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Pension Reform and Retirement Incentives: Evidence from Austria

Roman Raab

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PENSION REFORM AND RETIREMENT INCENTIVES: EVIDENCE FROM AUSTRIA

BY

ROMAN RAAB

A Dissertation Submitted in Partial Fulfillment
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ACCEPTANCE

This dissertation was prepared under the direction of the candidate's Dissertation Committee. It has been approved and accepted by all members of that committee, and it has been accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Economics in the Andrew Young School of Policy Studies of Georgia State University.

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ABSTRACT

PENSION REFORM AND RETIREMENT INCENTIVES: EVIDENCE FROM AUSTRIA

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August 2008

Committee Chair: Dr. Sally Wallace

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The scope of this dissertation is to investigate the impact of pension reform on the financial incentives to retire for private sector workers in Austria. How do financial incentives embedded in the Austrian pension system affect individual retirement behavior? Was pension reform effective in changing these financial incentives in order to affect retirement behavior? How would future reform scenarios impact retirement behavior? Micro-estimating the impact of financial incentive measures on the probability of retirement shows that the behavioral response to financial incentives in Austria is relatively large in international comparison. Simulations demonstrate that pension reform was ineffective in providing incentives for delayed retirement. However, there are future reform scenarios that would have a huge impact on retirement behavior by altering the financial incentives.

CHAPTER 1

INTRODUCTION

Motivation

This dissertation deals with the financial incentives to retire in Austria. Older workers retire relatively early compared to similar OECD countries. Therefore, labor force participation of older workers is one of the lowest among OECD countries. The public pension system and its retirement policies as well as old age unemployment account for the trend to retire at the earliest possible point in time. In particular, financial incentives to retire before the statutory retirement ages are embedded in the Austrian PAYGO-pension system. These incentives are relatively high in international comparison. Moreover, politicians often tried to solve the issues of older workers on the Austrian labor market by early retirement. Even disability pensions were used to take out older workers form the labor market. Therefore, a key issue of pension reform is to bring actual retirement ages closer to the statutory retirement ages. Around the millennium, government implemented some gradual pension reforms to change retirement behavior. Also, micro-data of Austrian workers became available.

The scope of this dissertation is to investigate the impact of pension reform on the financial incentives to retire for private sector workers. How do financial incentives embedded in the Austrian pension system affect individual retirement behavior? Was

pension reform effective in changing these financial incentives? How would future reform scenarios impact retirement behavior?

Hofer and Koman (2006) showed for some stylized cases, that the incentives to retire early are relatively high in Austria compared to other countries. Using the methodology portrayed in Gruber and Wise (2004), this study will expand the analysis in Hofer and Koman (2006) by micro-estimating the response of Austrians to changes in financial incentives. Moreover, this dissertation is looking at the gender differences in behavior, and at the impact of pension reform 2000. Finally, this study will use theses estimates to simulate the impact of past and future reform scenarios on retirement behavior.

Austria is often left out in international comparative studies. However, it is a very interesting country in many areas. Austria has a long tradition of early retirement and hence a very low labor force participation of older workers. Moreover, the granting of disability pensions is very generous in Austria. So a huge share of Austrian retirees retires on disability pensions unlike in most other countries. Furthermore, the public pension system is the only source of old age income for Austrians. There are almost no private pension plans or firm pension plans. Finally, Austria is one of the very few countries that have different legal retirement ages for men and women. Gruber and Wise (2004) show that the features of pension plans vary largely form country to country. Therefore, this study analyzes the Austrian case using a detailed administrative micro-data set.

This dissertation shows that the behavioral response to financial incentives embedded in the Austrian pension system is relatively large in international comparison. Also, there are some striking behavioral differences between men and women. Therefore, past and future reforms altering the financial incentives had and will have a huge impact on retirement behavior.

In order to address these questions, this study will first show how pension benefits are calculated in Austria. Then, it is shown how reform 2000 altered this calculation. Next, there is need to construct the financial incentive measures. This study uses these to regress them on the choice to retire along with a set of controls. The estimates are the base for simulating the effect of reform 2000 and two future reform scenarios. The simulations show how the probability of retirement at certain ages changes as pension benefits and the incentives alter by reform.

Therefore, the organization of this dissertation is as follows. Chapter 2 will give a brief overview of the institutional setup of the Austrian pension system and of past reform steps. Chapter 3 reviews the previous related literature on labor supply of older workers and retirement incentives. Chapter 4 introduces a theory of labor supply in a life-cycle setting endogenizing the date of retirement. Chapter 5 discusses the micro-data used in the regressions, and the empirical strategy. Main explanatory variables are the financial incentives to retire, i.e., social security wealth, the social security wealth accrual, the peak value, the option value, and the implicit social security tax on work. Chapter 6 presents the regression results. Chapter 7 uses the estimates to simulate the effects of past and future reforms on retirement behavior. Chapter 8 will conclude this study summarizing the main results as well as presenting a set of policy recommendations for future reforms.

Background

The major reason to discuss the Austrian public pension system is the very low labor force participation rate of older workers. An increasingly aging population puts enormous current and future pressure on the financing of the pension system. Therefore, it is

appropriate to give a brief overview of the key features describing the Austrian retirement economics. In an international comparison, the extent of the low labor force participation rate among older workers in Austria becomes apparent, while other retirement parameters are within international standards. The Austrian public pension system guarantees a relatively high standard of living for seniors. However, it suffers from some serious issues that compromise the long-term sustainability of its finances as well as intergenerational fairness. Especially the increasingly aging population has become a major threat for future generations' old age income security. Paralleling the general trend in most developed countries, the elderly dependency ratio[1] will increase from 22.9 percent in 2002 to 54.9 percent in 2050 (refer to table 1).

In 1996, contributions paid by workers into the pension system covered 75 percent of total pension expenditures. The remainder was paid out of the federal budget. Also, the share of old age benefits relative to GDP which is 11.25 percent is not showing any abnormality in a cross-country comparison. Therefore, these numbers are not a priori alarming considering that they roughly reflect the current shares of elderly population in those societies.

The high replacement rate[2] in Austria is often criticized as too generous as for instance Koch and Thimann (1999) point out. However, it is understandable that in complete absence of a private pension pillar, this is a way to avoid widespread old age poverty. Therefore, net pension benefits that cover 90 percent of pre-retirement earnings are appropriate given the complete absence of private pension plans. However, it seems that the benefit structure is a priori the reason for crowding out private pension insurance.

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[1] The elderly dependency ratio is defined as the population aged 65 or older/population aged 15 to 64. More generally, the elderly dependency ratio is retirees/population in labor force.

[2] The replacement rate is defined as pension benefits/pre retirement earnings.

Additionally, the payroll tax contributions of 22.8 percent of gross income are also relatively high in international comparison. Lower replacement rates could only be justified in case of lower payroll taxes or in case of a discontinuing the employer-financed part of the payroll tax. Thus, the basic cost-benefit structure of the Austrian pension system is not the primary issue that needs to be resolved.

Table 1. Retirement in Austria and selected countries

Country	Old age benefits as % of GDP	Labor force participation rate (b) Age Group 55-59	60-64	65-69	70-74	75+	Statutory retirement age Males	Females	Average retirement age (d) Males	Females
Austria	11.25	51.9	14.0	6.2	2.8	1.0	65	60	59.6	58.9
US	5.07	71.4	51.6	28.3	16.3	6.4	65	65	65.0	62.9
Germany	12.19	73.2	31.6	6.6	2.9	0.9	65	65	60.9	60.2
Switzerland	13.12	80.2	55.6	15.3	8.2	2.7	65	63	66.6	63.2
Sweden	11.55	82.2	60.9	-	-	-	65	65	63.5	62.0

Country	Net replacement rate by earnings level, men (e) Share of average pre-retirement net earnings 0.5	0.75	1	1.5	2	2.5	Payroll tax rate (f)	Elderly dependency ratio (g) 2002	2050
Austria	91.2	93.4	93.2	93.5	79.3	63.2	22.80	22.9	54.9
US	61.4	54.6	51.0	44.9	39.0	35.5	12.40	18.5	32.2
Germany	61.7	66.6	71.8	79.2	67.0	54.2	19.50	26.3	49.1
Switzerland	71.4	68.9	67.3	53.0	41.4	34.3	22.30	23.6	55.3
Sweden	90.2	76.4	68.2	70.1	74.3	75.0	18.91	26.5	46.8

Sources:
(a) ILO, Social Security Expenditure Database, 2001 (1999 number for US). Available from http://ilo.org/dyn/sesame/ifpses.socialdbresexp, accessed August 15, 2006.

(b) ILO, LABORSTA, Labor Force Survey, 2005. Available from http://laborsta.ilo.org, accessed August 16, 2006.

(c) US Social Security Administration, Social Security Programs Throughout the World, Europe: 2004. SSA Publication Number 13-11801, September 2004.

(d) OECD, Index of Statistical Variables, Official versus Effective Age 1997-2002. Available from http://oecd.org/dataoecd/32/21/36029941.html, accessed August 16, 2006.

(e) OECD, Index of Statistical Variables, Old Age Pension Replacement Rate, Mandatory Pension Plans, Percentage of Individual Pre-retirement net earnings 2005. Available from http://oecd.org/dataoecd/32/21/36029941.html, accessed August 16, 2006.

(f) US Social Security Administration, Social Security Programs Throughout the World, Europe: 2004. SSA Publication Number 13-11801, September 2004. Numbers include tax rates for old age, survivor, and disability pensions.

(g) OECD, Index of Statistical Variables, Age-dependency Ratio, defined as Population 65+/Population 15-64, projected 2050 numbers. Available from http://oecd.org/dataoecd/32/21/36029941.html, accessed August 16, 2006.

More alarming issues arise if we turn to labor force participation. While in younger age groups, labor force participation rates are in line with other countries, they are particularly low for older workers in Austria. In all age groups close to statutory retirement age, the major issue is a participation rate 20 to 30 percentage points lower than in comparable countries.[3] In the age group of 55 to 59, the participation rate is only 51.9 percent, sharply dropping to only 14.0 percent in the age group 60 to 65. In contrast, Sweden has labor force participation rates of 82.2 percent and 60.9 percent in the respective age groups. Also, Germany, Switzerland, and the United States have significantly higher labor force participation rates of older workers. *Tu felix Austria*, retire? Thus, this low participation rate turns out to be the most striking abnormality and the most important challenge for a reform of the Austrian pension system. Due to an extensive use of early retirement and the disability pension, there is a significant difference between statutory and real retirement age: As the mirror image of the low participation rate, Austrian men and women retire on average at ages 59.6 and 58.9, respectively. This happens long before the statutory - internationally non abnormal - retirement ages of 65 and 60, respectively, which significantly distinguishes Austria from other developed countries.

Thus, Austria is a highly interesting object of research. It has an expensive pension system, even in comparison to similar economies. On the one hand, the major advantages of the PAYGO system are that Austria hardly has to deal with old age poverty, and that the labor market is relatively quickly cleared of old workers in order to give younger workers the opportunity of employment. On the other hand, even though the system is presently

[3] Looking at younger ages shows no big deviation of Austrian labor force participation rates from other countries (ILO, LABORSTA, Labor Force Survey, 2005. Available from http://laborsta.ilo.org, accessed May 15, 2008). In the age group 40-44, Austria has a participation rate of 89 percent, Germany 89.6 percent, Sweden 90.6 percent, Switzerland 88.9 percent, and the US 84 percent. The rates for age group 45-49 are 87.4 (Austria), 88.6 (Germany), 89.6 (Sweden), 90.1 (Switzerland), and 79.4 (US).

working relatively well, there is inevitable need for continued reform. Socioeconomic and political constraints suggest that raising labor force participation near retirement ages combined with labor market reforms is the single most important criterion for successful reform.

CHAPTER 2

THE AUSTRIAN PENSION SYSTEM

A summary of the institutional features and recent reforms should provide an overview of the public retirement system in Austria. We will look at the way a retirement pension is calculated. Also, we need to know how this calculation changed by pension reforms.

The Institutional Setup

The Austrian public pension system for private sector workers is a pay-as-you-go (PAYGO) system with a defined benefit plan. It is primarily an income maintenance program rather than a pure anti-poverty program. Its main objective is to preserve a person's standard of living in old ages. The current pension system was implemented in 1955 for private sector workers by Austria (1955). There are different pension plans for civil servants, self-employed, farmers, miners, and notaries. Implicitly, the PAYGO pension plan is a two-pillar system, jointly financed by employers and employees. For that reason, additional firm pension plans or private pension plans hardly exist in Austria. Any deficit is covered out of the federal budget. The following presentation of the institutional features is based on the legislation in Austria (1996). A comprehensive summary of European social security programs can be found in Administration (2004).

The pension formula for private sector workers consists of two components, pensionable income and the replacement rate. In the initial year of retirement a person receives a pension benefit according to

$$\text{Pension Benefit} = \text{Average Pensionable Income} \cdot \text{Replacement Rate}, \tag{1}$$

where average pensionable income is defined as

$$\text{Average Pensionable Income} = \frac{\sum_{t=1}^{n} Annual\ Gross\ Income_t \cdot Valuation\ Factor_t}{n}. \tag{2}$$

Pensionable income is the average of the "*n* best income years". Annual income for pension calculation is defined as the sum of gross earnings and unemployment compensation. Earnings or unemployment compensations in the year of retirement are not considered. There is an upper threshold for annual income that enters into the above formula. In 1998, this annual threshold was 42,732 Euros. In order to correct for inflation, pensionable income of each year is multiplied by a valuation factor according to Hauptverband (Various years-b).

The second component of the pension formula, the replacement rate, is defined as

$$\text{Replacement Rate} = Increment\ Factor \cdot Insurance\ Years \tag{3}$$

The replacement rate increases by an increment factor for each year of pension insurance. In 1998, the increment factor was 1.83 percentage points for the first 30 insurance years, and 1.675 percentage points for any subsequent year. The maximum replacement is 80 percent in case of retirement at the statutory age or one of the early retirement options. The replacement rate decreases by an early retirement penalty if a person retires before the statutory age. If retirement is postponed beyond the statutory age, a bonus is added to the replacement rate. Average pensionable income is multiplied by the replacement rate which yields the annual gross pension benefit at the time of retirement. If a pension benefit falls below a certain threshold, a means-tested allowance can be claimed from the federal government. This increases the pension to a minimum benefit which was 8,131 Euros per year in 1998. Pensions are paid in 14 installments per year, 12 current month installments, and two allowances. Gross pension benefits are subject to an individual income tax and a health insurance contribution.

There are generally four pathways to exit the labor force into retirement: the old-age pension, early retirement, the disability pension, and partial retirement. For old-age pensions, the statutory retirement age is 65 for men, and 60 for women. Eligibility additionally requires 15 years of contributory service,[4] or 15 years of insurance coverage in the last 30 years, or 25 years of insurance coverage over the whole working life, what ever applies first.

Early retirement is a special, however, frequently used case of old-age pensions. The conditions for receiving an early pension are either long contributory service, or unemployment, or reduced working capacity. Early retirement can be granted to men at a minimum age of 60 and women at a minimum age of 55. For early retirement due to long

[4] The pension law distinguishes contributory and qualifying periods in insurance coverage. Typical examples of qualifying periods are military service and maternity leave.

contributory service, at least 37.5 years of insurance or 35 years of contributory service are required. Early retirement due to unemployment requires at least 12 months of unemployment in the last 15 months. Finally, early retirement due to reduced working capacity requires that a person cannot continue the work predominately pursued in the last 15 years.

Disability pensions are available before the early retirement ages. A person is eligible for a disability pension if his loss of earnings capacity is 50 percent or more compared to persons with a similar level of education. Also, he must have 5 years of contributions[5] in the last 10 years, 25 years of insurance, or 15 years of contributions. If the disabled person is younger than 56.5, the number of insurance years for the replacement rate calculation is projected to that age. The maximum replacement rate is 60 percent of average pensionable income. All other regulations follow the old-age case.

Partial retirement was implemented in 1993. Due to the very small number of workers[6] using this form of retirement, it was discontinued in 2004. Instead, legislature introduced an old-age part time work program. Reduced hours of work and earnings combined with a wage subsidy should help reduce the costs of an older worker to a company, and therefore reduce old age unemployment. Workers do not make a lot of use of this program either.

To give an example of calculating pension benefits, let us look at a man aged 62 in 1998 (table 2). His average pensionable income is Euros 25,000 which is the average of the 15 best income years. The man is entitled for early retirement due to long contributory

[5] Additional months of contributions are required from age 50. From age 57, the eligibility conditions are relaxed.

[6] In 1998, only 1,058 persons received a partial pension, until 2003, the number decreased sharply to 337 persons.

service. Retiring in 1998 at the age of 62, he retires 3 years before the statutory retirement age of 65. During his life, he accumulated 43 insurance years. His replacement rate is calculated as follows. For the first 30 insurance years, he receives 54.9 percentage points (A), for the remaining 13 insurance years 21.775 percentage points (B). This would add up to a replacement rate of 76.675 percent. However, due to early retirement, his replacement rate reduces by 6 percentage points (C). The overall replacement rate is therefore 70.675% (A+B-C). Average pensionable income times the replacement rate results in a gross pension benefit of Euros 17,668.75 (I x II) for the year 1998.

Table 2. Case study: calculation of pension benefits (1998)

Male person retiring in 1998 Entitled for early retirement due to long contributory service 62 years old in 1998, i.e., 3 years prior to statutory retirement age of 65 43 insurance years	
I. Average pensionable income of best 15 years	Euros 25,000
II. Replacement rate = A+B-C (max. 80%)	70.675%
A. First 30 insurance years: 30 x 1.83 = 54.9	
B. Next 13 insurance years: 13 x 1.675 = 21.775	
C. Penalty for early retirement: 3 years x 2 = 6	
Gross pension benefits in 1998 = I x II	Euros 17,668.75

Note: Example of pension calculation for a male person retiring in 1998. For the calculation of pension benefits, two components are required. First, we need average pensionable income of the best 15 income years. Second, we need the replacement rate. The product of both components results in before-tax pension benefits in the initial year of retirement.

Pension Reforms

The pension system belongs to the most important government programs, since it greatly affects the standard of living of every citizen. Around the millennium, a couple of pension reforms were implemented. They were done in a very gradual way, reflecting the political constraints in Austria, and also the fact that the pension system is per se a very sensitive area. Which reforms took place, and which parameters in the pension system were changed?

The main change of reform 1997 was a new treatment of the increment factors. However, parts of reform 1997 never became effective. A situation based on the pension law effective from 1997 to 2000 will throughout be called legislation 1997. Reform 1997, which was implemented in Austria (1997), brought the following novelties:

- The increment factor in the replacement rate calculation increases from 1.675 percentage points (1.83 percentage points in the first 30 insurance years) to uniquely 2 percentage points per insurance year (effective January 1, 2000). The maximum replacement rate remains at 80 percent of average pensionable income.
- Early retirement reduces the replacement rate by 2 percentage points per year of early retirement with an upper ceiling of 10 percentage points or 15 percent of the replacement rate (effective January 1, 2000).

In the same year as reform 1997 became effective, the retirement law changed again. The reform affected the early retirement ages, the penalty for early retirement, and the

options for early retirement. A situation based on this reform will likewise be called legislation 2000. In particular, reform 2000 in Austria (2000) included the following changes:

- Early retirement age is gradually raised from 60 to 61.5 for men, and from 55 to 56.5 for women (effective October 1, 2000).

- Early retirement reduces the replacement rate by 3 percentage points per year of early retirement with an upper ceiling of 10.5 percentage points overall or 15 percent of the replacement rate (effective October 1, 2000).

- A bonus for postponing retirement beyond the statutory ages is increased from 2 percentage points to 4 percentage points per year with an upper ceiling for the replacement rate of 90 percent (effective October 1, 2000).

- There is one exception from reform 2000. Men born before October 1, 1945 and already having at least 45 contributory years, and women born before October 1, 1950 and already having at least 40 contributory years, can still retire at early retirement ages and penalties according to the 1997 legislation.

- Early retirement due to reduced working capacity is abolished.

Though, the analysis in the following chapters does not include reform 2003, let us briefly look at it for the sake of completeness. Again, penalties for early retirement increased, and the access to early retirement was more restricted. In detail, reform 2003 changed the following in Austria (2003a) and in Austria (2003b):

- The assessment base for average pensionable earnings is increased from the "15 best years" gradually by 12 months for each year until it reaches the "40 best earnings years" in 2028 (effective January 1, 2004).
- The increment factor in the replacement rate calculation decreases to 1.96 percentage points per insurance year (effective January 1, 2004), and even further in subsequent years.
- Early retirement reduces the replacement rate by 4.2 percentage points per year of early retirement with an upper ceiling of 15 percent of the replacement rate. The deduction applies to a maximum replacement rate of 80 percent of less. The loss compared to legislation 2000 cannot exceed 5 percent in 2004, gradually increasing to 10 percent in 2024 (effective January 1, 2004).
- A bonus for postponing retirement beyond the statutory ages is increased to 4.2 percentage points per year with an upper ceiling for the replacement rate of 91.76% (effective January 1, 2004).
- Early retirement due to long contributory service and due to unemployment are abolished (effective July 1, 2004, and January 1, 2004, respectively). For cohorts born before October 1, 1952 (men) and before October 1, 1957 (women), these forms of early retirement are gradually abolished by an increase in the eligibility age until it reaches the statutory ages in 2014.

Therefore, the changes of pension reform can be summarized as follows. All forms of early retirement were abolished. However, the phasing out period is very long, so immediate effects will be quite small. The minimum ages for early retirement changed by legislation 2000. They were raised from 60 to 61.5 for men, and from 55 to 56.5 for women.

The replacement rate altered in two ways. First, the increment factor for each year of insurance rose from 1.83 (1.675) to 2 percentage points. Second, the penalty for each year of early retirement rose from 2 to 3 percentage points. This implies a higher replacement rate of legislation 2000 compared to legislation 1997. Table 3 shows that the calculation of pension benefits according to legislation 2000 results in a replacement rate of 77 percent. Compared to table 2 which is based on legislation 1997, this is an increase of 6.325 percentage points. Thus, reform 2000 increased the generosity of the pension system. Reform 2003 tried to "repair" this situation. However, pension reform increased penalties for early retirement. This is the right direction to a system of more actuarial fairness. The steps-by-step strategy in pension reform on the one hand minimizes the financial effects on the system. Further reform is needed. So, on the other hand, the long gradual reform process generates a lot of uncertainty among persons approaching the retirement age. Also, younger persons question the reliability of their old age income out of the public pension system in far future.

Table 3. Case study: calculation of pension benefits (2001)

Male person retiring in 2001 Entitled for early retirement due to long contributory service 62 years old in 2001, i.e., 3 years prior to statutory retirement age of 65 43 insurance years	
I. Average pensionable income of best 15 years	Euros 25,000
II. Replacement rate = A-C (max. 80%) A. 43 insurance years: 43 x 2 = 86 C. Penalty for early retirement: 3 years x 3 = 9	77%
Gross pension benefits in 1998 = I x II	Euros 19,250

Note: Example of pension calculation for a male person retiring in 2001. For the calculation of pension benefits, two components are required. First, we need average pensionable income of the best 15 income years. Second, we need the replacement rate. The product of both components results in before-tax pension benefits in the initial year of retirement.

CHAPTER 3

LITERATURE REVIEW

The relevant literature on retirement behavior and the financial incentives to retire comes from three sources. First, from the literature on labor supply of older workers, second, from the literature on the financial incentives driving retirement behavior. For control variables, literature on other determinants of the retirement decision like health or family status is important.

In order to theoretically determine retirement behavior, we need a model that features a lifetime perspective. The standard framework on labor supply of older workers bases on the idea that individuals optimize their economic decisions over a lifetime horizon. Technically, this implies that individuals maximize lifetime utility subject to a lifetime wealth constraint. From a history of economic thought perspective, these models ground on the *Life Cycle Hypothesis* by Modigliani and Brumberg (1954), as well as the *Permanent Income Hypothesis* by Friedman (1957). Dealing with retirement behavior, Gustman and Steinmeier (1986) propose a life cycle model in which an individual maximizes the present value in utility of consumption and leisure subject to a present value lifetime budget constraint. This approach is an extension of the basic model of labor-leisure choice in a multi-period setting. Many versions of this model exist throughout the literature, either in discrete or in continuous time.

In the newer literature, Stock and Wise (1990) introduce a reduced form approach. They propose a model in which the option value of future earnings and pension benefits is

maximized. Retirement takes place in the period that yields the maximum option value. The motivation for the option value approach comes from Lazear (1979), who finds that a worker retires when his wage does not anymore exceed his value marginal product of labor. Both approaches are complements rather than substitutes, therefore the reduced option value approach can easily be integrated into a more comprehensive life cycle approach.

Samwick (1998) introduces a life cycle model of consumption and the endogenous date of retirement, and shows how the option value aspect is included in the first order condition for the retirement date. Building upon that, the theoretical model extends the Samwick analysis by using parameters that describe the Austrian situation.

There are many factors driving the retirement decision. In the empirical literature, financial incentives of retirement are the key variables in the retirement decision. The usual incentive measures are social security wealth, the accrual in social security wealth, the peak value, the option value, and the implicit tax on work (see chapters 4 and 5 definitions). However, also coordination among older couples, health and disability, institutional rigidities, care giving, and labor demand for older workers bear substantive implications on retirement behavior.

An extensive international comparison of retirement incentives embedded in the public pension plans of selected OECD countries is provided in Gruber and Wise (1999). In their very influential study, they analyzed the impact of financial incentives coming out of pension systems using macro data. However, their project did not include Austria. They found that there is a very strong causality across all countries between the financial incentives of pension plans and the labor force exit of older workers. Moreover, all of the countries bear an implicit tax on work in their pension systems such that many individuals retire before the statutory retirement ages. Regressing unused labor force capacity on the log

of tax force to retire, they found a strikingly high relationship with $R^2 = 0.82$. As two points of caution for their result, they first emphasize that each social security system encourages retirement at certain ages in order to provide more jobs for younger workers. Second, early retirement is often deliberately used as an instrument against old age unemployment. This study provides a comprehensive methodology to calculate the financial incentive measures.

An important study to compare the behavior of Austrian workers to other countries is Gruber and Wise (2004). In this second stage of their project, they perform a micro-estimation of the link between the probability of retirement and the financial incentives. They use the same sample of OECD countries as in their first stage. Their results show an empirically very strong relationship between financial incentives and the retirement behavior across all countries. Under these country studies Baker, Gruber, and Milligan (2004) did the Canadian part; Brugiavini and Peracchi (2004) treated Italy; Boersch-Suppan et al. (2004) Germany; Coile and Gruber (2004) the United States. Applying a synchronized methodology, the county papers used probit models in order to explain the probability of retirement as a function of financial incentives and a set of controls. They estimated equations separate by sex for each of the incentive measures. Then, they use the estimates to perform policy simulations. Also, they show that with this kind of subject, strong assumptions have to be made frequently, because micro data usually do not give information about complete individual lifetime income histories. Austria is often left out in international comparative studies. However, it is a very interesting country in many areas: the long tradition of early retirement, the frequent use of disability pensions, the unique one pillar system, and the different legal retirement ages for men and women. Gruber and Wise (2004) show that the features of pension plans vary largely form country to country. Therefore, this study analyzes the Austrian case using a detailed administrative micro-data set.

To control for factors different from the financial incentives in the retirement decision, the following studies are of interest as well. Other factors include coordination among couples, the health condition, institutional rigidities, care giving in the family, and various demographic characteristics. Blau (1998) investigates the coordination among couples on the retirement decision. They find evidence of joint retirement, leading to the conclusion of preferences for sharing leisure as an important consideration among couples. Rust (1989) and Sammartino (1987) draw their attention on the health status of retirees, and find evidence of poor health encouraging early retirement. Hurd (1996) deals with institutional rigidities that encourage retirement, like hours of work restrictions, cost of older labor, and age discrimination. However, these ideas have not been empirically fully investigated. Another important consideration is care giving in the family as a reason to quit a job. Gorey, Rice, and Brice (1992) show that up to a third of informal care giving leads to labor market exit. Gruber and Wise (2004) furthermore use controls for expected earnings next year, lifetime earnings, education, race, experience, industry, occupation, and region. These contributions help me find the important variables and controls for the estimations. Some of them are, however, not available in the data used, for instance marriage status.

For the Austrian case, the literature on pensions in general and on financial incentives in particular is relatively thin. Some papers have been published recently. A summary on recent pension reforms including a numerical evaluation is provided by Buczolich et al. (2003). Also, a policy evaluation on recent pension reforms is found in Mayrhuber (2003). The paper most closely related to this study is Hofer and Koman (2006). Methodologically, they follow the first stage of the Gruber and Wise (1999) project. For some stylized cases, they calculate accrual rates and levels of social security wealth, as well as implicit tax rates on continued work. They conclude that the financial incentives coming out

of the Austrian public pension system bear huge incentives for early retirement. This study will expand their work using a detailed micro-data set in order to micro estimate the response of Austrians to changes in the financial incentives. Also, an important feature of this dissertation is to look at behavioral differences between men and women. Then, this study uses the estimates to simulate past and future reform scenarios, including pension reform 2000. Keuschnigg and Keuschnigg (2004) simulate some scenarios of Austrian pension reform, finding that lowering the replacement rate or decreasing the retirement age can have strong labor market effects. This study is going to add a micro-estimation of the impact of financial incentives on the retirement probability and policy simulations using the estimates.

CHAPTER 4

THEORETICAL MODEL

We are specifying a model that predicts the influence of financial incentives on the date of retirement. Therefore, we will show how the financial incentives to retire fit into a life cycle model. Next, we have to identify an optimality condition for retirement. Using this optimality condition, we finally look at how the optimal date of retirement changes as a response to an exogenous increase in the financial incentive measures.

A Life Cycle Model of Consumption and the Date of Retirement

The natural framework to deal with retirement behavior is a life cycle model. Basically, we are following the analysis proposed by Samwick (1998), however, extend the model by adding taxes, individual and institutional parameters. Workers are assumed to maximize utility over the life-cycle subject to a lifetime budget constraint. Pensions are financed by a proportional payroll tax τ in the working part of life, and paid to retirees. The level of pension benefits received after retirement depends on the calculation formula for pension benefits defined by the social security law. The pension system is a PAYGO-system, where benefits do not depend on the tax rate on earnings. Capital markets are perfectly competitive, so that individuals can borrow and lend at an exogenous market interest rate r. Finally, there is no bequest motive, so individuals will have zero net wealth at the end of their life.

An individual is born at time $s = 0$, retires at time $s = R$, and dies at time $s = T$. It receives work income before R, and a pension benefit after R. It maximizes lifetime utility

$$\max_{\{R,C_s\}} \int_t^R e^{-\delta(s-t)} u^W \left(C_s, 0\right) ds + \int_R^T e^{-\delta(s-t)} u^R \left(C_s, 1\right) ds \tag{4}$$

subject to a lifetime wealth constraint

$$A_t + \int_t^R e^{-r(s-t)} (1-m-\tau) Y_s ds + \underbrace{\int_R^T e^{-r(s-t)} B_s \left(R, \Theta\right) ds}_{SSW} = \int_t^T e^{-r(s-t)} C_s ds \,. \tag{5}$$

$u(\bullet) =$ Utility function, which is order preserving, increasing, continuous, regular strictly quasi-concave and time separable in the endogenous argument. The second argument in the utility function represents the effect of retirement leisure on utility.

$u^W \left(C_s, 0\right) =$ Utility during working periods.

$u^R \left(C_s, 1\right) =$ Utility during retirement periods.

$C_s =$ Consumption in period s, $s = 0, \dots, R, \dots, T$.

$\mathrm{R} =$ Endogenous date of retirement.

$\delta =$ Rate of time preference.

$A_t =$ Net wealth at time t.

$r =$ Discount rate.

$B_s(R,\Theta)$ = Net pension benefits received in period *s*, $\frac{\partial B_s}{\partial R} > 0$, and $\frac{\partial^2 B_s}{\partial R^2} \equiv 0$.

$\Theta =$ Exogenous parameter vector of individual characteristics affecting pension benefits, such as poor health. Since individuals with these characteristics usually retire before the normal retirement age and get a lower pension benefit, we assume that $\frac{\partial B_R}{\partial \Theta} < 0$.

$Y_s =$ Gross real income from work in period *s*.

$m =$ Proportional income tax rate.

$\tau =$ Proportional payroll tax rate.

The Financial Incentives to Retire

Retirement behavior is largely determined by financial incentives that come either out of the pension system or from labor force participation. An individual will compare future wealth streams coming out of different sources, and then decide which date of retirement *R* maximizes these future wealth streams. The measures for the incentives to retire are explicitly imbedded in the model and are used in the empirical part in order to determine the respective magnitudes.

Social Security Wealth is defined as $SSW = \int_R^T e^{-r(s-t)} B_s(R,\Theta)ds$. This is the present discounted value of net pension benefits paid to an individual out of the pension system. Persons with a greater *SSW* are more likely to retire than persons with a smaller *SSW*.

The *Accrual* is $ACC = \frac{\partial SSW}{\partial R} = \int_R^T e^{-r(s-t)} \frac{\partial B_s}{\partial R}(R,\Theta)ds - e^{-r(R-t)} B_R(R,\Theta)$. It represents the increment in *SSW* by postponing retirement. This is in other words just the marginal benefit from postponing retirement. The magnitude of the *ACC* might vary with every year, and even be negative. Thus, just looking at a single year *ACC* might not be sufficient; it has to be determined for each and every year of retirement eligibility. Furthermore, he might not only look ahead one year at the *ACC*, but at the complete future path of the *ACC*s.

The *Peak Value* $PV = ACC(s^*)$ is the maximum accrual that can be obtained by postponing retirement to s^*. So far, these incentive measures are just including the benefits received out of the pension system. However, an individual might also consider future earnings from work in his retirement decision.

The *Option Value* is defined as $OV = e^{-r(R-t)}(1-m-\tau)Y_R + ACC$. This is earnings from continued work and the gain or loss in social security wealth by postponing retirement. An individual retiring later, he will gain or loose from future wage earnings as well as social security benefits. The *OV* can also be interpreted as the price of leisure as shown below. The person compares the *SSW* from retiring now at age *t* with the gains or losses of retiring at a later time. The incentive prediction is that an individual would retire if $OV \leq 0$. However, the *OV* measure does not take account of different tastes concerning work and leisure.

The *Implicit Social Security Tax on Work*, $IST = -\frac{ACC}{e^{-r(R-t)}\left((1-m-\tau)Y_R\right)}$, is the ratio of gains or losses in *SSW* compared to earnings if retirement is delayed. So, by postponing retirement for one more year, an individual might expect the increase in social security wealth to be positive or at least non-negative, because he foregoes one year of social security

benefits. This is the case if the *SSW* is at least non-decreasing. Gruber and Wise (1999) call this benefit structure "actuarially fair". If the accrual is negative, then the individual's gains in earnings are partially or fully offset by a loss in social security wealth, the implicit tax on work. Thus, an actuarially fair structure of benefits implies $\frac{\partial SSW}{\partial \mathrm{R}} \geq 0$.

The Optimal Date of Retirement

The Lagrangian for the above problem (4) subject to (5) is

$$\begin{aligned} L &= \int_t^{\mathrm{R}} e^{-\delta(s-t)} u^W \left(C_s, 0\right) ds + \int_{\mathrm{R}}^{T} e^{-\delta(s-t)} u^{\mathrm{R}} \left(C_s, 1\right) ds \\ &+ \lambda \left[A_t + \int_t^{\mathrm{R}} e^{-r(s-t)} (1-m-\tau) Y_s ds + \int_{\mathrm{R}}^{T} e^{-r(s-t)} B_s(\mathrm{R}, \Theta) ds - \int_t^{T} e^{-r(s-t)} C_s ds \right] \end{aligned} \tag{6}$$

Assuming intertemporal separability of utility and $r = \delta$, we take the first order conditions with respect to R[7] and C_s

$$\frac{\partial L}{\partial \mathrm{R}} = \left[u^W(C_{\mathrm{R}}, 0) - u^{\mathrm{R}}(C_{\mathrm{R}}, 1) \right] = -\lambda \underbrace{\left[(1-m-\tau) Y_s \overbrace{- B_{\mathrm{R}}(\mathrm{R}, \Theta) + \int_{\mathrm{R}}^{T} e^{-r(s-\mathrm{R})} \frac{\partial B_s}{\partial \mathrm{R}} d\, s}^{ACC} \right]}_{OV} \tag{7}$$

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[7] Leibnitz's Rule on differentiation under the integral: If $g(y) = \int_{\alpha(y)}^{\beta(y)} f(x, y) dx$, then $\frac{\partial g(y)}{\partial y} = \int_{\alpha(y)}^{\beta(y)} \frac{\partial f(x, y)}{\partial y} dx + \beta'(y) f(\beta(y), y) - \alpha'(y) f(\alpha(y), y)$.

$$\frac{\partial L}{\partial C_s} = \frac{\partial u^W\left(C_s,0\right)}{\partial C_s} = \lambda \quad \forall s < R \text{, and} \tag{8}$$

$$\frac{\partial L}{\partial C_s} = \frac{\partial u^R\left(C_s,1\right)}{\partial C_s} = \lambda \quad \forall s \geq R \tag{9}$$

The first order condition with respect to *R* in (7) represents the immediate incentive to retire, implicitly defining the optimal date of retirement R^*. The left-hand side of (7) is the difference in utility that results from a marginal increase in the retirement date. The right-hand side of the equation represents the utility change of wealth resulting from a marginal increase in the retirement date. The term in brackets is the price of leisure, in other words the option value *OV* of continued labor force participation.

(8) and (9) implicitly define the Frisch or λ-constant demand functions for consumption. The Lagrangian multiplier λ can be interpreted as marginal utility of wealth, (8) and (9) imply that $\lambda > 0$. The first order conditions with respect to C_s state that the marginal utility of consumption at date *s* is equal to the marginal utility of wealth. From (8) and (9), we get the Frisch demand functions $C_s^* = C_s(\lambda) \;\; \forall s$, and therefore (7) becomes

$$F = \left[u^W(C_s^*,0) - u^R(C_s^*,1)\right] + \lambda \underbrace{\left[(1-m-\tau)Y_R \overbrace{- B_R(R,\Theta) + \int_R^T e^{-r(s-R)} \frac{\partial B_s}{\partial R} ds}^{ACC}\right]}_{OV} = 0 \tag{10}$$

For a maximum, it is required that

$$\frac{\partial F}{\partial \mathrm{R}} = \lambda \left[-2\frac{\partial B_{\mathrm{R}}}{\partial \mathrm{R}} + e^{-r(s-\mathrm{R})} \int_{R}^{T} r \frac{\partial B_s}{\partial \mathrm{R}} ds \right] < 0 \tag{11}$$

Comparative Statics Analysis

We are interested in the question how retirement behavior or more precisely the optimal date of retirement alters when the parameters of the model are changed. Because of the crucial role of the Lagrangian multiplier λ in this kind of model, we have to take a closer look at it. An extensive discussion on λ can be found in MaCurdy (1981). While Marshallian demand functions hold income constant, and Hicksian demand functions hold utility constant, Frisch demand functions are holding marginal utility of wealth λ constant. Consumption decisions at a point in time are related to variables outside that point in time only through λ, which also influences the retirement decision, as the relationship in (10) shows. So, λ summarizes all information about lifetime wealth, assets, income and tastes the individual requires determining the optimal current period consumption. In other words, it captures the effect of an increase in the present value of lifetime wealth on maximized lifetime utility. But what does an increase in λ mean? From (8), we get $\partial C_s^* / \partial \lambda < 0$.[8] Substituting (8) and (9) into (5), we get

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[8] Using (8) and the Implicit Function Theorem,
$\partial C_s^* / \partial \lambda = -\left(\frac{\partial F}{\partial \lambda} \Big/ \frac{\partial F}{\partial C_s^*} \right) = -\left(-1 \Big/ \frac{\partial^2 u^W}{\partial C_s^{*2}} \right) < 0$ because of diminishing marginal utility of consumption.

$$\frac{\partial\lambda}{\partial A_t}<0,\frac{\partial\lambda}{\partial Y_s}<0,\frac{\partial\lambda}{\partial B_s}<0 \quad (12)$$ [9]

Thus, a decrease in income or wealth from various sources causes an increase in λ. Intuitively this is plausible, because an additional Euro in wealth or income would add more utility if wealth or income is very low as opposed to adding less utility as wealth or income is very high.

Since λ summarizes all intertemporal changes, all parameter changes can be expressed by λ. The intuition about such changes is that they are unanticipated and permanent, for instance a permanent change in the lifetime income profile or a permanent change in the profile of pension benefits. Such a permanent change will cause a substitution effect and a wealth effect. For the optimal date of retirement R^*, described in (10), an increase in λ leads to an ambiguous sign in (13). This is an important finding, because it tells us that any intertemporal influence on the retirement decision depends on the sign of the option value OV only. The individual will delay retirement if the OV is positive, i.e., if the individual can expect a gain in future wealth streams from postponing retirement compared to retiring now.

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[9] Using (5) and (8), and the Implicit Function Theorem, we get $\frac{\partial\lambda}{\partial A_t}=-\frac{\frac{\partial F}{\partial A_t}}{\frac{\partial F}{\partial\lambda}}=-\frac{1}{\underbrace{-\int_t^T e^{-r(s-t)}\frac{\partial C_s}{\partial\lambda}ds}_{+}}<0$,

$\frac{\partial\lambda}{\partial Y_s}=-\frac{\overbrace{\int_t^R e^{-r(s-t)}\left[(1-m-\tau)\right]ds}^{+}}{+}<0$, $\frac{\partial\lambda}{\partial B_s}=-\frac{\overbrace{\int_R^T e^{-r(s-t)}ds}^{+}}{+}<0$.

$$\frac{\partial R^*}{\partial \lambda} = -\frac{\frac{\partial F}{\partial \lambda}}{\frac{\partial F}{\partial R}} = -\frac{OV}{\underbrace{\frac{\partial F}{\partial R}}_{-}} \begin{matrix} > \\ = \\ < \end{matrix} 0 \text{ as } OV \begin{matrix} > \\ = \\ < \end{matrix} 0 \tag{13}$$

So far, we have been looking at permanent changes that have an influence on R^*. However, we also want to look at temporary or anticipated changes that do not affect the overall marginal utility of wealth. Therefore, this kind of changes only causes substitution effects. Applying the Implicit Function Theorem to (10), we get the following comparative statics predictions changes in parameters:

The optimal date of retirement R^* is increasing in the accrual *ACC*, since

$$\left(\frac{\partial R^*}{\partial ACC}\right)_{d\lambda=0} = -\frac{\frac{\partial F}{\partial ACC}}{\frac{\partial F}{\partial R}} = -\frac{\overbrace{\lambda}^{+}}{\underbrace{\frac{\partial F}{\partial R}}_{-}} > 0 \tag{14}$$

An increase in the accrual *ACC* increases the price of leisure, and therefore makes individuals postpone retirement. Furthermore, the optimal date of retirement R^* is increasing in the option value *OV*, since

$$\left(\frac{\partial R^*}{\partial OV}\right)_{d\lambda=0} = -\frac{\frac{\partial F}{\partial OV}}{\frac{\partial F}{\partial R}} = -\frac{\overbrace{\lambda}^{+}}{\underbrace{\frac{\partial F}{\partial R}}_{-}} > 0 \tag{15}$$

Similarly, as the price of leisure is increased, individuals will postpone retirement. The optimal date of retirement R^* is increasing in net income Y_R, since

$$\left(\frac{\partial R^*}{\partial Y_R}\right)_{d\lambda=0} = -\frac{\dfrac{\partial F}{\partial Y_R}}{\dfrac{\partial F}{\partial R}} = -\frac{\overbrace{\lambda}^{+}\overbrace{\left[(1-m-\tau)\right]}^{+}}{\underbrace{\dfrac{\partial F}{\partial R}}_{-}} > 0 \qquad (16)$$

Higher income Y_R increases the price of leisure, so individuals postpone retirement. An exogenous increase in the proportional income tax m or an increase in the payroll tax τ makes an individual shift the optimal date of retirement to an earlier point in time, since

$$\left(\frac{\partial R^*}{\partial m}\right)_{d\lambda=0} = -\frac{\dfrac{\partial F}{\partial m}}{\dfrac{\partial F}{\partial R}} = -\frac{\overbrace{-\lambda Y_R}^{-}}{\underbrace{\dfrac{\partial F}{\partial R}}_{-}} < 0, \qquad (17)$$

$$\left(\frac{\partial R^*}{\partial \tau}\right)_{d\lambda=0} = -\frac{\dfrac{\partial F}{\partial \tau}}{\dfrac{\partial F}{\partial R}} = -\frac{\overbrace{-\lambda Y_R}^{-}}{\underbrace{\dfrac{\partial F}{\partial R}}_{-}} < 0 \qquad (18)$$

An increase in the income or payroll taxes would decrease net income of individuals, and therefore decrease the price of leisure. The optimal date of retirement R^* is decreasing in net pension benefits B_R, since

$$\left(\frac{\partial R^*}{\partial B_R}\right)_{d\lambda=0} = -\frac{\frac{\partial F}{\partial B_R}}{\frac{\partial F}{\partial R}} = -\frac{\overbrace{-\lambda}^{-}}{\underbrace{\frac{\partial F}{\partial R}}_{-}} < 0 \tag{19}$$

Again, an increase in net pension benefits decreases the price of leisure and makes individuals retire earlier. Moreover, the optimal date of retirement R^* is increasing in life expectancy *T*, since

$$\left(\frac{\partial R^*}{\partial T}\right)_{d\lambda=0} = -\frac{\frac{\partial F}{\partial T}}{\frac{\partial F}{\partial R}} = -\frac{\overbrace{\lambda e^{-r(T-R)}\frac{\partial B_T}{\partial R}}^{+}}{\underbrace{\frac{\partial F}{\partial R}}_{-}} > 0 \tag{20}$$

Finally, the negative effect of an increase in poor health or an increase in the degree of disability on the optimal date of retirement R^* is

$$\left(\frac{\partial R^*}{\partial \Theta}\right)_{d\lambda=0} = -\frac{\frac{\partial F}{\partial \Theta}}{\frac{\partial F}{\partial R}} = -\frac{\lambda\overbrace{\frac{\partial B_R}{\partial \Theta}}^{-}}{\underbrace{\frac{\partial F}{\partial R}}_{-}} < 0 \tag{21}$$

Comparative statics shows that unanticipated permanent changes in wealth or income have an ambiguous effect on the optimal date of retirement R^*. This ambiguity depends on the sign of the option value *OV*. Permanent changes are causing wealth and

substitution effects. Anticipated or temporary changes have an unambiguous effect on R^*. They only cause a substitution effect. Theoretically, financial incentives play a crucial role in the retirement decision.

The focus of this study is on the financial incentives that drive retirement. The main questions of interest are: How do financial incentives embedded in the Austrian pension system affect individual retirement behavior? Was pension reform effective in changing these financial incentives? How would future reform scenarios impact retirement behavior? Therefore, we are deriving predictions for empirically testable hypotheses for these questions. This model discussed above explains the optimal date of retirement. In the empirical specification in the following chapters, we will however use the probability of retirement as the endogenous variable of interest. This means for any comparative statics predictions that a positive effect on the date of retirement is equivalent to a negative effect on the probability of retirement and vice versa.

Hypothesis 1: An anticipated increase in one of the accrual measures[10] (*ACC*, *PV*, *OV*) increases the price of retirement leisure.[11] Therefore, the date of retirement *R** is postponed. This is the same as decreasing the probability of retirement.

Hypothesis 2: An unexpected increase in the profile of lifetime wealth as for instance induced by a pension reform has an ambiguous effect on the date of retirement. The effect is composed of a negative *wealth effect* and a positive *accrual effect*. This is equivalent to a positive *wealth effect* and a negative *accrual effect* on the probability of retirement. The direction of the impact depends on the relative magnitudes of these two effects.

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[10] Also, the *IST* is an accrual measure. However, it is defined as a (negative) tax rate. Therefore, an increase in *ACC* is equivalent to a decrease in IST. So, the probability of retirement increases as the *IST* goes up.

[11] There is no or only a very small wealth effect associated with anticipated changes.

CHAPTER 5

DATA AND EMPIRICAL STRATEGY

In order to estimate the impact of the financial incentives on retirement probabilities, we have to look at the data and empirical strategy. Therefore, we are going to discuss the data used, the sample selection, summary statistics, the treatment of income histories, the construction and age profiles of the incentive variables, and the regression method.

The Data

We are using the detailed administrative Databank (2006) containing micro data on 4,975,624 individuals, i.e., the whole labor force in Austria. The data mainly comes from administrative records of the Austrian Social Security Administration. Therefore, the format of the data is insurance spells and earnings career spells. The time frame of the earnings records is 1997 to 2004.

Variables available in the data base are

- Labor market variables: Insurance status at social security administration (e.g., employed, retired) and labor market status (e.g., employee, worker, public servant, unemployed).

- Individual attributes: anonymized individual identification numbers, sex, year of birth, citizenship, academic degree, and date of death (unfortunately, citizenship has a lot of missing values).

- Earnings variables: gross earnings distinguishing between current earnings and allowances.

- Employer attributes: Firm establishment ID, founding year of firm, sector of firm activity (NACE-code), and territorial location of firm activity (NUTS-code).

The data is relatively comprehensive and offers a great deal of detail to researchers. However, at the same time there are some shortcomings. First, there is no information on marriage status of a person, which would be useful in order to control for a couple's joint retirement decision. Second, there is no data on individual's *whole* lifetime income history, only the constrained time frame earnings are available. Therefore, we have to construct income histories for the purpose of calculating average pensionable income according to the pension formula. Also, we have to make assumption on the labor force entry of a person, since the replacement rate depends on the number of insurance years. Third, the data only contains information about earnings from work. Pension benefits are missing. Fourth, no information on property and non-work related income is available, which would be helpful to control for.

Thus, the data is appropriate for testing the hypotheses, but it does not include all of the features and control variables suggested in the literature on retirement behavior. In order to correct for these omitted variables, we are using a fixed effects estimator. Also, some assumptions about an individual's income career are required. To minimize a bias coming from measurement errors in the income histories and the variables derived from them, a fixed effects estimator is the best choice as well.

Sample Selection

For the purpose of a panel regression, the spell-duration format of the data requires the transformation into a person-year format. From the original data universe, we are taking a twenty percent random sample. We only consider individuals who participate in the labor force. Persons who reenter the labor force after their first retirement are also dropped. Then, we exclude persons not employed in the private sector, i.e., farmers, civil servants, self-employed. We also exclude widowers and orphans due to special taxation rules and special earnings patterns. Furthermore, we are dropping workers with more than two years of unemployment. Since earnings histories have to be reconstructed backwards beyond 1997 for pension benefit calculation purposes, we exclude persons who did not work or were already retired in 1997. Also, we are dropping persons who did not retire in any of the years between 1998 and 2004.

A comparison between the original sample and the sample used in the further analysis is in table 4. The original sample refers to the same birth cohorts and age groups as the sample used. Year of observation, birth year, and death year are therefore almost identical. Individuals in the original sample are on average older, because also post-retirement years are included. Gross earnings are higher in the sample used than in the original sample. This reflects the fact that the original sample contains post-retirement part-time workers, civil servants, farmers, and persons with very rudimentary earnings times. All of these groups typically have lower earnings than employees in the private sector. The same

groups also usually have less sick days. Also, the Health variable is smaller in the original sample because post retirement years are included.

The resulting data sets for males and females used in the regressions are person-year observations over the time interval 1998 to 2003. The first and the last years of the individual observations are used in the variable calculation. However, they are lost in the regression, since we have to look forward one year in the accrual calculation, and one year backwards in the earnings history reconstruction. The male panel consists of 20,612 persons with 75,494 observations and the average observation duration of 3.7 years. The female panel consists of 15,108 persons with 47,153 observations, and the average observation duration of 3.1 years. The female panel is restricted to ages up to age 60, because the legal retirement ages are earlier than for males. Birth years range from 1938 through 1945. This implies that in 1998, a person is between 53 and 60 years of age. In 2003, individuals are between 58 and 65 years of age.

Table 4. Difference original sample and sample used

	Means of men		Means of women	
Variable	Original sample	Sample used	Original sample	Sample used
Year of obs.	2000.483	1999.74	2000.143	1999.341
Birth year	1941.775	1941.733	1942.917	1942.934
Death year	2094.94	2095.167	2097.701	2098.196
Gross earnings	16,066	25,288	8,959	14,441
Allowances	2,683	4,094	1,914	2,239
Age	58.708	58.007	57.226	56.407
Health	0.014	0.032	0.009	0.015
Obs.	280,775	75,494	153,283	47,153
Individuals	47,383	20,612	32,151	15,108

Notes: Table compares means of some characteristics between the original sample and the sample used in the analysis. Identical birth cohorts and age groups are compared. Variables are defined intuitively, monetary variables are nominal. Allowances are extra earnings paid for Christmas and vacation purposes, usually in the amount of two additional salaries. Health is the share of sick days relative to labor force participation.

Descriptive Statistics

The following summary statistics are based on persons per year, since every person has a unique observation in a year. Also, means of all observations over all years are discussed. Tables of descriptive statistics are in the appendix, table A2.1 for the male sample and A.2.2 for the female sample. Retirement incentives are discussed in the following sections. 24 percent of male and 27 percent of female observations are initial retirement years. Since earlier years of the panels include earlier ages, the share of initial retirement years increases in the year of the observation. Both sexes show a slight reduction in the share of retirement after reform 2000, i.e., from year 2000 to 2001. The mean retirement year is 2001 for both sexes. Females earn roughly 68 percent of male net earnings, and moreover accumulate pensionable earnings of only 59 percent of the average level for males. These shares stay relatively constant over years 1998 through 2003. The distribution of the age dummies shows the stepwise drop out of younger ages and addition of older ages over time. This represents the cohort structure of the sample. The share of sick days during labor force activity is 3.2 percent of males and 1.8 percent of females. Also, this number stays relatively constant over the years. 45.8 percent of male and 15.8 percent of female observations are reported as work in the production sector as opposed to working in the services sector or being out of the labor force, again with not big changes over time. Male blue collar workers represent 41.4 percent of the observations, females only 30.3 percent. Roughly 26 percent of both sexes are working in Vienna, between 14 percent (males) and 11 percent (females) in Eastern Austria, 11 percent work in Southern Austria, the remainder in Western Austria.

These location shares also stay relatively constant over time. The mean year of observation is 1999 for both sexes.

The share of retirees of each age group given that one not already retired in table 5 shows some striking behavioral differences between men and women. On average, men retire at age 59, women at age 57. For men, the early retirement option becomes available at age 60, for women at age 55. The statutory retirement ages are 65 for men and 60 for women. Before early retirement, only a disability pension is available. Men are using the early retirement option more frequently than women. One year before the statutory retirement age, 22.6 percent of men and only 13.2 percent of women retire. These huge differences remain through all ages before statutory retirement age. Moreover, women are making largely less use of a disability pension than men. One year before early retirement becomes available, 12.3 percent of men, but only 1.7 percent of females retire on a disability pension. Also, these differences persist through all ages that only allow retirement on a disability pension. This suggests that women are much more adapting their retirement behavior to the legal scheme of retirement ages than men. A possible reason might be that men are working in more health deteriorating jobs than women. Also, the later legal retirement ages and the shorter life expectancy might discourage men to stay in the labor force until age 65. Men would also want to coordinate retirement decisions with their wives. Moreover, it is often criticized that disability pensions are granted too generously in Austria.[12] Thus, different retirement ages for men and women seem to induce effects on retirement behavior.

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[12] In Germany, disability pensions are also granted very generously. According to Boersch-Suppan, Axel, Reinhold Schnabel, Simone Kohnz, and Giovanni Mastrobuoni. 2004. Micro-modeling of retirement decisions in Germany. In *Social security programs and retirement around the world: Micro estimation*, ed. Jonathan Gruber and David A. Wise:285-344. Chicago: University of Chicago Press., 29 percent of German private sector workers retire on a disability pension, while only 20 percent of them retire statutorily. Moreover, 40 percent of German civil servants enter retirement on a disability pension.

Reform 2000 unintendedly increased the share of early retirees at each age for both sexes. Moreover, there is a sharp increase in male disability pensioners following reform 2000. This suggests that retirees evade into the disability pensions since there is no minimum age requirement for this option.

Table 5. Percentage of retirees, by sex and age

Age	Males			Females		
	Base case	Pre reform 2000	Post reform 2000	Base case	Pre reform 2000	Post reform 2000
53	0.058	0.058		0.015	0.015	
54	0.053	0.053		0.017	0.017	
55	0.071	0.071		0.431	0.431	
56	0.071	0.068	0.109	0.315	0.295	0.435
57	0.194	0.182	0.241	0.202	0.177	0.263
58	0.174	0.159	0.209	0.178	0.155	0.211
59	0.123	0.121	0.126	0.132	0.133	0.131
60	0.558	0.631	0.468	0.708	0.626	0.775
61	0.661	0.563	0.709			
62	0.440	0.323	0.478			
63	0.335		0.335			
64	0.226		0.226			
65	0.789		0.789			

Notes: Table shows the share of retirees of an age group given that one not already retired. For males and females, three cases are distinguished: the base case representing the whole panel from 1998 to 2003, the panel pre reform 2000, and the panel after reform 2000. The statutory retirement age is 65/60 (men/women), the minimum early retirement age is 60/55 (men/women). Before early retirement, the only retirement option is a disability pension.

Treatment of Income Histories and Pension Benefit Calculation

In order to calculate pension benefits and the financial incentives to retire, we need an income history of each person. The time frame of the data is not long enough for a complete income history. Also, there is no data on pension benefits and unemployment compensation, only gross earnings from 1997 to 2004 are available. Pension benefits are

calculated according to the pension formula in chapter 2. They depend on the average pensionable income of the best 15 income years. Also, they depend on a replacement rate. So, we have to impute the income data necessary to calculate pension benefits.

Pensionable income consists of earnings from work, but also of unemployment compensation. There are 4 different cases for the treatment of earnings and unemployment compensation in a person's income history:

The first case is the treatment of years before the data window 1997 to 2004. We are imputing earnings and unemployment compensation 15 years backwards from year 1997. Using the earnings in 1997 as the base, pre-1997 earnings are assumed to grow at the annual aggregate growth rate of nominal earnings[13] as found in Databank (2007a). Then, for each year pre-1997, we calculate the amount of pensionable unemployment compensation. Weighing earnings and unemployment compensation by a predicted share of being unemployed for each person results in the amount of pensionable income (see appendix 1 for the method to predict the share of unemployment at a certain age).

The second case is the treatment of observed data in working years from 1997 to 2004. Earnings are observed, unemployment compensations are not. The pensionable unemployment compensation is calculated and prorated for the observed time of

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[13] In order to determine the growth of earnings as age increases, we have to look at the age earnings profile in Austria. In contrast to many OECD countries, salaries in Austria grow according to seniority until retirement. This implies an age-earnings profile strictly increasing in age rather than being concave in age near-retirement as described on page 129 in OECD. 2005. *Ageing and Employment Policies: Austria.* Paris: OECD. Also, all wage increases are bargained on the federal level by labor unions and employer organizations of an industry. Consequently, all employees in an industry will have an identical salary growth rate each year. Under these circumstances, the "best 15 years" for pension computation are most likely to be the last 15 years before retirement. We will therefore, adopting the method portrayed in Brugiavini, Agar, and Franco Peracchi. 2004. Micro-modeling of retirement behavior in Italy. In *Social security programs and retirement around the world: Micro estimation*, ed. Jonathan Gruber and David A. Wise:345-398. Chicago: University of Chicago Press. and on page 300 in Hofer, Helmut, and Reinhard Koman. 2006. Social security and retirement incentives in Austria. *Empirica* 33, no. 5: 285-313., assume that earnings pre-1997 and prospective future earnings between 1998 and 2004 grow at the annual aggregate growth rate of earnings as found in Databank. 2007a. Austrian Chamber of Commerce: Pro-Kopf-Einkommen der Arbeitnehmer [Per capita income of employees]. Available from www.wko.at/Extranet/Langzeit/Lang-Einkommen.pdf, accessed July 1, 2007.

unemployment. Following the pension law, unemployment times in a particular year enter into the pension formula by the amount of 70 percent of the previous year's gross earnings. For unemployment times exceeding 52 weeks, only 92 percent of the latter amount count as pensionable income. Both components, earnings and pensionable unemployment compensation, add up to pensionable income for one year.

Third, there is a special treatment of the retirement year. In case someone retires in a year after working parts of this year, the pre-retirement earnings are projected to a whole year's earnings. In case someone retires on January 1st, his potential earnings in the retirement year are projected forward from the earnings in the year before retirement.

Fourth, we need projected earnings from the last working year until year 2004. Adopting the same method as sooner in the backwards earnings calculation, the earnings after the last working year grow at the annual aggregate growth rate of nominal earnings. However, after as soon as retirement is observed, it is irrational to be unemployed. A worker would rather retire before he becomes unemployed. He would only look at prospective future earnings from work. Therefore, we are not projecting pensionable unemployment compensation for these years.

For the calculation of the replacement rate according to the pension formula, we need the number of insurance years of a person. However, the age of labor force entry is unknown. Therefore, considering the economic activity rates by sex in 1950 as described in Databank (2007c), this study will assume that all men start their insurance career at the age of 20, and all women at the age of 17.[14]

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[14] An investigation of average statutory retirement ages in 1998 in the data supports this assumption: going back 45 years from the mean age of retirement by sex results in the maximum replacement rate if insurance careers started at ages 20 and 17, respectively.

Another problem of identification arises from individuals exempt from reform 2000. It is observable, that people who retired at ages 55/60 (females/males) in 2001, 2002, and 2003 are exempt from reform 2000. If they were not exempt, they would not have been able to take an early retirement pension at ages 55/60, since reform 2000 increased the early retirement ages to 56.5/61.5. However, it is not clear if people who retired in ages later than 55/60 in that time frame were exempt from reform 2000 or not. This study is treating them as exempt, because they could have already retired at the earliest age possible. However, this might give rise to a bias in the estimates.

In order to calculate earnings and pension benefits net of all taxes, we are using the Austrian payroll and personal income taxation regulations (appendix 1).

Social Security Wealth

The main variables of interest are the financial incentives of retirement. Once becoming eligible for retirement, workers consider pension benefit streams as well as potential earnings from delayed retirement in their participation decision. There are various possibilities to combine these financial elements.

The basic magnitude for calculating the incentive measures is social security wealth (*SSW*). *SSW* is the present discounted value of the sum of expected future pension benefits. One would expect that persons with a higher level of social security wealth can consume more of all goods including retirement leisure. Therefore, the probability of retirement should increase in the level of *SSW*. It would also be natural to expect that a pension system provides a higher or at least non-decreasing level of *SSW* the longer retirement is postponed.

If *SSW* though decreases in the age of retirement, a pension system is actuarially not fair, since it financially punishes to stay longer in the labor force.

We are calculating social security wealth according to the following formula which is equivalent to the definition of gross social security wealth on page 911 in Feldstein (1974):

$$SSW_t(R) = \sum_{s=R+1}^{T} B_s(R) p(s \mid t) \delta^{s-t} \tag{22}$$

$SSW_t(R)$ = present discounted value in year *t* of all future net pension benefits from retiring at age *R*.

$B_s(R)$ = net pension benefit in year *s* from retiring at age *R*, where $s \geq R+1$.

$p(s \mid t)$ = conditional probability of survival until year *s* given survival until year *t*.

$\delta = \frac{1}{1+r}$ discount factor.

r = nominal interest rate.

T = age of certain death.

Since future pension benefits $B_s(R)$ are unknown, we have to adapt an indexation rule that represents the current practice. The policy is that nominal wages and nominal pensions should increase at the same rate as described on page 301 in Hofer and Koman (2006). Therefore, we assume a pension growth in line with the long term projected rate of wage growth of 1.6 percent per year. The pension benefit of each single year is corrected by a conditional survival probability $p(s \mid t)$. To this end, we are using life tables provided from Databank (2007b). Maximum age *T* provided in these life tables is 95. In order to discount

future pension benefits to current year *t*, we are using a 4.6 percent nominal interest rate *r*. It is the sum of a 3 percent real interest rate and a 1.6 percent long term projected inflation rate. This implies a nominal discount factor of $\delta = 1/(1.046)$.

The structure of *SSW* in Austria is not set in a way to provide incentives for delaying retirement until the statutory retirement ages. How does *SSW* actually behave at different retirement ages in Austria, and which changes did reform 2000 bring? For males, we see in figure 1 and in table 6 that *SSW* increases in the age of retirement until it reaches a spike. *SSW* in the base case spikes for retirement at age 60. Reform 2000 even shifted the spike back from age 62 to age 60. The immediate incentive prediction is to delay retirement until the age at which *SSW* spikes. For the early retirement ages from age 60 to 64, *SSW* even strictly decreases. Reform 2000 inverted the previously correct incentive structure from age 60 to 64. So, the incentive to wait until the local age-65 spike age is reached, weakens. After the spike age, there is no more incentive to delay retirement, since *SSW* decreases with every year of postponement. Therefore, this incentive structure of *SSW* suggests retiring before the statutory age for men of 65. Furthermore, the levels of *SSW* at each age of retirement decreased after reform 2000, inducing another weakening of the *SSW* incentive.

For females, we see in figure 1 and in table 6 that *SSW* increases in the age of retirement until it reaches a spike at age 63 in the base case. Reform 2000 shifted the spike from age 62 to age 63. However, looking at the ages of early retirement, age 55 to 59, shows a local spike at age 56. Reform 2000 even shifted this local spike backwards. Therefore, this incentive structure of *SSW* suggests retiring before the statutory age for women of 60. Furthermore, the levels of *SSW* at each age of retirement decreased for most ages after reform 2000.

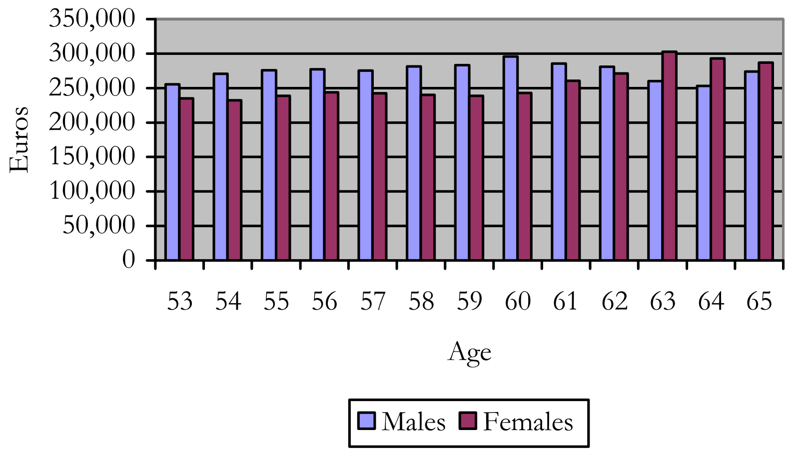


Figure 1. Age profile of *SSW*, by sex, base case.

Table 6. Age profile of SSW, birth cohorts 1938-1945

Retirement age	Males			Females		
	Base case	Pre reform 2000	Post reform 2000	Base case	Pre reform 2000	Post reform 2000
53	255,425	255,425		234,909	234,909	
54	270,665	270,665		232,398	232,398	
55	275,810	275,810		238,683	238,683	
56	277,419	279,400	256,576	243,624	244,933	235,796
57	275,453	276,840	270,063	242,416	248,397	228,230
58	281,327	283,752	275,425	240,142	248,697	227,594
59	283,301	284,776	280,652	238,531	246,876	229,828
60	*295,759	296,029	*295,425	242,726	242,282	243,090
61	285,613	306,399	275,278	260,750	255,465	264,315
62	281,134	*314,334	270,180	271,347	*276,285	269,720
63	260,236		260,236	*302,902		*302,902
64	253,110		253,110	293,048		293,048
65	274,149		274,149	287,084		287,084

Notes: (a) Numbers are age profiles of the incentive measure showing means in 1996 Euros. The table compares the means of the incentive measure in the base case, pre and post reform 2000. This also applies to figure 1, except for figure 1. only showing the base case.

(b) * indicates spikes of the incentive measure.

Acrual

The first incentive variable is the accrual in social security wealth. This is the difference in *SSW* if a worker delays retirement by one year. The *ACC* gives an incentive to stay in the labor force if it is positive or at least non-negative. By postponing retirement by one year, a worker will be rewarded if he received a higher level of *SSW* compared to retiring now. If the accrual is negative, there is no incentive to postpone retirement for another year, because this would penalize a worker by providing a lower level of *SSW* compared to retiring now.

The accrual is calculated according to

$$ACC_t(\mathrm{R}+1) = SSW_{t+1}(\mathrm{R}+1) - SSW_t(\mathrm{R}) \tag{23}$$

ACC in year t is therefore the difference in *SSW* between retiring at age R+1 in year t+1 and retiring at age R in year t. The formula requires that $SSW_{t+1}(\mathrm{R}+1)$ has to be discounted by an additional δ to the present year t in order to compare the two *SSW* streams at the same discounting level.

The Austrian pension system has in principle an actuarially unfair accrual age profile For the base case, before, and after reform 2000 the *ACC* at different ages is pictured in figure 2 and in table 7. For males, the accrual spikes in the base case at age 64. Before reform 2000, the spike happens to be at age 59, which increases to age 64 after the reform. For females, the accrual spikes at age 62 in the base case. Before reform 2000, the spike was at

age 56, which changed to age 62 following the reform. The spike would imply the general *ACC* incentive to retire at age 64 for men, and 62 for women. However, once becoming eligible for early retirement, the *ACC* decreases with every year of postponement until age 63 for men and age 58 for women. Therefore, for both genders, reform 2000 succeeded in shifting the *ACC*-spike incentive to a later age, but did not take the early retirement years into account. Also, the accrual is positive at almost all ages of retirement, the magnitudes though are often very small. This raises the question if a slightly positive accrual can really induce an incentive to stay in the labor force for another year. Moreover, after reform 2000, the level of the accrual decreased at all ages for men, weakening the incentive effect originally intended even more. However, the magnitudes of the accrual incentives are very small especially before the early retirement ages where an individual is only eligible for disability pensions.

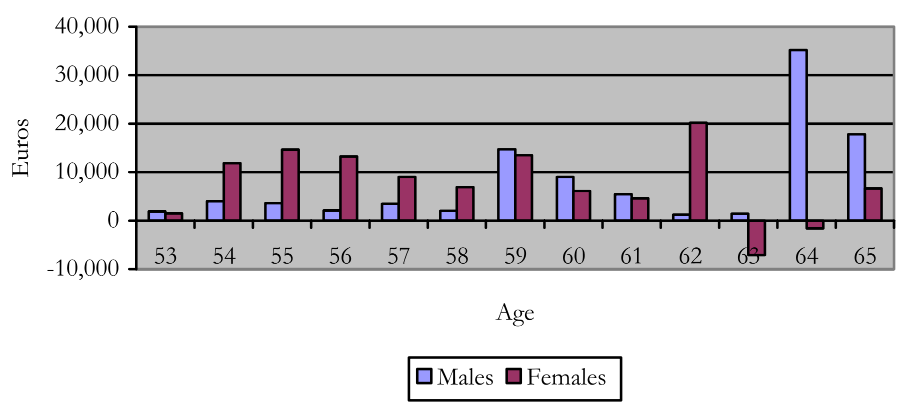


Figure 2. Age profile of *ACC*, by sex, base case.

Table 7. Age profile of ACC, birth cohorts 1938-1945

Retirement age	Males			Females		
	Base case	Pre reform 2000	Post reform 2000	Base case	Pre reform 2000	Post reform 2000
53	1,893	1,893		1,463	1,463	
54	3,986	3,986		11,860	11,860	
55	3,619	3,619		14,659	14,659	
56	2,063	2,368	-1,143	13,234	*15,656	-1,253
57	3,456	4,966	-2,413	9,051	13,316	-1,067
58	1,992	2,869	-144	6,914	11,512	171
59	14,682	*21,743	2,006	13,517	9,210	18,009
60	9,034	12,009	5,349	6,085	5,934	6,208
61	5,484	12,108	2,189	4,596	3,550	5,302
62	1,234	-1,480	2,130	*20,198	-3,840	*28,119
63	1,419		1,419	-7,061		-7,061
64	*35,157		*35,157	-1,600		-1,600
65	17,797		17,797	6,667		6,667

Notes: see notes to table 6.

Peak Value

An individual might not just look ahead one year, but have a longer horizon for making his retirement decision. Looking ahead one year might also ignore a situation in which the *ACC* is negative in the next year, but positive in another year. Then, the individual might retire at the age that yields the maximum in *SSW*. Therefore, another incentive measure, the peak value (*PV*), is the difference between the maximum of *SSW* and *SSW* from retiring now. However, there might be pension systems in which *SS*W decreases for every year of retirement, or in other words the *ACC* is negative for all possible years of retirement. Then, the *PV* collapses into a negative single year accrual, and there is no incentive to delay retirement.

So, the *PV* measure is calculated as

$$PV_t(s > R) = \max\left[SSW_{s>t}(s > R)\right] - SSW_t(R), \qquad (24)$$

which is the gain in *SSW* in year *t* from postponing retirement until year $s > t$, where year *s* yields the maximum possible level of *SSW*. The peak value is right-censored, i.e., the last year to consider the maximum in *SSW* is 2004. However, there should not be a lot of right-censoring since comparing the age profiles of *PV* and a three-year accrual yields almost identical results.

The *PV* incentive in the Austrian pension system (figure 3. and table 8) is not set in a way to postpone retirement, either. The spikes for the *PV* incentive are in the base case 64 for men and 54 for women. Reform 2000 shifted the spikes from 59 to 64 for men, and from 54 to 62 for women. During the early retirement ages, *PV* is often negative for men and decreasing in retirement age for women. This implies the incentive to retire before the statutory retirement ages. Reform 2000 improved this structure for women by inverting the decrease of *PV* in early retirement age. For men, *PV* was inverted, but is negative until age 62. The level of *PV* for men decreased at all ages after reform 2000, weakening the incentive to stay in the labor force. For females, reform 2000 increased the levels of *PV* at most ages, strengthening the incentive.

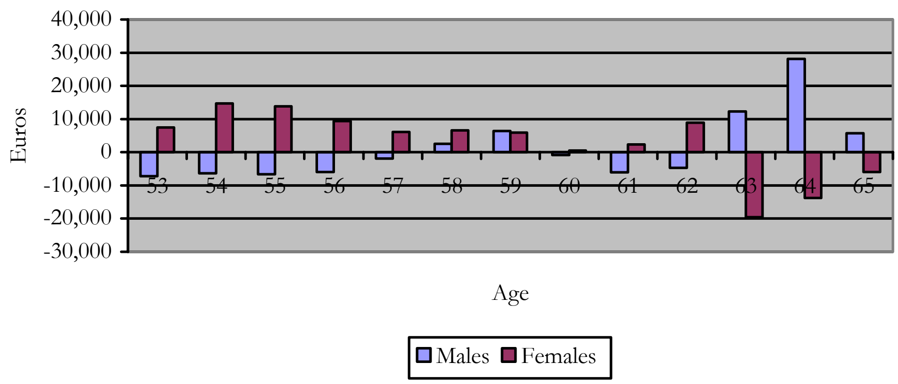


Figure 3. Age profile of PV, by sex, base case.

Table 8. Age profile of PV, birth cohorts 1938-1945

Retirement age	Males Base case	Males Pre reform 2000	Males Post reform 2000	Females Base case	Females Pre reform 2000	Females Post reform 2000
53	-7,210	-7,210		7,473	7,473	
54	-6,392	-6,392		*14,725	*14,725	
55	-6,650	-6,650		13,876	13,876	
56	-5,999	-5,432	-11,967	9,421	12,901	-11,394
57	-1,936	925	-13,055	6,122	8,665	90
58	2,571	7,984	-10,601	6,555	4,811	9,112
59	6,388	*14,891	-8,875	5,912	632	11,417
60	-815	3,142	-5,714	505	-3,351	3,665
61	-6,073	-671	-8,759	2,331	-7,242	8,788
62	-4,698	-14,127	-1,587	8,869	-15,071	*16,758
63	12,249		12,249	-19,559		-19,559
64	*28,125		*28,125	-13,772		-13,772
65	5,741		5,741	-5,958		-5,958

Notes: see notes to table 6.

Option Value

Individuals might not only consider *SSW* in their retirement decision, but also potential earnings from continued work. The option value Boersch-Suppan et al.) combines both income sources. It is the sum of the accrual and potential earnings from postponing retirement by one year. If the *OV* is positive, a worker has an incentive to delay retirement. A negative accrual might be offset by the amount of potential earnings, so that the *OV* becomes positive. A positive accrual might furthermore result in a very large *OV*, which even strengthens the incentive effect of staying in the labor force. If the *OV* is negative, however, potential earnings are not high enough to offset a loss in *SSW*. Then, there is no incentive to delay retirement.

In formulae, the *OV* of postponing retirement to age *R*+1 is defined as

$$OV_t(\mathrm{R}+1) = NETEARN_{t+1} + ACC_t(\mathrm{R}+1)\,, \tag{25}$$

where $NETEARN_{t+1}$ is the present discounted value of potential net earnings during the year of postponing retirement.

The age profile of the *OV* (figure 4 and table 9) does not provide incentives to delay retirement. The spike ages of the *OV* are in the base case 64 for men and 62 for women. Reform 2000 shifted these spikes from 59 to 64 for men, and from 56 to 62 for females. During the early retirement years, the *OV* decreases in age. Reform 2000 did not change this basic structure for men. However, it slightly improved for women. The *OV* levels decreased

for both genders at most ages following reform 2000. Therefore, the incentive to postpone retirement weakened.

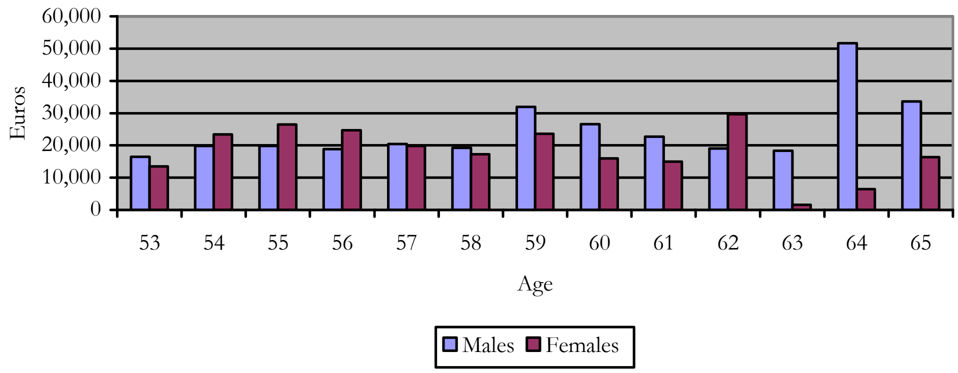


Figure 4. Age profile of OV, by sex, base case.

Table 9. Age profile of OV, birth cohorts 1938-1945

Retirement age	Males			Females		
	Base case	Pre reform 2000	Post reform 2000	Base case	Pre reform 2000	Post reform 2000
53	16,472	16,472		13,513	13,513	
54	19,855	19,855		23,432	23,432	
55	19,873	19,873		26,455	26,455	
56	18,795	19,459	11,807	24,667	*27,064	10,336
57	20,445	22,370	12,965	19,848	24,083	9,804
58	19,284	20,339	16,719	17,259	21,855	10,518
59	31,946	*38,807	19,630	23,605	19,587	27,794
60	26,561	29,457	22,976	15,972	15,973	15,970
61	22,706	29,905	19,127	14,926	13,115	16,147
62	18,996	15,270	20,225	*29,671	4,659	*37,912
63	18,318		18,318	1,574		1,574
64	*51,624		*51,624	6,461		6,461
65	33,572		33,572	16,323		16,323

Notes: see notes to table 6

Implicit Tax on Work

Another way to look at the interaction of *SSW* and potential earnings is called social security tax on work or penalty on work (*IST*). This is the negative ratio of the accrual and potential net earnings from work during the year of postponing retirement. A positive accrual will result in a subsidy rate, the *IST* being negative. This represents an incentive to stay in the labor force. Delaying retirement is rewarded by a gain in *SSW*. The more negative the subsidy ratio, the bigger this incentive effect is. If the accrual is smaller than potential earnings, then the *IST* is negative but greater than (-1). In this case, the incentive to work is very weak. If the *IST* is positive, we think of it as a tax on continued work. Having a negative accrual makes the *IST* a tax, and penalizes staying in the labor force. The more positive the *IST* in this case is, the higher the incentive to retire now is, tax rates below 1 provide a very weak incentive to retire.

Therefore the implicit tax on work is calculated as

$$IST_t(\mathrm{R}+1) = -\frac{ACC_t(\mathrm{R}+1)}{NETEARN_{t+1}} \qquad (26)$$

The age profile of *IST* (figure 5 and table 10) provides for most ages a correct, but weak incentive to postpone retirement. The *IST* spikes at ages 64 for men and 62 for women. Reform 2000 shifted these spikes from 59 to 64 for men, and from 56 to 62 for women. At the early retirement ages, the *IST* is often negative but greater than (-1),

providing a very weak incentive to stay in the labor force. Reform 2000 did not improve this situation for males. It even worsened the *IST* incentive for females shifting from a weak subsidy to a tax on continued work. The levels of the *IST* increased by reform 2000 for both genders, also weakening the incentive to postpone retirement.

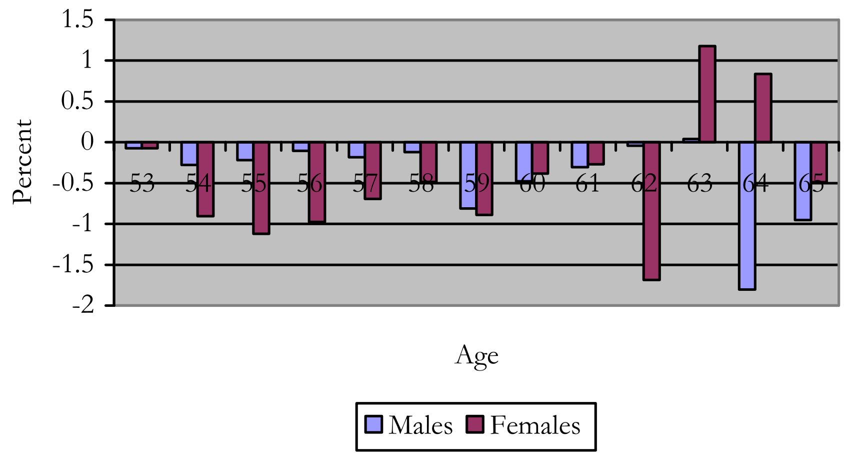


Figure 5. Age profile of IST, by sex, base case.

Table 10. Age profile of IST, birth cohorts 1938-1945

Retirement age	Males			Females		
	Base case	Pre reform 2000	Post reform 2000	Base case	Pre reform 2000	Post reform 2000
53	-0.074	-0.074		-0.075	-0.075	
54	-0.278	-0.278		-0.906	-0.906	
55	-0.219	-0.219		-1.120	-1.120	
56	-0.104	-0.129	0.161	-0.975	*-1.156	0.104
57	-0.185	-0.278	0.176	-0.695	-1.067	0.186
58	-0.120	-0.171	0.005	-0.487	-0.912	0.138
59	-0.813	*-1.208	-0.106	-0.890	-0.661	-1.129
60	-0.476	-0.667	-0.240	-0.383	-0.429	-0.345
61	-0.305	-0.670	-0.123	-0.271	-0.224	-0.303
62	-0.041	0.071	-0.078	*-1.686	0.623	*-2.446
63	0.040		0.040	1.179		1.179
64	*-1.802		*-1.802	0.838		0.838
65	-0.953		-0.953	-0.491		-0.491

Notes: see notes to table 6.

Regression Approach

Empirically, we are looking at the effect of the incentive variables on the probability of retirement. The main empirical hypothesis to be tested is that retirement behavior in Austria responds to the financial incentives embedded in the pension system. In particular, one would expect an increase in the level of *SSW* to have a positive impact on the probability of retirement. Also, we expect an increase in one of the accrual measures, i.e., the one year accrual, the peak value, and the option value to have a negative impact on the probability of retirement. Finally, an increase of the implicit tax on work should have a positive effect on the probability of retirement.

The incentive effects on the probability of retirement are twofold. First, there is a *wealth effect*, represented by a variation in the level of *SSW*. A higher *SSW* would induce the consumption of more goods, including retirement leisure. This effect is similar to an income effect in the basic labor-leisure choice model. The second effect is the *accrual effect*. Increasing consumption in the retirement period resulting from an additional year of work is compared to an additional year of leisure. The accrual effect is the equivalent of the substitution effect in the basic labor-leisure choice. It represents the effect of the change in the relative price of retirement leisure over time on the decision to retire. The accrual effect can be represented by any of the above accrual measures, the one year accrual *ACC*, the *PV* accrual, the *OV* or the *IST*.

We are estimating a linear probability model with fixed effects in which the dependent variable *R* is a binary indicator of retiring at age *t* conditional on being in the labor force in year *t*-1. Retirement is an absorbing state, so for each individual, only the first year of retirement is used. The regression equation for the *i*-th individual observed in year *t* is specified as

$$\begin{aligned} R_{it} &= \beta_0 + \beta_1 SSW_{it} + \beta_2 INCENT_{it} + \\ &+ \beta_3 INCOME_{it} + \beta_4 AGE_{it} + \beta_5 X_{it} + \beta_6 Y_{it} + a_i + u_{it}. \end{aligned} \tag{27}$$

SSW is social security wealth, $INCENT$ is one of the above incentive measures, either the accrual, or peak value, or the option value, or the implicit tax on work. $INCOME$ is a set of income controls, including potential earnings next year as well as pensionable earnings and squares. The reason for using income controls is that higher income should increase the probability of retirement. Individuals then can buy more goods including retirement leisure. AGE is a set of age dummies. X is a matrix of individual characteristics

affecting the retirement decision, including health, industry affiliation, occupation, and location. Due to the fixed effects estimation, a dummy for academic degree is not included. However, the individual fixed effects controls for this. Y is a set of year dummies, and a_i is an individual fixed effect. For further explanation of the variables used in the regressions refer to appendix *A.2*.

As an important point for capturing the effects of reforms, the panel variables are constructed in the following way. Individuals are completely surprised by pension reform. Therefore, they adapt their expectations about present and future incentive measures according to the current year legislation. Once a reform is implemented, individuals change their expectations following the reform, and changing their expectations for all current and future years according to the reform legislation. This approach enables me to simulate the effect of retirement incentives on the probability of retirement before and after the reform.

CHAPTER 6

REGRESSION RESULTS

A first round of results contains the regression results of financial incentives, a set of controls on the probability of retirement as well as the goodness of fit of theses models. The coefficient estimates of the financial incentive variables show striking differences in international comparison. Austrians respond much stronger to a change in financial incentives than older workers in other countries. Also, unlike in most other countries, women respond stronger to accrual incentives than men.

Retirement Incentives

First, we will report regression results for males and females in table 11. For complete regression output, please refer to appendix A.3. There are four different models for males and females each. For each regression model, coefficient estimates of the linear probability model are reported. In the regression, *SSW*, *ACC*, *PV*, *OV* and the income controls are expressed in units of 10,000 Euros. The interpretation of a coefficient estimate in a linear probability model is straight forward. The coefficient represents *ceteris paribus* the percentage point change in the probability of retirement following a unit increase in the explanatory variable. The estimates on the financial incentives get the expected signs and are significant all across the models. There are three exceptions. The coefficient on *SSW* in the

PV model for females is insignificant. The coefficient on the *IST* for men gets the wrong sign, for females it gets the right sign but is insignificant.

Table 11. Linear probability model (fixed effects),
Retirement probability (dependent variable)

Variable				
		Males		
	ACC model	*PV* model	*OV* model	*IST* model
SSW	0.096	0.094	0.096	0.099
t-value	(57.18)**	(54.58)**	(57.18)**	(59.38)**
ACC	-0.011			
t-value	(9.39)**			
PV		-0.013		
t-value		(10.65)**		
OV			-0.011	
t-value			(9.39)**	
IST				-0.011
t-value				(6.73)**
Number of obs.	75,494	75,494	75,494	75,494
		Females		
	ACC model	*PV* model	*OV* model	*IST* model
SSW	0.009	0	0.009	0.013
t-value	(3.91)**	(0.08)	(3.91)**	(6.08)**
ACC	-0.021			
t-value	(10.86)**			
PV		-0.023		
t-value		(11.84)**		
OV			-0.021	
t-value			(10.86)**	
IST				0
t-value				(0.08)
Number of obs.	47,153	47,153	47,153	47,153

Notes: (a) Model estimated as a linear probability model with fixed effects. *SSW*, *ACC*, *PV*, and *OV* are in 10,000 Euros. Only incentive measures are reported. For complete regression results, see tables A.3.1 through A.3.4.

(b) * Significant at 5 percent; ** significant at 1 percent.

All across the four models, coefficients of *SSW* are highly significant for men and get the expected positive sign. For males, the effect of a 10,000 Euro increase in the level of *SSW* increases the probability to retire between 9.4 and 9.9 percentage points. For females, all estimates for *SSW* are significant and get the expected positive sign as well. Therefore, a 10,000 Euro increase in the level of *SSW* increases the probability of retirement by 0.9 to 1.3 percentage points. The magnitude of the coefficient on *SSW* is smaller for women than for men.

In the *ACC* model, we see that for males, the coefficient on the *ACC* is significant and gets the expected negative sign. The same holds for females. A 10,000 Euro increase in the *ACC* decreases the probability of retirement by 1.1 percentage points in the male case, and by 2.1 percentage points in the female case. This is relatively surprising, since the financial incentives should work better with men rather than with women. As found in Gruber and Wise (2004), men should respond stronger to financial incentives than women. The reason for that is the higher share of household income originating from men rather than from women. However, there is a special situation in Austria concerning legal retirement ages. Women in Austria have earlier retirement ages, and couples are to a certain degree making joint retirement decisions. Therefore, the joint retirement decision seems to be women driven rather than men driven, which would point at a better hold of financial incentives with women compared to men. Zweimuller, Winter-Ebmer, and Falkinger (1996) support this hypothesis. They present evidence that the cross-effect on men's participation rates, resulting from a rise in the women's early retirement age, is almost one half of the direct effect on the women's participation rates. There is no similar effect vice versa. Another country that has different legal retirement ages for men and women is Italy. Brugiavini and Peracchi (2004) found that like in Austria, men respond stronger to changes

in *SSW*, while women respond stronger to changes in the accrual incentives. So, there seems to be a correlation between different retirement ages for men and women and a gender difference in the response to financial incentives.

In the peak value model, the estimated coefficients on the *PV* are significant and get the expected negative sign for both sexes. Any 10,000 Euro increase in the *PV* results in a decrease in the probability of retirement of 1.3 percentage points for males, and 2.3 percentage points for females, respectively. Again, women respond stronger to the peak value incentive than men.

In the option value model, coefficients on the *OV* are both significant and get the expected negative sign for both sexes. For females, any 10,000 Euro increase in the *OV* results in a decrease of the probability of retirement by 1.1 percentage points. For females, this magnitude is 2.1 percentage points. Remarkably, the estimated models for the *ACC* and the *OV* give almost identical results, both for men and women. The *OV* is the sum of *ACC* and prospective earnings from postponing retirement. Therefore, the identical estimates for *ACC* and *OV* might indicate that the retirement decision looking ahead one year is only determined by the accrual in social security wealth alone, but not by prospective earnings in the year of postponement.

In the *IST* model, the coefficient on the implicit tax on work is significant, but gets the wrong negative sign for males. For females, it is insignificant, but gets the right sign. However, the magnitude of this coefficient for females is very close to 0. This suggests that individuals in Austria do not respond to the *IST*. However, this does not contradict the estimates for the other incentive variables. The *IST* is inconsistent with the other incentive measures in the way that it is a rate rather than a marginal benefit measure.

Overall, individuals in Austria respond to the financial incentive to retire. The strongest response comes from the *PV* incentive for both sexes. The *ACC* shows a lower degree of responsiveness. This finding is in line with most country studies in Gruber and Wise (2004). People respond stronger to several-year accruals than to one-year accruals. This suggests that people not only look ahead one year, but more importantly have a longer horizon in making their retirement decision. Accrual effects are usually stronger than wealth effects for females. For males, wealth effects are stronger than accrual effects which points in the direction of men being on their backwards bending portion of the inter temporal labor supply function. Therefore, the overall effect of an increase in the relative price of retirement leisure on the probability of retirement is negative for women and positive for men.

Also, the effects of a change in the incentive measures on the retirement probability are relatively high in international comparison. We are relating the incentive effects in Austria to the findings in Gruber and Wise (2004). This shows that an increase in *SSW* on the probability of retirement in Austria is 107 times higher than in the US, 96 times higher than in France, and 48 times higher than in Sweden. An increase in the *ACC* in Austria changes the probability of retirement by percentage points 2.75 times higher than in the US, 10 times higher than in France, 2.75 times higher than in Sweden, and 1.5 times higher than in Germany. Similar patterns apply to the other incentive measures. An explanation for this high responsiveness of Austrians is certainly linked to the number of pension pillars. Austrians only rely on the one public pension system. Their whole retirement income comes out of this unique source. The United States, on contrary, have a long tradition of 3 or even more pension pillars, so Americans will not respond that strongly to changes in public social security. France has a state plan and a complementary occupational scheme. Swedish rely on a public plan, a private defined benefit plan, and a private defined contribution plan. Only

Germans also heavily rely on the public pillar. Their responsiveness comes therefore very close to that of Austrians.

Other Control Variables

The impact of the control variables on the probability of retirement can be summarized as follows. The income controls show that for both sexes, the probability of retirement increases in expected earnings next year. This supports retirement leisure to be a normal good. Increasing pensionable income (squared) also increases the probability of retirement, except for males (coefficient on the *PE* variable). Since social security wealth is a function of pensionable income, this finding is consistent with the above findings about the sign of *SSW*.

Age plays a crucial role, having the highest impact on the probability of retirement at ages 61 (65) for males, and 60 for females, pointing at a barely different retirement age for both sexes despite the legal five year differences. These age effects are highly significant, large in magnitude, and consistent all across the different models.

Also, health is a very important control variable. The effect of a percentage increase in the share of sick days relative to labor force participation is strong. For males, it increases the probability of retirement by roughly 44 percentage points. For females, it decreases the retirement probability by 7 percentage points which is counterintuitive. This result suggests that for males, health condition is playing a more prominent role in the decision to retire than for women. The largely higher share of disability pensions for males confirms this result.

Controlling for the sector of employment shows that workers in the production sector have a lower probability to retire relative to workers in the service sector. This is counterintuitive. We would expect a positive effect of more health deteriorating jobs in production on the retirement probability. For occupation, the results are as expected. Being a blue collar worker rather than a white collar employee increases the probability of retirement because of more health deteriorating jobs.

Location dummies show that working in Vienna or Western Austria increases the probability of retirement. In these two regions, earnings are traditionally higher than in the economically disadvantaged regions of Eastern and Southern Austria.

Year dummies indicate that the "social norms" change into the direction of a higher probability to retire in later years of the panel. This might suggest an impact of the continuing reform process on retirement behavior. Individuals expect pension reforms to make retirement regulations more disadvantageous. Therefore, they retire before another reform is implemented. It might, however, also reflect the age structure of the panel, where later years represent older age groups than earlier years in the panel.

Overall, the control variables largely get the expected signs and are mostly significant. They show that age and health play a crucial role in the retirement decision in line with financial incentives.

Goodness of Fit

We are assessing the goodness of fit by looking at the share of correct retirement choice predictions across the models. The higher proportion of correct prediction for men supports the differences in the within R squared for men and women. The within R squared

for men is 51 percent (table A3.1) compared to a within R squared for women of 48 percent (table A3.2). Table 12 compares observed and predicted choices to retire or not to retire. Overall, the predictive power of all models is relatively high. For males, the proportion of correctly predicted retirement choices ranges from 44.9 to 45.5 percent. Females show a smaller degree of correctly predicted outcomes, ranging from 40.5 to 40.8 percent for the choice to retire. Again, the *ACC* model and the *OV* model yield identical results. For males, the *PV* model has the highest predictive power, while for females it is the *IST* model. Both sexes show a higher proportion of successes in the *PV* model. This implies that the *PV* model captures the retirement decision slightly better than the *ACC* or the *OV* models. Therefore, the regression results that people respond stronger to the *PV* than to the *ACC* or the *OV* are confirmed by the assessment of goodness of fit.

Table 12. Correctly predicted retirement choices (frequencies and proportions)

		Predicted					
		Males			Females		
Model	Observed	0	1	% correct	0	1	% correct
ACC	0	47,658	9,449	0.835	27,025	7,322	0.787
	1	10,071	8,316	0.452	7,619	5,187	0.405
PV	0	47,507	9,600	0.832	27,571	6,776	0.803
	1	10,019	8,368	0.455	7,584	5,222	0.408
OV	0	47,658	9,449	0.835	27,025	7,322	0.787
	1	10,071	8,316	0.452	7,619	5,187	0.405
IST	0	47,697	9,410	0.835	26,911	7,436	0.784
	1	10,132	8,255	0.449	7,526	5,280	0.412

Notes: Table compares observed and predicted retirement choices, by model and sex. Success (1) is defined as a predicted probability greater or equal to 1. 1=retire, 0=do not retire.

CHAPTER 7

POLICY SIMULATIONS

The estimates in the last chapter are used to simulate some policy scenarios. The basic idea behind the simulations is the following. A pension reform scenario changes pension benefits, and hence the financial incentives. For mean representative agents of each age group, we evaluate how these reforms alter the predicted probabilities of retirement as the incentives change, holding everything else constant. Then, we use the simulations to predict the public savings in pension expenditures from any of the reform scenarios.

The retirement probabilities are therefore calculated by predicting the probability of retirement for each observation, then averaging these probabilities by age. Since the linear probability model can return predicted probabilities outside the [0,1]-interval, it is assumed that every prediction smaller than 0 has a predicted probability of 0. Likewise, every prediction greater than 1 is assumed to be a predicted probability of 1.

First, we are going to describe the reform scenarios. Then, we will present the impact of each scenario on the age profile of predicted retirement probabilities compared to the base case (i.e., the data used in the regressions). Finally, we are calculating the public savings implied by each scenario.

Simulation Approach

We are using the estimates from the last chapter in order to simulate the impact of past and future reform scenarios on the predicted probability of retirement at the appropriate ages. To this end, we are evaluating the change of the predicted probabilities of retirement at the means of the age profile. As the base case, we are using the incentive calculations applied in the estimation. For the reference cases, we are recalculating pension benefits and retirement incentives according to the rules in S1 and S2 below. Then, we are comparing the changes in predicted probabilities at the new incentive means by age to the base case.

Therefore, the predicted retirement probability $\hat{R}$ for a representative agent of age *a* is

$$\hat{R}(a,x) = \beta_1 \overline{SSW(a,x)} + \beta_2 \overline{INCENT(a,x)} + \sum \beta_n \overline{Control_n(a)}\,, \qquad (28)$$

where scenario *x* is either the base case, pre reform 2000, post reform 2000, S1 or S2. An overbar indicates the mean of a variable at a certain age *a* as calculated for each scenario. Basically, each scenario changes the incentive variables *SSW* and *INCENT*. So, for a mean representative agent, we are using the incentive variables at their means for each age (see table A4.1). The betas are the estimated coefficients from table A3.1. for men and A.3.2. for women. The controls from the regression are held constant across the simulated scenarios. They are also at their means for each age.

The simulations are done separate by incentive model and sex. Looking in the past, this study is trying to simulate the impact of reform 2000 on the probability of retirement. It basically compares the probability effects of legislation 1997 and legislation 2000 at the mean incentives of the age profile. Early retirement age was raised from 60 to 61.5 for men and from 55 to 56.5 for women, respectively. The penalty for retiring before the statutory retirement age was raised from 2 to 3 percentage points deduction per year in the replacement rate. Early retirement due to reduced working capacity was abolished.

Looking in the future, the first simulation scenario (S1) is a hypothetical reform that delays all eligibility ages for early and normal retirement by three years. This implies statutory retirement ages to increase from 65 to 68 for men, and from 60 to 63 for women, respectively. All other factors of pension benefit computation remain unchanged. All ages before early retirement follow the rules for disability pensions. The basic idea simulating this reform scenario is a three year shift in the distribution of predicted retirement probabilities. Therefore, we are using for instance a representative agent of age 54 along with the recalculated incentive measures for age 57. This gives the predicted retirement probability for age 57.

The second hypothetical reform scenario (S2) can be called "common reform". Gruber and Wise (2004) performed this scenario for each of the country studies. Therefore, S2 is the most direct way to compare the incentive effects in Austria to other OECD countries, even though it is a highly unrealistic scenario. In this hypothetical reform, early retirement age is 60 for men, 55 for women. The statutory ages are 65 and 60, respectively. Disability pensions before the early retirement ages are abolished. The replacement rate is fixed at 60 percent of age 65/60 earnings. For each year of early retirement, the pension

benefit decreases by 6 percent. Likewise, the same principle applies to reward delayed retirement after ages 65/60. Minimum and maximum pension rules will be preserved.

Simulation Results

The simulations suggest that reforming a pension system is a very tough undertaking. On the one hand, legislation not only has to consider the age profile of social security wealth, but also the age profile of accruals in social security wealth. This implies that policy makers have to know the directions and relative magnitudes of wealth and accrual effects. Not knowing them might lead to adverse effects of pension reform. The simulation results in figures A.4.1 through A.4.4 (appendix A.4) show very similar predictions of the age profiles across all models. The calculated changes in the age profiles of incentive measures are in table A4.1. Table A4.2 reports the predicted probabilities of the appropriate model by age and sex. Males usually have spikes in predicted retirement probabilities at ages 57, 61, and 65 in the base case. Women have those spikes at ages 56 and 60. The predicted probability of retirement sharply inclines once the early retirement option becomes available. However, especially men have higher retirement probabilities than women at ages where only a disability pension is available. Most studies in Gruber and Wise (2004) show no or only one pronounced spike at early retirement ages. However, Brugiavini and Peracchi (2004) find in the Italian case multiple spikes similar to Austria.

Experimenting with retirement probabilities by firms in the production and the service sector shows no differences compared to the mean representative agent in the spikes. However, the overall predicted retirement probability in the production sector is 15.4/18.6 percentage points (males/females) lower than in the service sector. This roughly confirms

the (counterintuitive) parameter estimates. Also, retirement probabilities across regions confirm the estimates. People working in Vienna have by far the highest retirement probabilities. The other Austrian regions are roughly 20 percentage points below Vienna.

Reform 2000 failed in strengthening the incentives to delay retirement. On contrary, it accomplished an adverse effect increasing all retirement probabilities for both sexes. This failure is partly due to looking too much at the effect of retirement wealth *SSW*, but overseeing a weakening of the accrual effects for postponing retirement. If for instance the one year accrual for men at age 60 decreases from Euros 12,009 pre reform to Euros 5,349 post reform, then there is no reason to believe that retirement will be postponed to age 61 to a greater extent.

Reform 2000 decreased *SSW* for all retirement ages of men. Therefore, we would expect a negative probability effect for the male wealth effect. For most ages, the accrual measures across all models decreased. This would imply a positive probability effect for the male accrual effects. The probability of retirement combining both, wealth- and accrual effects, increases for almost all ages compared to the pre reform 2000 case. This represents a situation in which the positive accrual effect dominates the negative wealth effect and makes the overall effect positive. Therefore, reform 2000 failed in providing stronger incentives for delayed retirement for men, mainly because of the accruals being decreased.

Also for women, reform 2000 failed the intent to provide incentives for postponing retirement. *SSW* decreased for all ages, which causes the probability of retirement to decrease. The accrual measures decline for most ages, so that we would expect the retirement probability to increase. Overall, the wealth effect is much smaller than the accrual effect. Therefore, the probability of retirement increased at all ages for females. Again, the accrual incentive effects were weakened by reform 2000.

Simulation S1, a three year delay in eligibility ages for early and statutory retirement would have strong effects on the retirement probabilities. It shifts the probability distribution to later ages, but is only effective in postponing retirement at certain ages.

Fore males, *SSW* has no unique direction at all ages. This implies a negative or positive wealth effect. Also, the accrual effect has not unique direction at most ages, inducing positive or negative accrual effects. Between ages 60 to 63 and at age 65, the probability of retirement decreases compared to the base case. In this case, *SSW* goes up or down and *ACC* goes up. The bigger negative accrual effect outweighs the wealth effect, resulting in a declining probability of retirement. Also, S1 is successful in shifting the peak of the probability of retirement to a later age.

For females, *SSW* declines at ages 56, 57, and 60, and hence decreases the probability of retirement. The accrual incentives at these ages in contrast incline, implying a decrease in the retirement probabilities. Combined wealth- and accrual effects working in the same direction cause the probability of retirement to decrease. At all other ages, S1 fails in decreasing the retirement probabilities.

Simulation S2, the common reform, is successful in decreasing the retirement probabilities. It reduces the level of *SSW* by a huge amount compared to all other scenarios. The *ACC* has no unique direction. Therefore, the huge negative wealth effect outweighs a smaller accrual effect. Hence, the probability of retirement decreases for all ages. Moreover, it shows no spikes at early retirement ages for males.

For women, S2 shows smaller retirement probabilities at all ages as well. *SSW* decreases strongly, the accrual measures also decrease, but not to a big extent. Therefore, the huge negative wealth effect outweighs the weaker positive accrual effect. This results in an

overall decreasing retirement probability at all ages. The only difference in S2 compared to males is a local spike at age 56 for women.

The simulations show that the features of pension plans can yield very different retirement incentives. It is not enough to just look at the age profile of *SSW*. Also, it is necessary to consider the different accrual measures which determine the relative price of retirement leisure. In Austria, this is especially true for women. For them, a change in the relative price of leisure has a greater effect than a change in retirement wealth.

Public Savings by Reform Scenarios

Finally, we are evaluating the public savings for all of the above reform options. Since this study is looking at the scenarios from a micro perspective, we are comparing the expenditure savings in *SSW* for each age group of retirees. Hence, for a representative agent retiring at age *a,* the expenditure savings *S* in *SSW* for any scenario are

$$S(a,x) = (-1)\frac{\overline{SSW(a, base\ case)}\cdot\widehat{\mathrm{R}}(a, base\ case) - \overline{SSW(a,x)}\cdot\widehat{\mathrm{R}}(a,x)}{\overline{SSW(a, base\ case)}\cdot\widehat{\mathrm{R}}(a, base\ case)}. \qquad (29)$$

This is the percentage change in *SSW* from the base case compared to one of the scenarios *x*. *SSW* for any scenario is weighted by the predicted retirement probabilities. In case of reform 2000, we are comparing the pre and post reform 2000 scenarios. Therefore, the simulated changes in public expenditures include two effects for a representative agent retiring at age *a*. The first effect represents the change in *SSW* expenditures induced by the change of pension benefit calculation rules of a reform scenario. The second effect

represents the behavioral change induced by altering the financial incentives in any of the reform scenarios. While the first effect is just the difference in *SSW* from the base case to a reference scenario (compare in table A4.1), the second effect captures the difference is retirement behavior at any age (comparing the predicted retirement probabilities in table A4.2).

The savings of different reform options are partially huge, having the biggest savings for reform scenario S2 (see table A4.3). The results do not vary a lot across models. While reform 2000 brought savings for male retirees starting at age 62, it implied higher expenditures for female retirees at all ages. Scenario S1, the 3 year delay in eligibility ages would imply saving for men retiring at the ages 60, 61, 62, and 65. For women, age 56, 57, and 60 retirees would bring savings in pension expenditures. The most successful scenario in terms of public savings is the “common reform” S2. Both, male and female retirees would induce public savings at all ages of retirement. Since S2 does not contain a disability options, these age groups would not require any more expenditures.

CHAPTER 8

CONCLUSIONS

In Austria, the responsiveness of older workers to retirement incentives is significant and high in magnitude. Austrian private sector workers respond stronger to financial retirement incentives than workers for instance in the US, Germany, France, and Sweden. Both sexes show the strongest response to the peak value incentive. Therefore, Austrians have a horizon over several years in their retirement decision. Changing retirement incentives can be decomposed into a wealth and an accrual effect. Both effects work in opposite directions. An increase in *SSW* (wealth effect) increases wealth. Therefore, one can buy more goods including retirement leisure. An increase in an accrual measure (accrual effect) makes retirement now more expensive compared to retiring later. For men, the wealth effect is greater than the accrual effect. For women, in contrast, the accrual effect is stronger than the wealth effect. The effect of an increase in social security wealth on the probability of retirement is positive and 10 times as strong for men compared to women. The effect of an increase in an accrual incentive (one-year accrual, peak value, option value) on the retirement probability is negative. Women respond 2 times as strong as men to accrual increases. Therefore, women are responding stronger to accrual incentives than men, which is surprising compared to most country studies in Gruber and Wise (2004). Though not observable, there seems to be a joint retirement decision making among couples driven by the woman's retirement decision. Men who have later legal retirement ages than women do not respond to accrual incentives to the extent women do, because they adapt their

retirement behavior to the decisions of their spouses. The case of Italy in Brugiavini and Peracchi (2004), also featuring different retirement ages for men and women supports this conclusion. Important influences on the retirement decision other than financial incentives come from age and health.

Simulations show that the impact of a change in the incentives on the probability of retirement is huge at every age. The impact of reform 2000 on retirement behavior was adverse to the intended effect. This is mainly due to a decrease in the accruals, decreasing the opportunity costs of retiring now. Simulation S1, a 3 year delay in all eligibility ages, is partly successful in decreasing the probability of retirement at some ages. Simulation S2, the "common reform" is an extreme policy scenario. Therefore, the decline in the probability of retirement happens at all ages for men and women. This is mainly due to a huge negative wealth effect.

What are the policy lessons we learn from the retirement behavior of Austrians? The 2 effects (wealth- and accrual effect) induced by a change in the incentives work into opposite directions. It is important to know the extent to which Austrians respond to either effect in order to make reform succeed.

The response to a change in an incentive measure is relatively strong compared to other countries. The reason for that might ground on the fact that Austrians, like no other OECD country, greatly rely on the one public pension pillar only. As mentioned before, there is barley any form of old age income security apart from the universal public pension plan. Therefore, small changes in the incentive measures induced by reform should have a strong impact on retirement behavior.

The accruals in social security wealth are currently relatively small. So, accounting for inflation and the time value of money, the loss from not postponing retirement is relatively small, too. Therefore, policy makers should increase the penalty for early retirement.

A special Austrian issue is the different legal ages at which men and women are entitled for any form of retirement (apart from a disability pension). The joint retirement decision within couples, however, seems to impose the motivation especially on men to make very frequent use of early retirement. Therefore, the actual average retirement ages of men and women do not differ a lot. A solution to this problem might be to bring down the statutory retirement age for men for two or three years. Then, the financial incentives set in a new way might make men retire even later than they currently do.

Another specifically Austrian problem is the evasion into a disability pension as early before early retirement becomes feasible. This points at a practice of disability entitlement that is too generous and does not necessarily serve the purpose it is implemented for. Unlike in Germany, where the share of disability pensions is also relatively high, the behavior of men and women differ. Women do not retire on a disability pension to the extent men do. Hence, the different legal retirement ages for men and women seem to have unintended consequences. In a joint retirement decision among couples, men seem to evade into a disability pension adapting their retirement date to that of their spouses.

Overall, the Austrian pension system needs further reform. Reforms so far were not very effective in implementing retirement incentives to delay retirement. The main directions for reform should concern the benefit calculation rules, the differences in legal retirement ages for men and women, as well as the handling of disability pensions. An increase in the accruals of *SSW* would strengthen the financial incentives to delay retirement. This implies higher deductions for each year of early retirement. Also, early retirement ages should not

have spikes in *SSW*. Bringing together the eligibility ages of men and women for different retirement options would eliminate the unintended behavioral consequences under the current system. The rules for granting disability pensions have to be tightened. Under the current practice, disability pensions are often used as a form of early retirement.

APPENDIX 1

INCOME HISTORIES

Predicting the Share of Unemployment

In order to impute pensionable income (*PE*) pre 1997, we are using a weighted sum of backwards projected earnings (*EARN*) and the pensionable amount of unemployment compensation (*PUE*), according to:

$$PE = EARN\left(1-\frac{\hat{d}}{365}\right)+PUE\left(\frac{\hat{d}}{365}\right), \tag{30}$$

where $\hat{d}$ is the predicted number of days being unemployed at a certain age and having certain other characteristics. We are estimating d with the OLS regression model (table A1.1)

$$d = \beta_0 + \beta_1 Age + \beta_2 Location + \beta_3 Degree + \beta_4 Sex + \varepsilon \ , \tag{31}$$

Table A1.1. OLS estimates for number of days in unemployment

Variable	Coefficient
Age37	-0.363
	(0.79)
Age38	-1.809
	(4.16)**
Age39	-3.452
	(8.18)**
Age40	-4.150
	(10.03)**
Age41	-3.878
	(9.50)**
Age42	-3.602
	(8.91)**
Age43	-3.398
	(8.46)**
Age44	-3.493
	(8.67)**
Age45	-3.632
	(8.99)**
Age46	-3.597
	(8.87)**
Age47	-3.246
	(7.98)**
Age48	-3.253
	(7.97)**
Age49	-3.451
	(8.42)**
Age50	-3.597
	(8.75)**
Age51	-3.372
	(8.17)**
Age52	-3.601
	(8.68)**
Age53	-2.793
	(6.70)**
Age54	-0.116
	(0.28)
Age55	0.437
	(1.03)
Age56	-0.062
	(0.14)
Age57	-5.061
	(11.37)**
Age58	-5.027
	(11.03)**
Vienna	15.263
	(133.80)**
EAustria	14.031
	(107.64)**
SAustria	20.127
	(146.88)**
Degree	-9.146
	(51.75)**
Sex	0.177
	(2.34)*
Constant	12.913
	(34.20)**
Observations	1,651,167
R-squared	0.03

Notes: (a) Regression for number of unemployment days. Variables used are age dummies, location dummies, an academic degree dummy, and a sex dummy.

(b) Absolute value of t statistics in parentheses. * significant at 5%; ** significant at 1%.

where *Age* is a set of age dummies from ages 36 to 58, *Location* is a set of locational dummies distinguishing labor force activity in Vienna, Southern Austria, Eastern Austria, and Western Austria. *Degree* is a dummy for an academic degree, *Sex* is a dummy for gender.

Then, this study will calculate a predicted number of unemployment days for every person having a combination of the above attributes.

It should be noticed that the sample used for the above regression is different from the sample described in chapter 5. The persons in the latter sample are at least 52 years of age in 1997. To predict unemployment days for them going back 15 years, there is need for age groups younger than 52.

Calculation of Net Earnings and Net Pension Benefits

Since the data only gives information on gross earnings, this study has to apply the rules of wage taxation to receive net earnings values. In general, net earnings in Austria are calculated according to the following schedule:

A. *Gross current earnings or gross current pensions*

B. Payroll tax (employees pay pension, health, and unemployment insurance; pensioners only pay for health insurance)

C. *Tax base for income tax* (A-B)

D. Personal income tax

E. Tax credits

Standard tax credit (employees and pensioners, family status)

Pensioner credit (pensioner only)

Traffic credit (employees only)

Employee credit (employees only)

Sole earner and sole parent credit (employees and pensioners)

F. *Net current earnings* (C-D+E)

The taxation schedules are based on Finances (Various years) and on Hauptverband (Various years-a). Due to a lack of information on family status, this study will linearly approximate the progressive standard tax credit, assuming a non-sole earner schedule. For the same reason, this study has to ignore the sole earner and sole parent tax credit which causes a relatively minor calculation error compared to annual earnings. Taxation rules of non-current income are different from the above schedule. Non-current income is mainly Christmas and vacation allowances, which are normally as high as two monthly earnings. The individual has to pay payroll tax, and a flat rate income tax on theses earnings parts, but there are no tax credits.

APPENDIX 2

VARIABLES

R = dummy dependent variable, 1 if retired in year *t* conditional on being in the labor force in year *t*-1, 0 otherwise.

Incentive Variables

SSW = present discounted value of social security wealth (in 1996 Euros).

INCENT = one of the below incentive measures (in 1996 Euros).

ACC = gain or loss in *SSW* by postponing retirement for one year.

PV = maximum of *SSW* minus *SSW* in current year over all possible retirement years.

OV = present discounted value of real net earnings plus *ACC* of postponing retirement for one year.

IST = *ACC* divided by present discounted value of real net earnings during the year of postponing retirement.

Income Controls

RNEARNNY = prospective real net earnings in year *t*+1 (in 1996 Euros).

RNEARNNY2 = RN*EARNNY* squared.

PE = pensionable earnings according to pension formula (in 1996 Euros).

PE2 = *PE* squared.

Age Indicators

Age53, …, Age 65 = dummies, 1 if aged 53, …, 65 in year *t*, 0 otherwise.

Individual Characteristics affecting Retirement Behavior

HEALTH = fraction of time sick or on rehab during work in current year.

Production = dummy, 1 if working in production sector, 0 otherwise.

S*ervices* = dummy, 1 if working in service sector, 0 otherwise.

Blue = dummy, 1 if blue collar worker, 0 otherwise.

White = dummy, 1 if white collar worker, 0 otherwise.

Vienna = dummy, 1 if work in Vienna, 0 otherwise.

EAustria = dummy, 1 if work in Eastern Austria, 0 otherwise.

SAustria = dummy, 1 if work in Southern Austria, 0 otherwise.

WAustria = dummy, 1 if work in Western Austria, 0 otherwise.

Year Dummies

Y1998, …, Y2003 = dummies, 1 if observation occurs in year 1998, …, 2003, 0 otherwise.

Table A2.1. Descriptive statistics male panel

Variable	1998	1999	2000	2001	2002	2003	Total
Retire	0.119	0.212	0.300	0.253	0.345	0.546	0.244
year	1998	1999	2000	2001	2002	2003	1999.740
RetYear	2000.771	2001.145	2001.722	2002.459	2002.952	2003.454	2001.656
Sex	1	1	1	1	1	1	1
YBirth	1941.265	1941.463	1941.807	1942.145	1942.392	1942.630	1941.733
YearDeath	2093.836	2094.535	2095.360	2096.342	2096.872	2097.536	2095.167
RNEARNNY	17,859	17,948	17,683	17,603	17,584	18,334	17,816
RNEARNNY2	375,000,000	387,000,000	382,000,000	383,000,000	385,000,000	408,000,000	384,000,000
PE	393,326	409,807	419,367	421,927	423,404	429,393	411,350
PE2	177,000,000,000	191,000,000,000	203,000,000,000	210,000,000,000	214,000,000,000	223,000,000,000	196,000,000,000
Age53	0.050	-	-	-	-	-	0.014
Age54	0.107	0.053	-	-	-	-	0.042
Age55	0.135	0.117	0.061	-	-	-	0.077
Age56	0.153	0.147	0.137	0.074	-	-	0.113
Age57	0.175	0.167	0.177	0.170	0.088	-	0.153
Age58	0.161	0.174	0.172	0.188	0.185	0.083	0.167
Age59	0.139	0.160	0.185	0.195	0.217	0.227	0.174
Age60	0.080	0.142	0.180	0.225	0.241	0.293	0.163
Age61	-	0.039	0.064	0.088	0.164	0.236	0.065
Age62	-	-	0.023	0.039	0.041	0.060	0.017
Age63	-	-	-	0.022	0.038	0.030	0.009
Age64	-	-	-	-	0.025	0.041	0.005
Age65	-	-	-	-	-	0.030	0.002
HEALTH	0.030	0.035	0.037	0.030	0.026	0.030	0.032
Production	0.485	0.479	0.469	0.427	0.404	0.381	0.458
Blue	0.452	0.428	0.404	0.378	0.369	0.370	0.414
Vienna	0.253	0.264	0.273	0.278	0.282	0.295	0.268
EAustria	0.151	0.152	0.152	0.150	0.145	0.135	0.149
SAustria	0.120	0.120	0.118	0.117	0.116	0.114	0.119
Y1999	-	1	-	-	-	-	0.241
Y2000	-	-	1	-	-	-	0.190
Y2001	-	-	-	1	-	-	0.133
Y2002	-	-	-	-	1	-	0.099
Y2003	-	-	-	-	-	1	0.065
Obs.	20,612	18,157	14,309	10,021	7,489	4,906	75,494
Indiv.	20,612	18,157	14,309	10,021	7,489	4,906	20,612

Notes: (a) If a person did not die in the panel window, the artificial death year is coded 2100.

(b) If applicable, numbers are in 1996 Euros.

Table A2.2. Descriptive statistics female panel

Variable	1998	1999	2000	2001	2002	2003	Total
Retire	0.170	0.269	0.342	0.301	0.355	0.507	0.272
year	1998	1999	2000	2001	2002	2003	1999.495
RetYear	2000.338	2000.830	2001.519	2002.338	2002.946	2003.493	2001.249
Sex	0	0	0	0	0	0	0
YBirth	1942.538	1942.792	1942.998	1943.080	1943.369	1943.731	1942.866
YearDeath	2097.553	2097.832	2098.153	2098.427	2098.603	2098.807	2097.971
RNEARNNY	11,831	11,829	11,387	10,780	10,563	10,883	11,491
RNEARNNY2	194,000,00	198,000,000	187,000,000	173,000,000	169,000,000	178,000,000	189,000,000
PE	273,369	283,478	287,150	284,813	284,880	287,750	281,364
PE2	102,000,000,000	108,000,000,000	113,000,000,000	114,000,000,000	114,000,000,000	117,000,000,000	109,000,000,000
Age53	0.144	-	-	-	-	-	0.046
Age54	0.234	0.174	-	-	-	-	0.120
Age55	0.215	0.283	0.241	-	-	-	0.187
Age56	0.132	0.169	0.222	0.186	-	-	0.149
Age57	0.100	0.121	0.167	0.241	0.160	-	0.134
Age58	0.080	0.104	0.140	0.213	0.307	0.142	0.133
Age59	0.060	0.085	0.124	0.187	0.275	0.446	0.126
Age60	0.034	0.064	0.106	0.173	0.258	0.411	0.104
HEALTH	0.018	0.020	0.019	0.014	0.013	0.013	0.018
Production	0.181	0.170	0.155	0.123	0.112	0.103	0.158
Blue	0.322	0.302	0.291	0.284	0.291	0.282	0.303
Vienna	0.259	0.261	0.260	0.275	0.270	0.280	0.263
EAustria	0.116	0.115	0.112	0.100	0.094	0.092	0.111
SAustria	0.100	0.101	0.102	0.100	0.103	0.101	0.101
Y1999	-	1	-	-	-	-	0.261
Y2000	-	-	1	-	-	-	0.185
Y2001	-	-	-	1	-	-	0.115
Y2002	-	-	-	-	1	-	0.075
Y2003	-	-	-	-	-	1	0.044
Obs.	15,108	12,306	8,706	5,415	3,546	2,072	47,153
Indiv.	15,108	12,306	8,706	5,415	3,546	2,072	15,108

Notes: see notes of table A2.1.

APPENDIX 3

REGRESSION RESULTS

Table A3.1. Linear probability model (fixed effects), males

Variable	*ACC* Model	*PV* Model	*OV* Model	*IST* Model
SSW	0.096	0.094	0.096	0.099
	(57.18)**	(54.58)**	(57.18)**	(59.38)**
ACC	-0.011			
	(9.39)**			
PV		-0.013		
		(10.65)**		
OV			-0.011	
			(9.39)**	
IST				-0.011
				(6.73)**
RNEARNNY	0.107	0.11	0.117	0.093
	(13.28)**	(13.56)**	(14.12)**	(11.69)**
RNEARNNY2	0	0	0	0
	(8.46)**	(8.61)**	(8.46)**	(7.40)**
PE	-219.589	-233.208	-219.589	-235.734
	(8.96)**	(9.52)**	(8.96)**	(9.61)**
PE2	0	0	0	0
	(14.41)**	(13.99)**	(14.41)**	(14.30)**
Age54	-0.092	-0.091	-0.092	-0.094
	(7.69)**	(7.60)**	(7.69)**	(7.84)**
Age55	-0.201	-0.199	-0.201	-0.201
	(17.09)**	(16.92)**	(17.09)**	(17.16)**
Age56	-0.317	-0.312	-0.317	-0.318
	(25.94)**	(25.48)**	(25.94)**	(25.98)**
Age57	-0.307	-0.298	-0.307	-0.31
	(23.27)**	(22.52)**	(23.27)**	(23.44)**
Age58	-0.41	-0.392	-0.41	-0.409
	(28.03)**	(26.68)**	(28.03)**	(27.95)**
Age59	-0.537	-0.53	-0.537	-0.557
	(32.80)**	(32.22)**	(32.80)**	(34.02)**
Age60	-0.356	-0.349	-0.356	-0.37
	(19.42)**	(19.01)**	(19.42)**	(20.17)**
Age61	-0.094	-0.091	-0.094	-0.098
	(4.61)**	(4.47)**	(4.61)**	(4.81)**
Age62	-0.167	-0.16	-0.167	-0.162
	(7.12)**	(6.83)**	(7.12)**	(6.92)**
Age63	-0.103	-0.079	-0.103	-0.094
	(3.84)**	(2.95)**	(3.84)**	(3.52)**
Age64	-0.202	-0.2	-0.202	-0.239
	(6.69)**	(6.62)**	(6.69)**	(7.90)**

Table A3.1 continued

Variable	*ACC* Model	*PV* Model	*OV* Model	*IST* Model
HEALTH	0.436	0.436	0.436	0.446
	(28.93)**	(28.93)**	(28.93)**	(29.53)**
Production	-0.222	-0.224	-0.222	-0.224
	(22.97)**	(23.11)**	(22.97)**	(23.17)**
Blue	0.015	0.016	0.015	0.021
	(1.39)	(1.5)	(1.39)	(1.93)
Vienna	0.25	0.25	0.25	0.251
	(19.12)**	(19.13)**	(19.12)**	(19.16)**
EAustria	0.053	0.053	0.053	0.053
	(2.79)**	(2.79)**	(2.79)**	(2.77)**
SAustria	-0.105	-0.105	-0.105	-0.102
	(4.41)**	(4.44)**	(4.41)**	(4.28)**
Y1999	0.272	0.27	0.272	0.258
	(59.30)**	(59.53)**	(59.30)**	(56.31)**
Y2000	0.447	0.446	0.447	0.447
	(65.06)**	(64.85)**	(65.06)**	(65.06)**
Y2001	0.635	0.621	0.635	0.649
	(66.96)**	(64.36)**	(66.96)**	(68.53)**
Y2002	0.841	0.832	0.841	0.858
	(69.10)**	(67.81)**	(69.10)**	(70.49)**
Y2003	1.122	1.111	1.122	1.109
	(77.81)**	(77.25)**	(77.81)**	(76.94)**
Constant	-0.975	-0.889	-0.975	-1
	(13.85)**	(12.52)**	(13.85)**	(14.21)*
R-squared (within)	0.51	0.51	0.51	0.51
Observations	75,494	75,494	75,494	75,494
Number of Persons	20,612	20,612	20,612	20,612

Notes: Coefficient estimates of retirement probability, linear probability model. *SSW*, *ACC*, *PV*, and *OV*, *RNEARNNY* (2), and PE(2) are in units of 10,000 Euros. Monetary units are in real terms.

Absolute value of t statistics in parentheses.

* Significant at 5 percent; ** significant at 1 percent.

Table A3.2. Linear probability model (fixed effects), females

Variable	*ACC* Model	*PV* Model	*OV* Model	*IST* Model
SSW	0.009	0	0.009	0.013
	(3.91)**	(0.08)	(3.91)**	(6.08)**
ACC	-0.021			
	(10.86)**			
PV		-0.023		
		(11.84)**		
OV			-0.021	
			(10.86)**	
IST				0
				(0.08)
RNEARNNY	0.022	0.019	0.042	0.029
	(1.38)	(1.21)	(2.65)**	(1.84)
RNEARNNY2	0	0	0	0
	(0.59)	(0.85)	(0.59)	(0.18)
PE	29.249	25.525	29.249	-4.946
	(1.37)	(1.2)	(1.37)	(0.23)
PE2	0	0	0	0
	(1.72)	(2.42)*	(1.72)	(1.99)*
Age54	-0.166	-0.167	-0.166	-0.168
	(19.59)**	(19.69)**	(19.59)**	(19.77)**
Age55	0.04	0.038	0.04	0.033
	(5.08)**	(4.75)**	(5.08)**	(4.14)**
Age56	-0.013	-0.024	-0.013	-0.024
	(1.74)	(3.06)**	(1.74)	(3.18)**
Age57	-0.162	-0.171	-0.162	-0.167
	(22.70)**	(24.02)**	(22.70)**	(23.48)**
Age58	-0.289	-0.291	-0.289	-0.289
	(43.39)**	(43.70)**	(43.39)**	(43.35)**
Age59	-0.444	-0.457	-0.444	-0.457
	(67.49)**	(70.68)**	(67.49)**	(70.37)**
HEALTH	-0.07	-0.07	-0.07	-0.075
	(2.42)*	(2.43)*	(2.42)*	(2.59)**
Production	-0.177	-0.177	-0.177	-0.18
	(7.28)**	(7.30)**	(7.28)**	(7.39)**
Blue	0.001	0.003	0.001	0.009
	(0.05)	(0.19)	(0.05)	(0.57)
Vienna	0.166	0.161	0.166	0.174
	(8.52)**	(8.25)**	(8.52)**	(8.91)**
EAustria	-0.054	-0.06	-0.054	-0.049
	(1.55)	(1.71)	(1.55)	(1.38)
SAustria	-0.05	-0.051	-0.05	-0.041
	(1.16)	(1.2)	(1.16)	(0.95)
Y1999	0.304	0.274	0.304	0.258
	(49.66)**	(59.18)**	(49.66)**	(52.35)**
Y2000	0.446	0.428	0.446	0.442
	(60.89)**	(57.79)**	(60.89)**	(60.26)**
Y2001	0.606	0.587	0.606	0.62
	(88.53)**	(80.97)**	(88.53)**	(91.45)**
Y2002	0.81	0.788	0.81	0.815
	(94.03)**	(88.36)**	(94.03)**	(94.48)**

Table A.3.3 continued

Variable	*ACC* Model	*PV* Model	*OV* Model	*IST* Model
Y2003	1.074	1.027	1.074	1.041
	(95.43)**	(94.35)**	(95.43)**	(95.28)**
Constant	-0.301	-0.088	-0.301	-0.337
	(5.65)**	(1.54)	(5.65)**	(6.32)**
R-squared (within)	0.48	0.48	0.48	0.48
Observations	47,153	47,153	47,153	47,153
Number of Persons	15,108	15,108	15,108	15,108

Notes: Coefficient estimates on retirement probability, linear probability model. *SSW*, *ACC*, *PV*, and *OV*, *RNEARNNY* (2), and PE(2) are in units of 10,000 Euros.

Absolute value of t statistics in parentheses.

* Significant at 5 percent; ** significant at 1 percent.

APPENDIX 4

SIMULATIONS

Table A4.1. Age profile of incentive measures, by sex and scenario

SSW	Males					Females				
Age	Base case	Pre 2000	Post 2000	S1	S2	Base case	Pre 2000	Post 2000	S1	S2
53	255,425	255,425			0	234,909	234,909			0
54	270,665	270,665			0	232,398	232,398			0
55	275,810	275,810			0	238,683	238,683			149,510
56	277,419	279,400	256,576	277,419	0	243,624	244,933	235,796	235,868	168,786
57	275,453	276,840	270,063	276,207	0	242,416	248,397	228,230	236,038	177,017
58	281,327	283,752	275,425	278,952	0	240,142	248,697	227,594	249,305	186,472
59	283,301	284,776	280,652	278,722	0	238,531	246,876	229,828	251,255	193,726
60	295,759	296,029	295,425	281,278	90,520	242,726	242,282	243,090	257,010	198,299
61	285,613	306,399	275,278	284,837	93,445	260,750	255,465	264,315		
62	281,134	314,334	270,180	305,399	141,404	271,347	276,285	269,720		
63	260,236		260,236	319,260	191,154	302,902		302,902		
64	253,110		253,110	310,329	245,165	293,048		293,048		
65	274,149		274,149	325,692	263,819	287,084		287,084		

ACC	Males					Females				
Age	Base case	Pre 2000	Post 2000	S1	S2	Base case	Pre 2000	Post 2000	S1	S2
53	1,893	1,893			0	1,463	1,463			0
54	3,986	3,986			0	11,860	11,860			0
55	3,619	3,619			0	14,659	14,659			8,262
56	2,063	2,368	-1,143	2,533	0	13,234	15,656	-1,253	3,187	7,193
57	3,456	4,966	-2,413	1,381	0	9,051	13,316	-1,067	19,137	6,240
58	1,992	2,869	-144	1,618	0	6,914	11,512	171	10,939	5,806
59	14,682	21,743	2,006	5,069	0	13,517	9,210	18,009	14,718	5,890
60	9,034	12,009	5,349	-1,174	4,878	6,085	5,934	6,208	7,558	5,394
61	5,484	12,108	2,189	22,891	4,573	4,596	3,550	5,302		
62	1,234	-1,480	2,130	22,995	4,331	20,198	-3,840	28,119		
63	1,419		1,419	1,738	5,441	-7,061		-7,061		
64	35,157		35,157	32,857	7,592	-1,600		-1,600		
65	17,797		17,797	10,606	7,810	6,667		6,667		

Table A4.1 continued

PV	Males					Females				
Age	Base case	Pre 2000	Post 2000	S1	S2	Base case	Pre 2000	Post 2000	S1	S2
53	-7,210	-7,210			0	7,473	7,473			0
54	-6,392	-6,392			0	14,725	14,725			0
55	-6,650	-6,650			0	13,876	13,876			4,586
56	-5,999	-5,432	-11,967	-9,155	0	9,421	12,901	-11,394	12,801	1,951
57	-1,936	925	-13,055	-8,873	0	6,122	8,665	90	18,090	252
58	2,571	7,984	-10,601	-5,306	0	6,555	4,811	9,112	9,579	-1,030
59	6,388	14,891	-8,875	6,043	0	5,912	632	11,417	8,537	-1,589
60	-815	3,142	-5,714	8,356	2,973	505	-3,351	3,665	-57	-2,558
61	-6,073	-671	-8,759	25,093	2,139	2,331	-7,242	8,788		
62	-4,698	-14,127	-1,587	14,156	-733	8,869	-15,071	16,758		
63	12,249		12,249	4,227	-2,325	-19,559		-19,559		
64	28,125		28,125	20,057	-2,815	-13,772		-13,772		
65	5,741		5,741	-3,717	-3,792	-5,958		-5,958		

OV	Males					Females				
Age	Base case	Pre 2000	Post 2000	S1	S2	Base case	Pre 2000	Post 2000	S1	S2
53	16,472	16,472			0	13,513	13,513			0
54	19,855	19,855			0	23,432	23,432			0
55	19,873	19,873			0	26,455	26,455			20,058
56	18,795	19,459	11,807	19,265	0	24,667	27,064	10,336	14,621	18,627
57	20,445	22,370	12,965	18,371	0	19,848	24,083	9,804	29,935	17,037
58	19,284	20,339	16,719	18,910	0	17,259	21,855	10,518	21,283	16,151
59	31,946	38,807	19,630	22,334	0	23,605	19,587	27,794	24,806	15,977
60	26,561	29,457	22,976	16,353	22,406	15,972	15,973	15,970	17,445	15,281
61	22,706	29,905	19,127	40,113	21,796	14,926	13,115	16,147		
62	18,996	15,270	20,225	40,757	22,093	29,671	4,659	37,912		
63	18,318		18,318	18,637	22,341	1,574		1,574		
64	51,624		51,624	49,325	24,059	6,461		6,461		
65	33,572		33,572	26,381	23,585	16,323		16,323		

IST	Males					Females				
Age	Base case	Pre 2000	Post 2000	S1	S2	Base case	Pre 2000	Post 2000	S1	S2
53	-0.074	-0.074			0	-0.075	-0.075			0
54	-0.278	-0.278			0	-0.906	-0.906			0
55	-0.219	-0.219			0	-1.120	-1.120			-0.701
56	-0.104	-0.129	0.161	-0.131	0	-0.975	-1.156	0.104	-0.247	-0.565
57	-0.185	-0.278	0.176	-0.067	0	-0.695	-1.067	0.186	-1.475	-0.509
58	-0.120	-0.171	0.005	-0.098	0	-0.487	-0.912	0.138	-0.791	-0.478
59	-0.813	-1.208	-0.106	-0.288	0	-0.890	-0.661	-1.129	-0.984	-0.462
60	-0.476	-0.667	-0.240	0.095	-0.282	-0.383	-0.429	-0.345	-0.495	-0.432
61	-0.305	-0.670	-0.123	-1.256	-0.259	-0.271	-0.224	-0.303		
62	-0.041	0.071	-0.078	-1.195	-0.225	-1.686	0.623	-2.446		
63	0.040		0.040	0.064	-0.263	1.179		1.179		
64	-1.802		-1.802	-1.639	-0.356	0.838		0.838		
65	-0.953		-0.953	-0.563	-0.464	-0.491		-0.491		

Notes: Numbers are age profiles of the incentive measure showing means in 1996 Euros. The table compares the means of the incentive measure in the base case, pre and post reform 2000, for simulations S1 and S2.

Table A4.2. Predicted retirement probabilities, by sex and age

ACC	Males					Females				
Age	Base case	Pre 2000	Post 2000	S1	S2	Base case	Pre 2000	Post 2000	S1	S2
53	0.301	0.301			0.000	0.121	0.121			0.000
54	0.282	0.282			0.000	0.098	0.098			0.000
55	0.253	0.253			0.000	0.329	0.329			0.272
56	0.209	0.179	0.523	0.526	0.000	0.368	0.316	0.679	0.102	0.320
57	0.244	0.165	0.552	0.424	0.000	0.321	0.210	0.586	0.083	0.273
58	0.213	0.106	0.475	0.390	0.000	0.300	0.138	0.539	0.341	0.258
59	0.154	0.043	0.354	0.351	0.000	0.250	0.080	0.427	0.367	0.227
60	0.417	0.256	0.616	0.387	0.003	0.629	0.373	0.839	0.326	0.604
61	0.684	0.602	0.724	0.341	0.025					
62	0.623	0.718	0.592	0.372	0.106					
63	0.604		0.604	0.529	0.292					
64	0.562		0.562	0.644	0.422					
65	0.978		0.978	0.691	0.695					

PV	Males					Females				
Age	Base case	Pre 2000	Post 2000	S1	S2	Base case	Pre 2000	Post 2000	S1	S2
53	0.309	0.309			0.000	0.112	0.112			0.000
54	0.286	0.286			0.000	0.087	0.087			0.000
55	0.256	0.256			0.000	0.324	0.324			0.343
56	0.211	0.181	0.525	0.529	0.000	0.360	0.303	0.701	0.105	0.374
57	0.245	0.166	0.554	0.427	0.000	0.312	0.197	0.586	0.086	0.320
58	0.215	0.104	0.485	0.390	0.000	0.289	0.128	0.526	0.334	0.300
59	0.156	0.046	0.353	0.347	0.000	0.241	0.063	0.426	0.362	0.252
60	0.415	0.257	0.610	0.380	0.004	0.637	0.383	0.846	0.322	0.641
61	0.679	0.599	0.719	0.339	0.029					
62	0.617	0.721	0.582	0.369	0.113					
63	0.594		0.594	0.518	0.299					
64	0.550		0.550	0.635	0.422					
65	0.973		0.973	0.685	0.690					

OV	Males					Females				
Age	Base case	Pre 2000	Post 2000	S1	S2	Base case	Pre 2000	Post 2000	S1	S2
53	0.301	0.301			0.000	0.121	0.121			0.000
54	0.282	0.282			0.000	0.098	0.098			0.000
55	0.253	0.253			0.000	0.329	0.329			0.273
56	0.209	0.179	0.523	0.525	0.000	0.368	0.316	0.679	0.106	0.320
57	0.244	0.165	0.552	0.423	0.000	0.321	0.210	0.586	0.086	0.274
58	0.213	0.106	0.475	0.389	0.000	0.300	0.138	0.539	0.345	0.259
59	0.154	0.043	0.354	0.350	0.000	0.250	0.080	0.427	0.371	0.228
60	0.417	0.256	0.616	0.386	0.003	0.629	0.373	0.839	0.328	0.603
61	0.684	0.602	0.724	0.340	0.025					
62	0.623	0.718	0.592	0.371	0.104					
63	0.604		0.604	0.530	0.291					
64	0.562		0.562	0.646	0.423					
65	0.978		0.978	0.694	0.697					

Table A4.2 continued

IST	Males					Females				
Age	Base case	Pre 2000	Post 2000	S1	S2	Base case	Pre 2000	Post 2000	S1	S2
53	0.305	0.305			0.000	0.116	0.116			0.000
54	0.283	0.283			0.000	0.095	0.095			0.000
55	0.252	0.252			0.000	0.328	0.328			0.217
56	0.208	0.176	0.535	0.533	0.000	0.369	0.318	0.673	0.092	0.273
57	0.242	0.161	0.558	0.426	0.000	0.323	0.213	0.582	0.075	0.243
58	0.213	0.102	0.484	0.392	0.000	0.301	0.142	0.535	0.332	0.238
59	0.153	0.048	0.341	0.356	0.000	0.253	0.076	0.437	0.367	0.202
60	0.416	0.256	0.614	0.388	0.003	0.631	0.371	0.845	0.326	0.592
61	0.685	0.613	0.720	0.359	0.023					
62	0.627	0.726	0.594	0.382	0.105					
63	0.609		0.609	0.524	0.294					
64	0.571		0.571	0.664	0.410					
65	0.981		0.981	0.701	0.679					

Notes: (a) Predicted retirement probabilities at various ages. The table compares the age profiles using 5 different simulation scenarios: the base case, pre and post reform 2000, simulation S1 (delay in all retirement eligibility ages by 3 years), and simulation S2 (common reform; no disability option, replacement rate at ages 65/60 is sixty percent, every year of early retirement reduces the age 56/60 benefit by 6 percent).

(b) The retirement probabilities are calculated by predicting the probability of retirement for each observation, then averaging these probabilities by age. For each scenario, changes in *SSW* and the respective incentive measure are represented in the predictions.

Table A4.3. Expenditure savings by reform scenarios (in percent), by sex and age

ACC	Males			Females		
Age	Reform 2000	S1	S2	Reform 2000	S1	S2
53			-1.000			-1.000
54			-1.000			-1.000
55			-1.000			-0.483
56	1.682	1.518	-1.000	1.069	-0.732	-0.398
57	2.264	0.743	-1.000	1.565	-0.748	-0.380
58	3.374	0.813	-1.000	2.583	0.179	-0.333
59	7.022	1.235	-1.000	3.988	0.549	-0.262
60	1.404	-0.116	-0.998	1.259	-0.450	-0.215
61	0.082	-0.503	-0.988			
62	-0.291	-0.352	-0.915			
63		0.074	-0.645			
64		0.405	-0.272			
65		-0.161	-0.317			

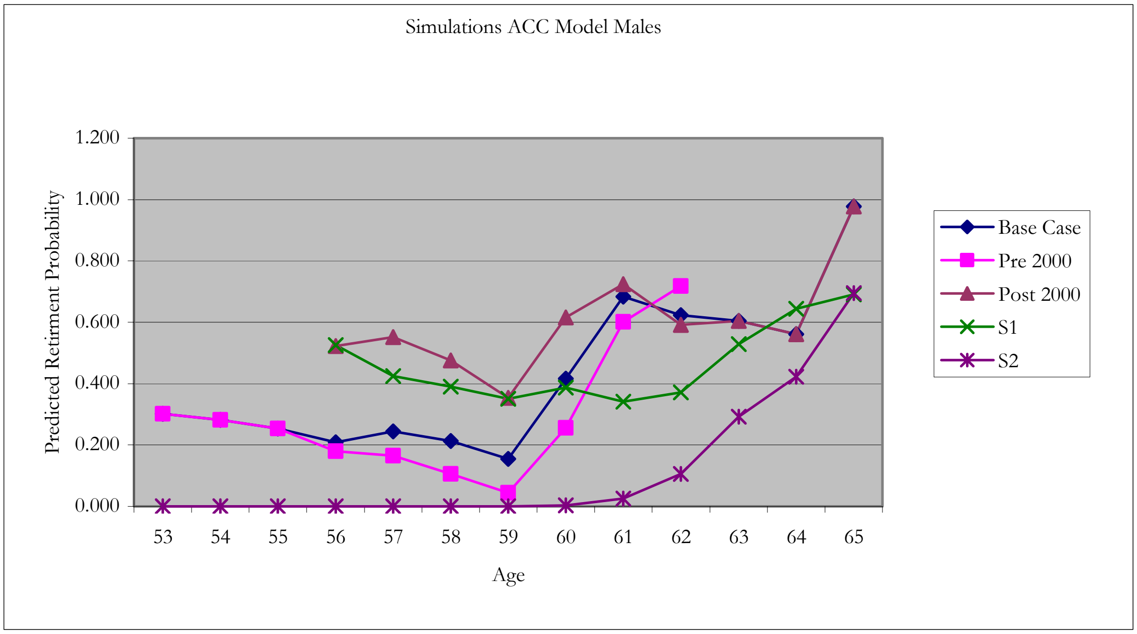
PV	Males			Females		
Age	Reform 2000	S1	S2	Reform 2000	S1	S2
53			-1.000			-1.000
54			-1.000			-1.000
55			-1.000			-0.338
56	1.667	1.511	-1.000	1.226	-0.719	-0.281
57	2.257	0.743	-1.000	1.735	-0.732	-0.252
58	3.514	0.799	-1.000	2.772	0.199	-0.196
59	6.609	1.194	-1.000	5.287	0.585	-0.148
60	1.374	-0.128	-0.997	1.219	-0.465	-0.178
61	0.078	-0.502	-0.986			
62	-0.305	-0.350	-0.908			
63		0.070	-0.630			
64		0.415	-0.258			
65		-0.164	-0.317			

OV	Males			Females		
Age	Reform 2000	S1	S2	Reform 2000	S1	S2
53			-1.000			-1.000
54			-1.000			-1.000
55			-1.000			-0.481
56	1.682	1.512	-1.000	1.069	-0.721	-0.397
57	2.264	0.739	-1.000	1.565	-0.739	-0.378
58	3.374	0.808	-1.000	2.583	0.191	-0.331
59	7.022	1.228	-1.000	3.988	0.563	-0.259
60	1.404	-0.118	-0.998	1.259	-0.447	-0.216
61	0.082	-0.504	-0.988			
62	-0.291	-0.354	-0.916			
63		0.076	-0.646			
64		0.409	-0.271			
65		-0.156	-0.314			

Table A4.3 continued

IST	Males			Females		
Age	Reform 2000	S1	S2	Reform 2000	S1	S2
53			-1.000			-1.000
54			-1.000			-1.000
55			-1.000			-0.585
56	1.783	1.569	-1.000	1.041	-0.760	-0.486
57	2.372	0.761	-1.000	1.508	-0.773	-0.451
58	3.609	0.824	-1.000	2.443	0.145	-0.386
59	5.989	1.292	-1.000	4.370	0.530	-0.351
60	1.392	-0.115	-0.998	1.286	-0.453	-0.233
61	0.056	-0.477	-0.989			
62	-0.297	-0.338	-0.915			
63		0.056	-0.645			
64		0.426	-0.305			
65		-0.151	-0.334			

Notes: (a) The table compares the public expenditure savings in *SSW* for reform 2000, simulation S1 (delay in all retirement eligibility ages by 3 years), and simulation S2 (common reform; no disability option, replacement rate at ages 65/60 is sixty percent, every year of early retirement reduces the age 56/60 benefit by 6 percent). Numbers represent the percentage change in *SSW* expenditures for a mean representative retiree of age *a* weighted by predicted retirement probabilities. The reference scenario for S1 and S2 is the base case, for reform 2000 it is the pre reform 2000 scenario. Negative numbers indicate a decline in public expenditures.



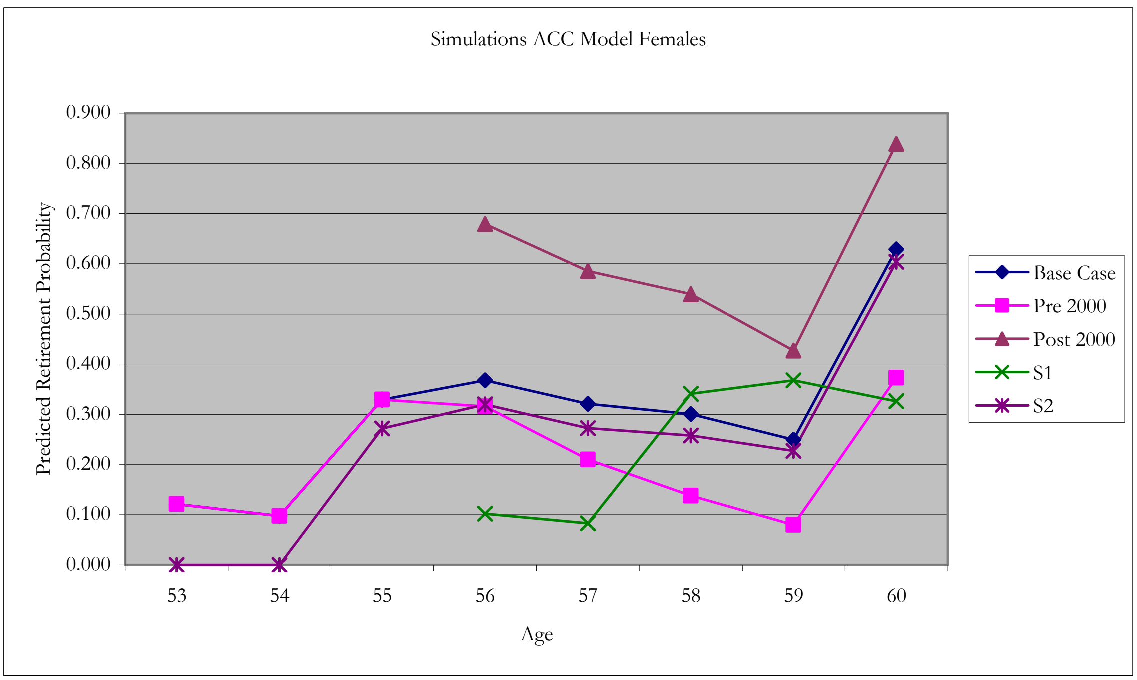
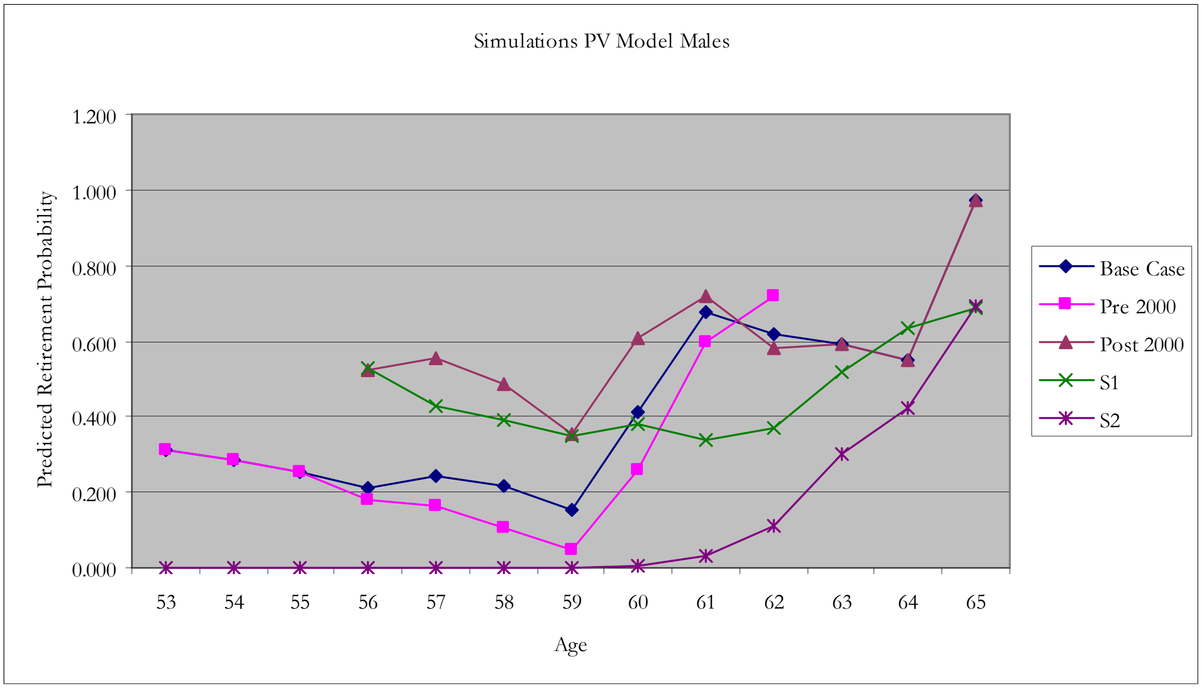


Figure A4.1. Age profile of predicted retirement probability, *ACC* model, by sex.

Notes: (a) Predicted retirement probabilities at various ages. The table compares the age profiles using 5 different simulation scenarios: the base case, pre and post reform 2000, simulation S1 (delay in all retirement eligibility ages by 3 years), and simulation S2 (common reform; no disability option, replacement rate at ages 65/60 is sixty percent, every year of early retirement reduces the age 56/60 benefit by 6 percent).

(b) The retirement probabilities are calculated by predicting the probability of retirement for each observation, then averaging these probabilities by age. For each scenario, changes in *SSW* and the respective incentive measure are represented in the predictions.



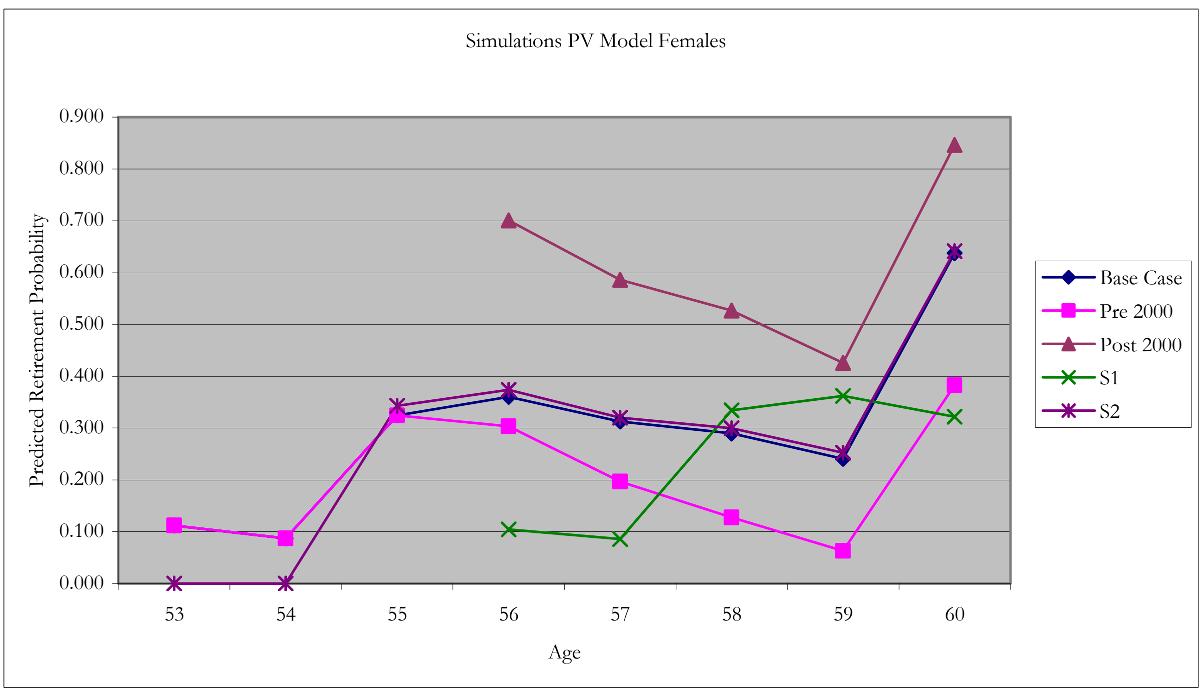


Figure A4.2. Age profile of predicted retirement probability, *PV* model, by sex.

Notes: see notes of figure A4.1.

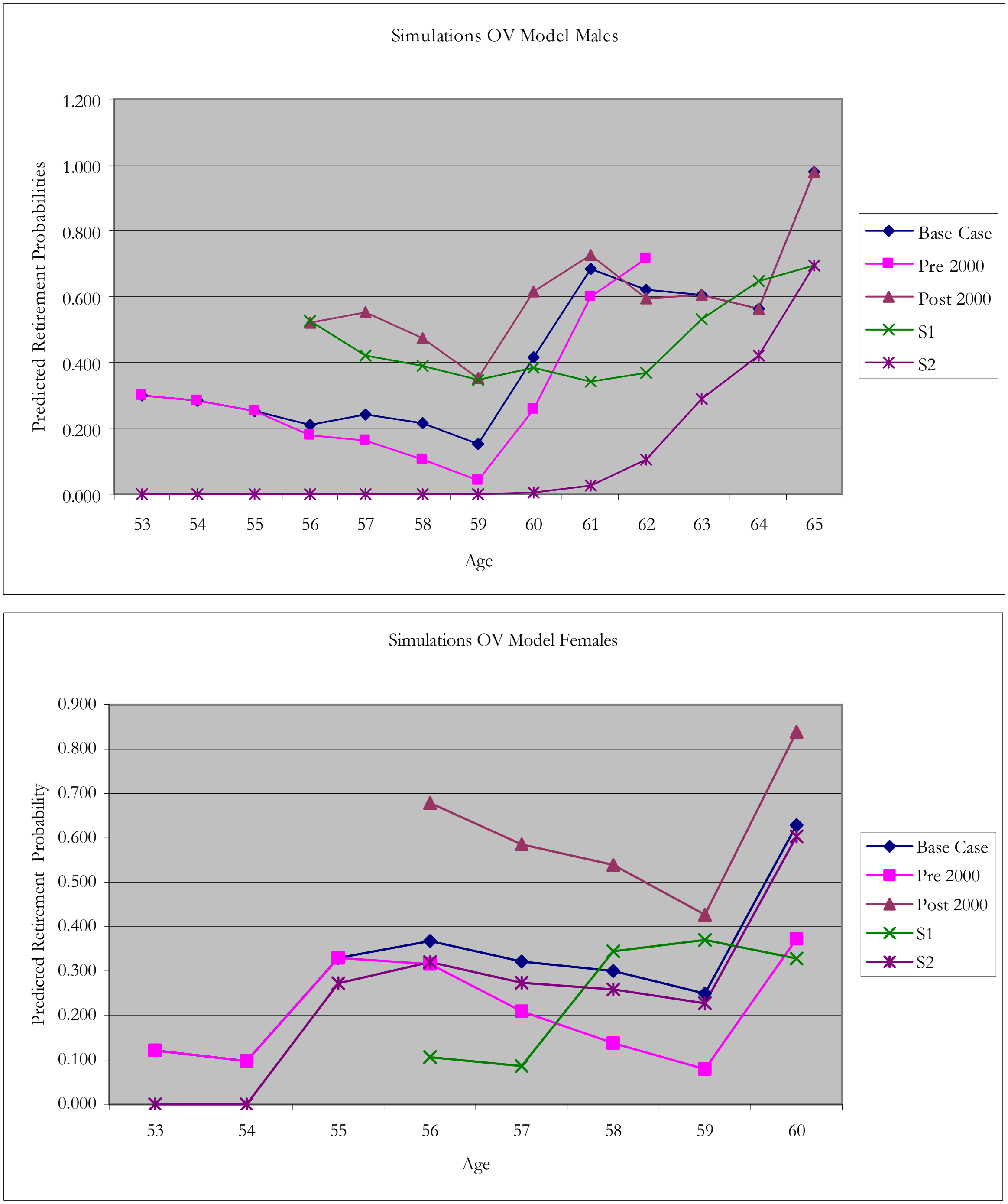
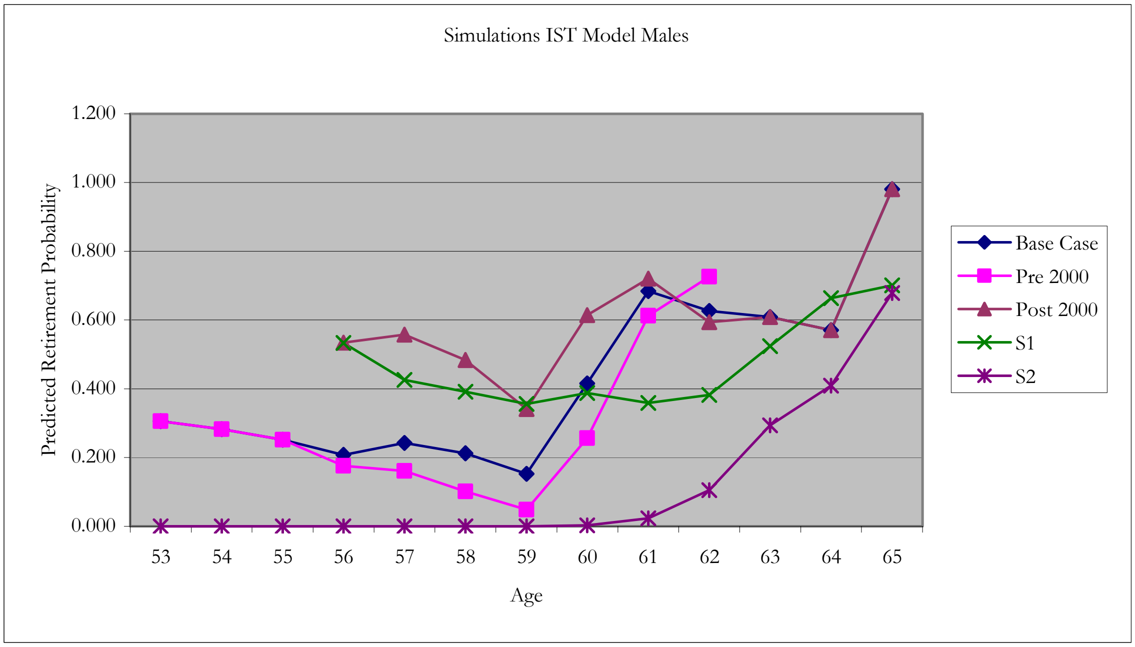


Figure A4.3. Age profile of predicted retirement probability, *OV* model, by sex.

Notes: see notes of figure A4.1.



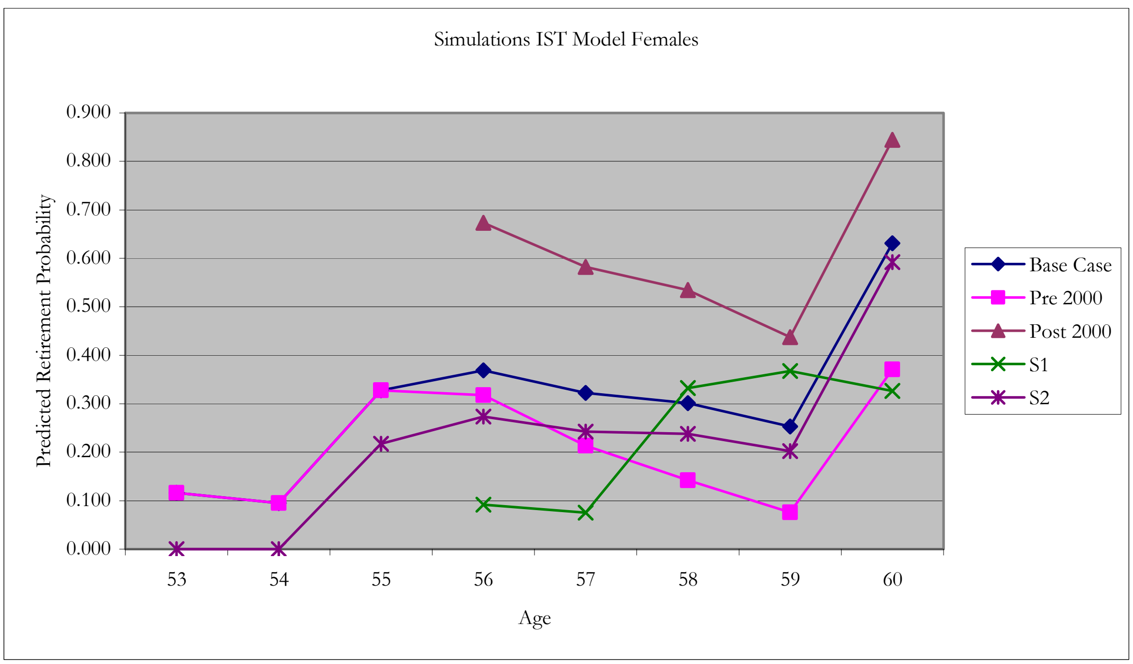


Figure A4.4. Age profile of predicted retirement probability, *IST* model, by sex.

Notes: see notes of figure A4.1.

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