consumer Preferences," *Annals of Social and Economic Measurement*, 4, 49-101.
- [57] Kaiser, H. (1993). "Testing for Separability between Commodity Demand and Labor Supply in West Germany," *Empirical Economics*, 18(1), 21-56.
- [58] Kapteyn, A., and C. Pannis (2003). "The Size and Composition of Wealth Holdings in the United States, Italy and the Netherlands," Working Paper 10182, National Bureau of Economic Research, Cambridge, MA.
- [59] Khawaja, A., S. Chung, and F.A. Sloan (2007). "The Relationship between Individual Expectations and Behaviors: Mortality Expectations and Smoking Decisions," *Journal of Risk and Uncertainty*, 35(2), 179-201.
- [60] Kiley, M.T. (2007). "Habit Persistence, Non-Separability between Consumption and Leisure, or Rule of Thumb Consumers: Which Accounts for the Predictability of Consumption Growth," Finance and Economics Discussion Series 48, Board of Governors of the Federal Reserve System (U.S.)
- [61] King, M.A., and L.D. Dicks-Mireaux (1982). "Asset Holdings and the Life-Cycle," *Economic Journal*, 92, 247-267.
- [62] Kleijnans, K.J., and A. Van Soest (2010). "Nonresponse and Focal Point Answers to Subjective Probability Questions," IZA Discussion Papers 5272, Institute for the Study of Labor (IZA).
- [63] Kotlikoff, L., K. Smetters, and J. Walliser (2001). "Finding a Way Out of America's Demographic Dilemma," NBER Working papers 8258, National Bureau of Economic Research.
- [64] Laibson, D. (1998). "Life Cycle Consumption and Hyperbolic Discount Functions," *European Economic Review*, 42, 861-871.
- [65] Laitner, J., and D. Silverman (2005). "Estimating Life Cycle Parameters from Consumption Behavior at Retirement," Working Paper 11163, National Bureau of Economic Research, Cambridge, MA.

- [66] Lillard, L.A., and R.J. Willis (2001). "Cognition and Wealth: The Importance of Probabilistic Thinking," Michigan Retirement Research Centre, Research paper no, WP 2001-007.
- [67] Low, H. (2005). "Self Insurance in a Life-Cycle Model of Labor Supply and Savings," *Review of Economic Dynamics*, 8(4), 945-975.
- [68] Lundberg, S.J., and J. Ward-Batts (2000). "Saving for Retirement: Household Bargaining and Household Net Worth," Econometric Society World Congress 2000 Contributed papers.
- [69] Ludwig, A., and A. Zimper (2008). "A Parsimonious Choquet Model of Subjective Life Expectancy," Working Papers, Centre for Retirement Research at Boston College, WP 20081-20.
- [70] Ludwig, A., and A. Zimper (2009). "On Attitude Polarization under Bayesian Learning with Non-Additive Beliefs," *Journal of Risk and Uncertainty*, 39(2), 181-212.
- [71] Manski, C.F., and F. Molinari (2010). "Rounding Probabilistic Expectations in Surveys," *Journal of Business and Economic Statistics*, 28(2), 219-231.
- [72] Mastrobuoni, G. (2009). "Labor Supply Effects of the Recent Social Security Benefit Cuts: Empirical Estimates Using Cohort Discontinuities," *Journal of Public Economics*, 93(11-12), 1224-1233.
- [73] Mazzocco, M. (2005). "Individual Rather than Household Euler Equations: Identification and Estimation of Individual Preferences Using Household Data," Social Science Research Network, Working Paper.
- [74] Modigliani, F., and R.H Brumberg (1954). "Utility Maximization and the Consumption Function: An Interpretation of Cross-Section Data," in *Kenneth, K Kurihara, ed, Post-Keynesian Economics*, New Brunswick, NJ. Rutgers University Press, 388-436.
- [75] Murphy, A., and R. Thom (1987). "Labour Supply and Commodity Demands: An Application to Irish Data," Open Access Publication from University College Dublin.
- [76] Pence, K. (2006). "The Role of Wealth Transformations: An Application to Estimating the Effect of Tax Incentives on Saving," *Contributions to Economic Analysis and Policy*, vol 5.

- [77] Pingle, J.F. (2006). "Social Security's Delayed Retirement Credit and the labor Supply of Older Men,". Finance and Economics Discussion Series, 2006-37, Board of Governors of the Federal Reserve System.
- [78] Purcell, P.J. (2008). "Older Workers: Employment and Retirement Trends,". Washington, DC, Congressional Research Service.
- [79] Romm, A., and M. Wolny (2010). "The Impact of Later Retirement Ages on Aggregate Saving Rates: An Analysis of OECD Countries," Working Paper, School of Economics and Business Sciences, University of the Witwatersrand.
- [80] Schirle, T. (2008). "Why have the Labor Force Participation Rates of Older Men increased since the mid 1990's?" *Journal of Labor Economics*, 26(4), 549-594.
- [81] Schmeidler, D. (1989). "Subjective Probability and Expected Utility without Additivity," *Econometrica*, 57, 571-587.
- [82] Smith, V.K., D.H. Taylor, and F.A. Sloan (2001). "Longevity Expectations and Death: Can People Predict their own demise?" *American Economic Review*, 91(4), 1126-1134.
- [83] Stokey, N., R.E. Lucas, and E. Prescott (1989). "Recursive Methods in Economic Dynamics," Harvard University Press, Cambridge, MA.
- [84] Vaňková, H., and A. Van Soest (2009). "How Sensitive are Retirement Decisions to Financial Incentives: A Stated Preference Analysis," IZA, paper No 4505.
- [85] Van Soest, A., A.Kapteyn, and J. Zissimopoulos (2006). "Using Stated Preference Data to Analyze Preferences for Full and Partial Retirement," DNB, Working Paper 081, Netherlands Central Bank, Research Department.
- [86] Wenzlow, A.T., J.Mullahy, and B. Wolfe (2004). "Understanding Racial Disparities in Health: The Income-Wealth Paradox," Institute for Research on Poverty, Discussion paper no 1283-04.
- [87] Ziliak, J.P., and T.J. Kniesner (2005). "The Effect of Income Taxation on Consumption and Labor Supply," *Journal of Labor Economics*, 23(4), 769-796.

## **Appendix A**

# **Trends in Labor Force Participation Rates of Older Workers in the US**

Data from the Current Population Survey (CPS) show labor force participation rates of men aged 62 and above, having trended downward for a large part of the 1900's, reaching a low in 1985, leveling out till about 1996, after which time they started trending upwards. In fact, for men in the age group between 65 and 69 labour force participation rates had reached levels of about 33% in March 2008, after having been at a low of 24% in 1985 and 27% in 1995. This rate is projected by the Bureau of Labor Statistics (BLS) to reach 40% by 2016. The increase in participation rates have also been noticeable for men in the 62 to 64 age group, rising from 43% in 1995 to 52% in March 2008. The projection for 2016 is 58%. While participation rates for older women did not follow the same downward trend as men before 1985 (due to the overall increase in participation rates for women), these rates have definitely been trending upwards since about 1995. In the 65 to 69 age group, labor force participation rates for women were 27% in 2008, compared to 17% in 1995 and is projected by the BLS to reach 31% by 2016. The participation rate was 41% in 2008 compared to 32% in 1995 for women in the age group 62 to 64, and is projected to reach 48% by 2016 (BLS).

There has also been an increase in older workers working full time. In 2008, 82% of men aged 62 to 64 employed, were working full time, as against 77% in 1995.

This rose from 57% in 1995 to 72% in 2008 for men in the age group 65 to 69. Of women employed in the age group 62 to 64, 65% were full time in 2008, as against 60% in 1995. For women in the age group 65 to 69, this figure rose from 43% in 1995 to 55% in 2008 (Purcell, 2008).

## **Appendix B**

# **A Brief Overview of the Structure of the Social Security Retirement System in the US**

While Social Security incentives governing retirement decisions are often complex and difficult to understand, our aim here is to provide a very brief account.

96 percent of American workers are covered by social security. Benefits are calculated based on lifetime earnings, with the 35 years of highest earnings being taken into consideration. If there were years when one did not work, or earned less, benefits will be lower than they would be had one worked steadily.

The Normal retirement age, or the age at which one can receive full benefits, is age 65 for those born before 1938, and increases by two months for those born every year thereafter. The Normal retirement age is 67 for those born in 1960 or thereafter. The earliest age at which one can receive benefits is age 62, but retiring before the normal retirement age means that benefits are permanently reduced. In fact, people retiring at age 62, will have benefits that are about 25%-30% less, than had they waited till normal retirement age to retire.

It is also possible to delay retirement past the Normal Retirement age. Social security benefits will increase in two ways. First, a higher level of lifetime earnings increases benefits. Secondly, there is an automatic increase in benefits if one works past the Normal Retirement age up until age 70. This increase depends on the year in

which one is born, and in particular, is 8% per year for those born in 1943 or thereafter. While a certain amount of research has debated the actuarial fairness of postponing retirement past the Normal Retirement age for those born before 1943, there is no question that retiring *before* the Normal Retirement age results in a permanent loss in benefits. Since, the question which we are concerned with in this research is that of working past the early retirement age of 62, it is this particular incentive that concerns us.