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# RACE FOR RETIREMENT

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Helsinki, 1999

To my very first economics teacher, late John Wynne-Hughes

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**ABSTRACT:** The study analyses the effects of the pension system on the labour supply of the elderly in Finland. A significant change in the age structure of the population, combined with falling employment rates for the aged, can yield pressures on the financing of the mainly Pay-As-You-Go, Defined Benefit pension system.

Empirical results provide some evidence that economic incentives matter also to the aged Finnish employees. It was verified by controlling a number of other variables, that if an individual was better off by postponing his retirement decision, he was more likely to continue working.

Two simulations demonstrate that even if altering economic incentives has some of the desired impact of postponing retirement, this impact seemed rather small. The study therefore suggests the need to alter also age restrictions if the average retirement age needs to be altered radically.

**Keywords:** Early retirement, early exit, random effects probit, option value

**TIIVISTELMÄ:** Tutkimuksessa analysoidaan eläkejärjestelmän vaikutuksia työmarkkinoille osallistumiseen. Ikääntyneiden työllisyysasteet ovat Suomessa olleet selkeässä laskussa viime vuosikymmeninä. Tämä voi johtaa pitkälti jakojärjestelmään perustuvan eläkejärjestelmän rahoitusvaikeuksiin - varsinkin kun Suomessa samaan aikaan toteutuu voimakas ikärakenteen muutos.

Tulokset antavat tukea väitteelle, jonka mukaan taloudellisilla kannustimilla on merkitystä myös suomalaisilla ikääntyneiden työmarkkinoilla. Työssä todetaan, että vaikka muutkin eläkkeelle siirtymiseen vaikuttavat tekijät otetaan huomioon, suurempi eläkkeellesiirtymispäätöksen siirtämisestä saatu taloudellinen hyöty johti korkeampaan todennäköisyyteen jatkaa työelämässä. Kahden eläkejärjestelmän muutossimulaation perusteella saadaan tulos, jonka mukaan muutoksilla on, odotusten mukainen, eläköitymistodennäköisyyksiä pienentävä vaikutus. Tämä ei kuitenkaan ollut kovin suuri. Tutkimus viittaisi siihen, että jos keskimääräistä eläkkeellesiirtymisikää halutaan selvästi korottaa, olisi tärkeää muuttaa myös varhaiseläkkeiden ikärajoituksia.

**Avainsanat:** Varhaiseläkkeet, taloudelliset kannustimet, satunnais-vaikutteiset probit -mallit

# Foreword

Ageing of the population is one of the major changes in industrialized societies, like Finland. Consequently, concern for the financial feasibility of the pension system has been at the centre of a heated public debate also in Finland. Changes in the underlying demographic structure will put pressure on a partly funded, but primarily a Pay-As-You-Go -based pension system in Finland. As the baby-boom generations reach the age of an early retirement, there is an increasing worry that these generations will withdraw "too early" from the labour force. This concern has clearly been recognized also by the political decision-makers. Recent years have already seen numerous pension reforms. Moreover, the government has set itself explicit targets to raise the employment level, and to raise the mean retirement age by two to three years. In order to assess these goals, it is essential to obtain empirical research on whether the reforms that have been implemented actually have any "bite", and if they do, what type of reforms would be the most effective.

Government Institute for Economic Research has, in recent years, invested in increasing its know-how on microeconometric research on economic incentives in the labour markets. This study belongs to a series of empirical research reports on incentive effects and labour market transitions. It widens the research area also into the consideration of the labour markets of the aged - an area which has, so far, received too little attention among the empirical economists in Finland.

Results of this study provide some empirical evidence that economic incentives matter in the labour supply of the elderly. Yet, it seems to also point out - somewhat surprisingly - that the incentive impact could be relatively small. It is important, therefore, to verify this finding with further work in this area. We hope that this report will generate discussion as well as further research on the labour markets of the aged.

Helsinki, October 1999

Reino Hjerppe

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All the remaining errors are my exclusive responsibility.

Helsinki, October 1999

Tuulia Hakola

# Yhteenveto

Suomalainen eläkejärjestelmä, useiden muiden teollistuneiden maiden eläkejärjestelmien tavoin, rakentuu pääosin jakojärjestelmän pohjalle[1] ja määrittelee etukäteen eläke-etuuksien tason[2]. Anglosaksiseen eläkejärjestelmään verrattuna suomalaisen systeemin vahvuutena on riskin hallinta yhden yksilön kannalta. Jakojärjestelmän yhtenä heikkoutena puolestaan on sen sopeutumiskyvyn heikkous väestöpohjien muutoksiin. Jakojärjestelmässä työssäkäyvä väestö rahoittaa jo työelämästä poistuneiden sukupolvien eläkkeet. Jos ikäluokkien koossa tapahtuu huomattavia muutoksia, jakojärjestelmän mukaan pienempi joukko joutuu isompaan eläkevastuuseen. Koska eläke-etuudet ovat pääosin ennalta määrättyjä, eivät myöskään eläkkeiden tasot jousta muuttuneessa väestösuhteessa. Vaikka Suomen eläkejärjestelmään onkin sisällytetty joitakin joustavuusmekanismeja väestöpohjan muutospaineiden varalle, jakojärjestelmän toimivuus tullaan punnitsemaan erityisesti vuosina 2010-2030. Silloin varhaiseläkeikäisten ja eläkeikäisten määrät ovat maksimissaan. Työikäisten määrän lasku ajoittuu myös samoihin aikoihin.

Eläkejärjestelmän paineita kasvattaa myös vanhempien ikäluokkien viime vuosikymmeninä vähentynyt työssäkäynti. Vaikka varsinainen työvoimaan osallistumisen lasku onkin rajoittunut vanhimpaan varhaiseläkeikäluokkaan, on työllisten määrän putoaminen ilmeistä jo ainakin viidestäkymmenestäviidestä ikävuodesta alkaen. Osaselitys työllisten määrän alenemiseen löytynee 1980-luvun puolella kehitetyistä varhaiseläkemekanismeista sekä eläkejärjestelmämme täysimääräisestä voimaantulosta[3]. 1990-luvun laman ja erityisesti työttömyyseläkejärjestelmän muutosten seurauksena, alle kuusikymmenvuotiaiden työttömyysosuudet ovat nousseet räjähdysmäisesti. Hyvin suuren osan kyseisestä ikäryhmästä ei oletetakaan pyrkivän - puhumattakaan pääsevän - takaisin työelämään. Kasvanut varhainen työelämästä poistuminen ajoittuu eläkejärjestelmämme kestävyyden kannalta hankalimpaan mahdolliseen ajankohtaan - aikaan, jolloin työelämästä poistuvat ikäluokat ovat poikkeuksellisen suuria.

Tutkimuksen tarkoituksena oli selvittää eläkkeelle siirtymiseen johtavia tekijöitä. Erityisen tärkeäksi koettiin eläkejärjestelmäämme liittyvien kannustimien vaikutusten kartoittaminen. Kannustimia määriteltäessä pyrittiin ot-

[1] Pay-As-You-Go

[2] Defined Benefits

[3] TEL-eläkejärjestelmän perustamisesta on tänä vuonna kulunut kolmekymmentäseitsemän vuotta. Täyden neljäkymmentä työvuotta, jotka oikeuttavat kuudenkymmenen prosentin eläkkeisiin eläkepalkasta lienevät jo tosiasia sekä tulevan ajan -säädöksen että eläkejärjestelmän perustamista edeltävien vuosien karttuma- säädösten vuoksi.

tamaan huomioon tarpeeksi pitkä aikaväli. Koska vain hyvin harva eläkkeelle siirtyneistä palaa takaisin työelämään, eläkkeelle siirtymistä miettivä käytännössä tekee päätöksen toimeentulostaan loppuelämänsä ajaksi. Siksi kannustimia tarkasteltiin mittarilla, joka otti huomioon muutoksen loppuiäksi odotettavassa vuotuisessa eläkkeessä, jos työntekoa jatkettaisiin. Kullekin varhaiseläkeiässsä olevalle yksilölle laskettiin vuosittainen arvio siitä, mikä olisi hänen odotettavissa oleva tulonmenetyksensä, jos hän jäisi välittömästi eläkkeelle eikä jatkaisi työtä siihen vuoteen saakka, jonka jälkeen hän saisi suurimman mahdollisen eläkkeen (kuitenkin ennen 65:n vuoden ikää).

Tutkimustulokset osoittavat, että eläkejärjestelmään liittyvillä kannustimilla oli merkitystä työvoimasta vetäytymisen ajankohtaan. Niille henkilöille, jotka poistuivat työvoimasta aikaisemmin, oli eläkkeelle siirtyminen kyseisenä ajankohtana taloudellisesti selvästi kannattavampaa kuin se olisi ollut niille, jotka eivät kyseisenä ajankohtana siirtyneet. Kattavammassa kehikossa voitiin todeta kannustimien kasvattavan eläkkeelle siirtymistodennäköisyyttä, vaikka muita siirtymistodennäköisyyksiin vaikuttavia tekijöitä kontrolloitaisiinkin. Väitteen paikkansapitävyyttä testattiin myös lisäämällä työn kysyntäpuolen (eli yritysten käyttäytymistä kuvaavia) muuttujia perusyhtälöön. Vaikka yritysten työvoimapolitiikalla onkin ollut tiettävästi korostunut merkitys ikääntyneiden työmarkkinoilla erityisesti laman aikana, oli työntekijöille tarjotuilla kannustimilla myös merkitystä.

Tutkimuksesta ilmeni myös, että yksilöspesifien ominaisuuksien (esimerkiksi terveydentilan) lisäksi työnantajapuolen rahoitusvastuilla näyttäisi olevan merkitystä työelämästä poistumistapaan. Yksityisellä sektorilla työnantajien eläkevastuiden erot eri varhaiseläkelajien välillä määräytyvät osin yrityksen henkilöstömäärän mukaan. Rajoitetun vastuun seurauksena suurien yritysten on ollut kannattavampaa käyttää henkilöstöuudistuksissaan työttömyyskanavaa (joka kyllä myöhemmin johtaa työttömyyseläkkeeseen). Pientyönantajien suuntautuminen suurtyönantajia selvemmin nopeampaan eläkkeelle siirtämiseen oli havaittavissa tässä tutkimuksessa. Toisin sanoen, pientyönantajalla työskentely lisäsi yksilön eläkkeellesiirtymistodennäköisyyttä.

Lopuksi mallinnettiin eläkepoliittisten uudistusten vaikutuksia työelämästä poistumistodennäköisyyksiin. Simulointien avulla havaittiin, että vaikka eläkeuudistuksilla on halutun suuntainen vaikutus ihmisten eläkkeelle siirtymisen myöhentämiseen, ovat vaikutukset verrattain pieniä. Tämä tuntuisi viittaavan siihen, että vaikka eläkkeelle siirtymisikään voidaankin jonkin verran vaikuttaa kannustimia muokkaamalla, vaatii suurten muutosten aikaansaaminen suoria toimia myös ikärajoitusten suhteen.

# Contents

# 1 INTRODUCTION

The expenditure on pension benefits constituted forty-two per cent of the social security expenditure, in Finland, in 1997, and about thirteen per cent of the gross domestic product. In 1997, expenditure on pension benefits was more than seventy-eight milliard Finnish Marks[1]. Henceforth, in expenditure terms, the pension system forms a highly significant part of the whole social welfare system.

The impact of the pension system on the economy, however, is not limited to its financial aspects. The pension system can (and does) assert a significant impact on several other aspects of the economic activity. These repercussions can be classified at least into five categories: a) impacts on the labour markets and the productivity of labour, b) capital accumulation (savings) and the allocation of capital, c) the ability of the government to finance public goods and services, d) inter- and intragenerational income distribution, and e) consumption patterns of the population. All of these effects, in turn, can have repercussions on economic growth.

The nature of these effects on the economic activity is highly dependent on how the pension system is organized. Essentially there are two features that are of a substantial importance. The first defines the nature of the financing of the pension system. Most public pension schemes function primarily as Pay-As-You-Go (PAYG) systems. In a PAYG pension system, the current working population pays the pension benefits of the retired population. A Fully Funded (FF) pension system provides an alternative to the PAYG system. In a FF scheme, each generation saves for its own pensions in pension funds that are, in turn, generally invested in capital markets. The second important feature of the pension system defines what determines the level of the pension benefits. Most pension systems today are schemes with Defined Benefits (DB). This implies that the pension provider (often the state) guarantees pre-specified pension levels for the insured. These benefits are a function of the individuals' working careers, and they are somewhat detached from the contributions that are paid. In the alternative, Defined Contribution (DC) scheme, pension promises are not tied to the benefit levels, but rather they are tied to the contributions (or the investment yields of these

[1] Statistics Finland, Yearbook 1998.

contributions). The Finnish pension system is a system with defined benefits. It functions primarily as a Pay-As-You-Go -system, with about a fourth of the system being currently funded[2].

Pension system effects on the labour markets are at least twofold. The primary function of the pension system is to enable a financially secure withdrawal (primarily by the elderly) from the labour market. Therefore, the labour supply of the older workers is naturally affected. The retirement payment contributions, in contrast, can provide disincentives to work in all age groups.

The effects of the pension system on the labour supply of the elderly have not been limited to those individuals who have reached the official retirement age (around 65 in most countries where the official retirement age is defined). So called early retirement schemes consist of opportunities to retire before obtaining pension benefits for the old-age. Generally, these "windows of withdrawal" give individuals an opportunity[3] to retire during approximately a ten-year period prior to the official retirement age. The early retirement schemes have led to a continuous and dramatic fall in the labour force participation rates for the 55 to 64 year olds, in the industrialized countries, in the past thirty years. In Finland this fall has been particularly dramatic. According to the World Bank (1994), Finland experienced the second largest drop among the industrialized countries' labour force participation rates of the aged between 1960-6 and 1986-90[4]. Only the fall in the Dutch men's labour force participation, in the age group of 55 to 64, was greater than the Finnish fall of forty percentage points. It is believed that as most of the pension systems don't reward, or even penalize, for late retirement, early retirements are implicitly encouraged by the pension systems.

These huge falls in the labour force participation rates are costly not only because of the consequent increases in the pension outlays, but they can also

[2]Lämsä et al, 1997. Vanne (1997) denotes that the pension funds in 1996 were about 240 milliards - out of which about 190 milliards were governed by the private sectors, and the rest by the public pension funds.

[3]A restricted opportunity that is governed by the specific regulations of each early retirement scheme.

[4]Viitamäki (1998) states that, in 1985 in Finland a half of the 60 year-olds and above received a pension, while in 1998, this was already 85 per cent. The starting level in 1985 was approximately the same in Denmark and in the Netherlands, but the rise has been smaller.

have big effects on production and productivity. The World Bank (1994) claims that if the same proportion of the 55 to 64 year olds had been working in 1990 as in 1960, the labour force would have been three to six per cent larger in the OECD countries. The World Bank estimates that this could have translated into a gain of two to four per cent of the GDP in national output[5]. These calculations, however, assumed that the older workers are at least as productive as the young ones - an assumption that is highly debatable. Yet, even if the total impact were not as large as claimed by the World Bank, there is a potential for a substantial loss in output.

As the PAYG systems with defined benefits break the link between the benefits and the contributions, the social security contributions for the pension system are viewed as a tax, both by the employers and employees. The pension scheme can, therefore, provide incentives for employers to reduce their hirings, for employees to reduce their labour supply and for employees simply to escape to the "grey sector". The incidence of the tax depends on the respective elasticities of the labour supply and the labour demand. In Finland, there is empirical evidence that employees have born twenty to fifty per cent of the contributory payments[6].

The impact of the PAYG pension system and the FF pension system on the savings rates can differ substantially. Empirical evidence on the effect of introducing a PAYG pension system on savings, remains mixed. Yet, there is a possibility that the PAYG systems may actually reduce savings[7], and, therefore, affect negatively capital accumulation. In contrast, the FF system has a potential to increase savings. The best example of the savings increase is provided by Chile. Chile made a switch from a PAYG to a FF pension system in 1981. Chile's savings rates increased from practically zero in 1979-1981, to seventeen per cent of the GDP, in 1990-1992[8]. Some of this increase has been attributed to the changes implemented in the pension system.

[5]This claim might seem somewhat absurd in the current period of high unemployment. The falling trend in the labour force participation, however, dates further back than the substantial problems in the labour markets of today.

[6]Koskela, 1991.

[7]Private savings are partially or totally substituted by the savings for social security. Yet, savings can also be increased if the individuals are induced to retire early, and therefore, want to save more for the old age. See section 2.3 for more details.

[8]Corsetti, Giancarlo and Schmidt-Hebbel, Klaus (1995): Pension Reform and Growth, World Bank Policy Research Working Paper 1471.

Pension payments are the largest item in the consolidated government budget in most of the OECD countries[9]. The availability of such finance produces an imminent danger to consume these funds if they are under the government management. It is also possible that the pension funds are lent by some kind of a preferential arrangement, for example, with more advantageous interest rates than those determined by the financial markets. In Finland, most of the pension funds are actually under the private management. Yet, some of the funds are lent through a preferential "back-lending system"[10]. The interest rate for this back-lending is officially set and has generally been below the market rates. Koskela (1991) argues that the most substantial effect of the back-lending system has not necessarily come through inefficient investments per se. Rather, the system has indirectly changed the relative prices of capital and labour, and therefore contributed to an over-investment in capital with respect to labour. Moreover, due to global financial liberalization and reduction in the rates of inflation, the back-lending system has lost its competitiveness as a financing mechanism (Vanne, 1997).

The Pay-As-You-Go pension system also has a potential for *inter*generational redistribution of income. As there is no automatic matching of the lifetime benefits to the lifetime costs for successive generations, it is possible (and even likely) that some generations gain at the expense of the others. Generational accounting tries to make the resulting income transfers explicit.

Defined benefit pension systems, in turn, may lead to *intra*generational income transfers. Because the link between the benefits and the contributions is broken, there is a possibility for redistribution of income between the income classes. In Finland, there is no financial ceiling on the pension benefits. Henceforth, there seems to be no intragenerational redistribution in the upper end of the income scale. In the lower end of the scale, however, there is a minimum security component which is totally independent of any contributions. This aspect, therefore, produces some intragenerational redistribution.

Pure PAYG pension systems weather badly substantial demographic changes[11]. Demographic changes strain the PAYG systems, raising the contributions that need to be collected from the working population. Currently, most of

[9] World Bank, 1994.

[10] Takaisinlainaus, vakuutusmaksulainaus eli TEL-lainaus

[11] This is one of the reasons why the Finnish pension system, for example, is partially funded.

the OECD countries - Finland being no exception - have been hit by a double aging process. On average the life expectancy at birth has risen by more than seven per cent, while fertility has fallen below the replacement rates[12]. Compounded by the falling trends in labour force participation rates, there has been an increasing pressure to raise the pension contributions by the working population, cut the pension benefits of those retired (or rather tighten the regulations for those who will retire), raise the average age of retirement and/or increase the funded portion of the current pension systems.

This study focuses on the impacts of the pension system on the labour markets. It is shown that demographic changes and early withdrawals from the labour markets present a considerable challenge also to the Finnish pension system. In order to contemplate the possible measures for alleviation of the potential financing problem, an effort was made to flesh out the causes for the early retirements by the elderly. Special focus was put on the most effective policy device available - the economic incentives, implicitly provided by the pension system.

Theoretical framework for the study relies on the optimization behaviour of an individual. Utility is maximized with respect to consumption which, in turn, is proxied by income. Utility is maximized over the expected remaining life-time, but re-optimization is performed every period as more information becomes available.

The economic incentive term is measured by an option value to retirement. The option value gives an opportunity cost of retirement today with regards to retirement at a later date. It is constructed by predicting the wage development if an individual had continued working, and calculating the corresponding pension benefits, had he retired. The wage predictions are done using a modified Arellano-Bond technique, combined with Hausman-Taylor regression estimations. Together these two estimation techniques give unbiased and consistent regression estimates for a number of explanatory variables - which, in turn, are used in wage imputations. Pension calculations are done using the corresponding pension system regulations each year of the estimation sample. The yearly pension benefit growth is estimated by predicting the index developments by the means of the real wage imputations.

The option value variable is used as an explanatory variable (together with

[12] Börsch-Supan, 1992.

some individual and state specific variables) in a random effects probit model. This statistical framework enables to assess the retirement probabilities for those eligible for early retirement. Panel probit is able to deal effectively with un-observable variables which are deemed to be important in determining the timing of retirement. Even if there is a multitude of early retirement channels, due to the panel structure, these are not treated separately in this study, but are left for further research.

The data for the empirical section of the study was provided by the Government Institute for Economic Research (VATT). The data set, compiled by the Statistics Finland, is a panel of about 12,000 individuals. It is a sample out of the working age population in Finland in 1990, and it contains observations on each individual from year 1987 to 1994. The variable set contains detailed information on individual socio-economic characteristics and financial variables (about 150 variables for each individual, most of them observed for all 8 years).

The structure of this study is as follows: After the introduction, there is an overview of the relevant retirement, and retirement and savings literature. The third chapter analyzes changes in the Finnish demographic structure, explains the main features of the Finnish pension system, overviews the retirement rates in the macro level and highlights some special incentive features of the pension system. The fourth chapter gives the theoretical and econometric background for the study. The fifth chapter reviews the micro-data, and gives the results with some simulations. The final chapter, the sixth, concludes.

# 2 A SELECTIVE SURVEY OF THE LITERATURE

Literatures on the economic incentives of the early exits and the effects of the social security on savings are vast and rich. Microeconometric research goes at least as far back as to the 1970s. A comprehensive, all-encompassing literature review is therefore far beyond the scope of this study. An attempt has been made to concentrate on the general developments of the literature, highlighting only some "path-breaking" papers. Research has basically been guided by methodologies developed for, and applied in the US, which is why also the literature review tends to concentrate on the papers written for the US economy.

The chapter is divided into three subsections. The first two deal with the literature on the economic incentives and labour force participation only. The third gives a brief overview of the literature that takes the analysis one step further. It considers the effects of the social security on savings.

Comparison of the results of this study to any other results is difficult - if not impossible. This is due to the lack of comparable data sets and differences in estimation methodologies. Reporting of more accurate results of the papers that are reviewed, is, therefore, intentionally kept to the minimum.

## 2.1 International Review of the Retirement Literature

### 2.1.1 Up to the 1980s - Early Research on the Economic Incentives to Retire

First papers of the retirement research - survey papers - tended to disregard the issue of financial incentives altogether. Yet, as the social security coverage and benefit levels increased in the 1970s in the US, while, at the same time, economic theory, research methodologies and data sets developed, the question of financial incentives started to call for more attention. It was understood that changes in public policy had a potential influence on the retirement rates, and therefore it was essential to understand the retirement mechanism better.

In the first phase of the microeconometric work, in the 1970s, the theoretical framework was based on a simple, one-period, budget-constrained utility maximization. This framework ignored the savings nature of the social security payments (or allowances), and treated these payments purely as taxes (or subsidies). Nevertheless, the first econometric contributions provided some evidence that economic incentives matter. Quinn et al. (1990) cite Boskin's paper from 1977 as one of the earliest econometric contributions. Boskin's results yielded an indication that the effect of non-linearities due to the social security, had a clear effect on the labour supply. Other papers, for example, Boskin and Hurd (1978) and Quinn (1977), followed with similar results. All these papers, however, were unable to determine what specific aspect of the benefit programs seemed to be responsible in inducing retirement.

Life cycle view on retirement research started to develop somewhat gradually. Quinn et al. (1990) credit Burkhauser (1979, 1980) for adding a multiperiod insight into the theoretical framework. "It is not simply the size of annual benefits received each year but the present value of the entire stream of benefits that emerges as theoretically and empirically significant." (Burkhauser, 1980). From here onwards, the pension right became viewed as an asset, value of which changes with the age of retirement. This "asset approach" rendered inadequate the earlier reliance on annual benefits and/or period-specific replacement rates as a measure of economic incentives. Today, the multiperiod approach is clearly a dominant paradigm on the retirement research. The approach has a strong impact on how pension systems are viewed today.

### 2.1.2 The 1980s - The US Research on Economic Incentives to Retire Picks Up

The retirement research in the US really took off in the 1980s. *Both* nationwide *and* pension plan specific data sets developed, giving possibilities for research on the general social security, or more focused research on both social security and pension plans. Because of the multitude of the pension schemes in the US, researchers faced a trade-off *between* more representative data sets (Retirement History Study and National Longitudinal Surveys) *and* the ability to take both the general social security and the private pension

plans into account[13]. For example, Fields and Mitchell (several articles in 1984, 1985), Mitchell and Luzadis (1988, 1989), Lazear (1990) and Stock and Wise (1990) took a deeper look at specific pension plans, attempting to determine the true value of all of the economic incentives. This, however, was done at the cost of possibly unrepresentative samples with regards the whole population.

Retirement literature, in the 1980s, also started to take focus on more specific issues and topics. For example, Burkhauser and Quinn (1983) concluded that retirement trends are not exogenous, and therefore, a mere change on mandatory retirement regulations is not sufficient to affect significantly retirement rates. Burtless (1986, 1987), Moffitt (1984, 1987) and Burtless and Moffitt (1984, 1985, 1986) considered non-linearities in the budget constraint, trying to explain retirement peaks at certain ages. Hausman and Wise (1985) compared whether a flow measure (annual benefits) or a stock measure (present discounted value of the benefits) explains better the retirement rates. Hurd (1988) considered joint retirement choices by husbands and wives.

Simulations of social security reforms were a central focus of some of the papers. For example, Fields and Mitchell (1984), Burtless and Moffitt (1984), Gohmann and Clark (1989), and Gustman and Steinmeier (1985, 1989), considered effects of some of the following policy changes: 1) increases in the age of normal benefit withdrawal, 2) changes in delayed/early withdrawal regulations, 3) delays in cost-of-living adjustments, and 4) across the board drops in pension benefits. All these papers yielded rather small effects for the reforms, but all of them were also partial equilibrium analysis. Due to the nature of the data sets available, these papers couldn't account for the financial incentives created by the whole retirement compensation system.[14]

Considerations for involuntary retirements inspired papers in two different spheres. Considerations for the appropriate measure of health, and, consequently, the magnitude of its effect on retirement, created its own sub-literature. This branch of the literature is surveyed, for example by Sammartino (1987). The second sphere of the involuntary retirement papers

[13]Taking into account both the general social security and the private pension plans, implied the use of firm or pension plan specific data sets. It has been possible to merge the two also at the national level in the US only in the 1990s. See Samwick, 1998.

[14]As mentioned before, in the US, it has been difficult to find representative data sets on both general social security and private pension system.

consists of labour demand considerations. These have been, due to the data difficulties, even more difficult to test empirically. The, articles contributing to this strand of the literature, concentrated, for example, on analysing the rates of unemployment of the elderly, (Herz and Rones, 1989; and Shapiro and Sandell, 1987); the industries in decline and their employment policies, (Hutchens, 1988); or simply relied on survey information of the labour demand for the elderly (Jondrow, Brechling and Marcus, 1987; Gustman and Steinmeier, 1983, 1985).

### 2.1.3 The 1990s - Consolidation of the US Retirement Research on the Economic Incentives and the Emergence of the European Empirical Literature

With the improvement of the research techniques, in the late 1980s and in the 1990s, models were better able to deal with uncertainty and individual's expectations. Dynamic optimization models tackled uncertainty directly, as, for example, is shown in Rust (1989, 1990), Daula and Moffitt (1995), Berkovec and Stern (1991) and a less computer intensive version, the option value model by Stock and Wise (1990). In these models, individuals recalculate their optimal behaviour in each time period, incorporating also the new information that has been obtained. Despite the more sophisticated frameworks of these models, their results generally seemed to be consistent with the preceding literature.

Work on the European microeconometric retirement research on the economic incentives seems to generally date from later than its American counterpart. As there are no survey articles confirming this claim, it was necessary to rely on one's own literature search only. It seems, however, that some of the early contributors in Europe are Börsch-Supan (1992, 1994) on the German data; Zabalza, Pissarides and Barton (1980) and Meghir and Whitehouse (1992) on the UK data; Hansson Brusewitz (1992) on the Swedish data; and Lindeboom (1994) on the Dutch data. All of them produce some evidence that economic incentives on the labour supply of the elderly, matter also in Europe.

In the late 1990s, at least two worldwide comparative retirement microeconometric research projects were brought into a conclusion; OECD (1998) and NBER (1998). OECD reported results of cross-sectional studies on Italy, the

UK and the US, and panel studies on the Netherlands and Germany. All of these results also confirm positive inducement of the financial incentives on the retirement rates. The NBER project, on the other hand, included studies of Belgium, Canada, France, Germany, Italy, Japan, the Netherlands, Spain, Sweden and the United Kingdom. The idea of the collection of these papers was to present institutional features of each country's social security system, highlighting the implicit incentive system through comparable analytic calculations. All systems seem to offer economic incentives for retirement - incentives that are non-linearly increasing with the age of retirement.

## 2.2 Literature on the Finnish Early Exits

If one leaves out a huge quantity of the descriptive analysis, the literature review of the economic research on the Finnish early exits is short. Because of the lack of suitable microeconometric data, only four earlier, somewhat comparable, studies seem to emerge - none of them concentrating on the issue of the economic incentives. Henceforth, even they don't produce results that could straightforwardly be compared with the results of the present study.

Perhaps the most comparable paper is Lilja's study (1994). This is a duration model of competing risks for the early exits from the labour force. It is based on four sets of panel of the Finnish Labour Force Surveys (with the starting years of 1984, 1985, 1986 and 1987). Lilja seems to have pooled together the four sets into one sample, spanning from September 1984 to May 1989. The number of observations in the final panel is 1,686 individuals. An unfortunate drawback in the data set is the lack of direct measures of individuals' pensions and income. To accommodate for this, Lilja uses years of past work experience as a proxy for compensation ratios (as pensions are a function of past work experience).

Lilja's findings indicate that a number of labour market status and working condition -specific variables, have an effect on the propensity for the early exits[15]. For example, the self-employed have a lower exit propensity. The

[15] Furthermore, there is a strong duration dependence which doesn't vary significantly between different channels of exit. Various covariates, however, don't have an equal effect on each channel. The channels of exit that are considered are a) actuarilly reduced early retirement, b) retirement due to the long-term unemployment, c) retirement due to the

variable that is used to proxy the economic incentives, the work experience, has only a slight, or no effect on the exit propensity. This implies that the results not only reject, but actually contradict, the null hypothesis that a longer work career, and the consequent higher pension benefits, induce more retirements. This, however, can hardly be considered as conclusive evidence against the influence of economic incentives on the Finnish early exits.

Gould (1996) uses survey data, combined with some information from registers of the private sector employment pension scheme (tel). Her data set consists of 1,123 individuals. The first questionnaire was collected in 1990 and the second in 1994. The data is, however, essentially a cross-section with regards to most of the variables. The core of the paper is implemented with logistic regression models - both for the probability of an early exit as a whole, as well as a separate equation for each of the three exit routes (namely; disability, unemployment and other pensions). Gould finds that different exit pathways tend to be best explained by somewhat different explanatory factors. A pure economic incentive effect (a variable measure which is somewhat rudimentary) seems to enter significantly only in the pathway that consists of other than the disability and unemployment pensions. Gould's study provides stronger causation effects for the labour demand variables.

Niemelä and Sullström (1998) focus on bus and tram drivers in the three largest cities - concentrating on changes in their special pension systems. Their analysis is done both with the time series (collected from several different sources) and the cross-section data (collected by each city's transport agency). The paper attempts to balance the cost savings from the changes in the pension system with the potential increases in accident risks. The data, however, doesn't yield straightforward conclusions.

Luoma's study (1995) focuses on disability pensions. He uses the Social Insurance Institution's Mini-Finland Health Survey data. This data is also essentially a cross-section, even if it was gathered between 1976 and 1980. A special feature of this data is its uniquely accurate health statistics. Health is evaluated both through self-response in surveys and "objectively" by a special medical core. Income variables, in contrast, are rather weak. They come from a survey question asking people to identify the appropriate category of income they received.

disability, and d) exit without a pension.

Luoma uses the data to estimate probit equations while correcting for sample selectivity in the income estimates.[16] Neither of the final probit equations attributes a significant role for the economic incentives in explaining the probability of retirement. Some of the equations actually produce rather contradictory results for the income variables, even if these coefficients mostly remain statistically insignificant. Coefficients for the health variables, in contrast, conform with the expectations[17].

Luoma's study is rather comprehensive on the definition and treatment of the disability. Yet, the data leaves great scope for improvement for assessing the importance of the economic incentives. The data was collected before the major reforms in the pension system, governing the early retirements, in the end of the 1980s. The two most important current avenues of early exit, disability pension due to a long work history and unemployment pension, are therefore not captured by this data.

At the macro level, early exits have been extensively reviewed by Hytti (1998). She analyses aggregate levels of early exits from a statistical-sociological perspective. She uses several different data sets[18]. Her study highlights two elements that are of interest also to this study. Her main conclusion is that early exits have been driven by the labour demand side, rather than the labour supply side. Her key evidence to support this claim, is the fact that declining industries seemed to have the highest ratios of early exits, and vice versa. Her second interesting stylized fact shows that early exits are an issue with those at the age of 60 and above, rather than the whole spectrum of those who are eligible for the early exits.

[16] Probit equations are run for two different sets of dependent variables. First equation uses the recipiency of disability pensions as the latent variable, and the second one, the labour force participation.

[17] The data set consists of three to four categories of health disability. All categories affect the probability of participation, the most severe disability having the strongest effect.

[18] Statistics Finland mortality and survival tables 1970-1995, Central Pension Security Institute and Social Insurance Institute 1990 and 1995, Census-Mortality- and Pension register combination - EKSY -1970, 1975, 1980 and 1985.

## 2.3 Literature on the Social Security (and/or the Pension System) and Savings

Literature on the social security and savings can be divided into two main categories. The first one consists of Feldstein's influential paper in 1974 and the stream of articles that followed this paper[19]. Secondly, there is a growing literature concentrating on individual retirement savings accounts.

### 2.3.1 Social Security (or/and Unfunded Pension Schemes) and Saving

The most domineering feature of the social security and savings literature is the fact that there still exists no consensus on whether the social security has any impact on the savings rates (let alone on the magnitude of the estimates). Theoretically the effect on savings is ambiguous, and empirical evidence has failed to resolve this ambiguity conclusively.

**Feldstein's Original Paper** In 1974, Feldstein published a paper in which he added a variable measuring social security wealth, to an Ando & Modigliani life-cycle consumption function. According to Feldstein, the social security system can have a twofold impact on the savings rates. The social security acts as a 'substitute asset', that is, it reduces the amount of savings needed for the old age. So, in essence, the amount of savings that because of the social security, is considered mandatory, is matched by the reduction in the private savings. On the other hand, however, the social security can also act as an 'inducement to retire'. Social security systems resort to means tests, and often make no actuarial adjustments for late retirement. If an individual has planned to retire at a specified age, he might be induced to retire earlier because of the social security system. The two effects ('substitute asset' and 'inducement to retire') have countering impacts on the savings propensity. The 'substitute asset' effect implies a negative correlation between the social security and the savings, and the 'inducement to retire' effect, in contrast, implies a positive one.

[19] For a more comprehensive survey, see Bodie and Munnell (1992), Pensions and Economy, Philadelphia: Pension Research Council and University of Pennsylvania Press.

Feldstein tried to resolve the theoretical ambiguity by running aggregate time series regressions on consumption, using the social security wealth[20] as one of the explanatory variables. On the basis of his results, Feldstein argued that the social security wealth halved the rates of personal savings. Social security system would, therefore, have among other things, affected negatively the rate of capital accumulation and national income.

Leimer and Lesnoy (1982) succeeded in tracking down a computing error in the social security wealth calculations underlying Feldstein's estimates. Correction for the error, however, according to Feldstein (1982), did not change the qualitative claim that the savings rates were reduced because of the social security. The magnitude of the coefficient, however, was lower than in Feldstein's original work.

**Different Variable Specifications** Robustness of Feldstein's result was tested, for example, by re-specifying the dependent variable. In Feldstein's original model the dependent variable was consumption. Burkhauser and Turner (1982) showed that ignoring the difference between the consumer-expenditure function and the savings function, leads to an overstatement of the social security's negative effect on saving. In a simple macroeconomic model, they show that studies based on the consumer-expenditure function, ignore part of the pre-retirement labour change, and henceforth, yield coefficients that overstate the savings effect.

Munnell (1974) had already, however, estimated a regression where the savings were used as the dependent variable. She reported results that were generally consistent with those of Feldstein[21]. The effect that was found between savings and social security, however, was weaker. In the light of the fact that Feldstein's paper contained a computing error, this finding would also be consistent with Feldstein (1974).

Feldstein and Pellechio (1978), in turn, used a stock of accumulated wealth as the dependent variable. Feldstein and Pellechio claimed that by using the equilibrium stock of wealth rather than yearly savings as the dependent

[20] Social security wealth variable measures the amount of benefits the individual anticipates to receive while retired. In Feldstein's work, it was calculated in gross and net terms and by gender and age.

[21] Leimer and Lesnoy (1982).

variable, they avoid a possible bias created by the correlation between the error term (influenced by individual tastes and the risk aversion) and the explanatory variable (studies using savings as a dependent variable often had lagged wealth as an explanatory variable). Feldstein and Pellechio's results confirm Feldstein's earlier findings. They state that the social security reduces substantially wealth accumulation. Moreover, the life-cycle model implication of a one-to-one reduction in the accumulated capital, could not be rejected on the basis of their results.

Different specifications of the independent variable of interest, namely the social security wealth, have also been tested. Feldstein himself (1977, 1980) ran regressions using a replacement ratio, that is, ratio of pension benefits to wages, as a measure of social security wealth. Average replacement ratio was simply defined as the benefit currently received per retiree to the average per capita income in the country. Problem with any estimation of the social security effect is the fact that the level of the *anticipated* benefits is not necessarily the same as the level of the *calculated* benefits or the benefits of the *current* retirees. Therefore, Feldstein (1980) also used a variable that he calls 'new retiree replacement ratio'. In a data set, collected by the US Social Security Administration, in cooperation with twelve other countries' respective agencies, there was a variable consisting of the estimated ratio of the pension benefits of a newly retired (aged) couple to the average earnings of a worker in manufacturing employment. Feldstein gets support for the life-cycle model when he uses the 'new retiree replacement ratio'. Average replacement ratio specification of the social security variable, in contrast, does not support his earlier conclusions in the 1980 paper, but does so in his 1977 paper. The estimations of the 1980 paper were seriously debatable, as Feldstein was able to use mere twelve data points for his estimations (one data point for each country). Additionally, Feldstein himself highlighted several measurement problems in the 'new retiree replacement ratio'. As benefit schedules are progressive and manufacturing workers are better paid than an average employee, the benefit estimate understates the true value. Also in the US, the social security benefits were free from taxes, whereas the income wasn't. Moreover, there was no information on indexing, nor on the perceived reliability of the social security system in each country that was included in the study.

Kotlikoff's (1979) model consisted of two variables for social security financial

incentives. The variable measuring taxes accumulated for the social security so far, caused a reduction in wealth in his model. The magnitude of the coefficient with its standard error was such that both the Keynesian and life-cycle models could be supported. The social security measure on net gains (benefits minus taxes), in contrast, produced a positive coefficient on the wealth accumulation, firmly rejecting the life-cycle view.

Bernheim and Levin (1988) emphasized that the measurement of the future benefits was highly problematic. Most studies assume that individuals understand the social security benefit formulas, and form their expectations rationally, according to the regulations. This assumption on the expectations is unlikely to hold. Retirement History Survey (RHS) circumvents this problem, as the information is gathered on the *expectations*. Bernheim and Levin found that using the RHS data, the social security depresses savings for single individuals, but doesn't do so for couples. This result is actually consistent both with the view that couples have a greater bequest motive or are more likely to suffer from credit constraints than single individuals.

Leimer and Lesnoy (1982) criticized Feldstein's assumption of constant pension benefits to permanent income ratios. Leimer and Lesnoy actually showed that the time series of benefits to income ratio presented considerable variation.[22] They also tested for a number of alternative expectation formation assumptions[23]. Leimer and Lesnoy found that none of these alternative assumption structures produced a positive relation between the social security and consumption. Hence, Feldstein's conclusion of a decreasing effect on savings was, according to their results, invalid.

**Cross-Section and Cross-Country Data Analysis and the Sensitivity of the Time-Series Analysis to the Time Period** Barro and MacDonald (1979) used data on sixteen industrialized Western countries. This allowed them to use cross-country variation in addition to the time series one. Barro and MacDonald produced results for a regression with a common intercept across the countries as well as a regression with individual intercepts. Common intercept specification derives information both from the

[22]This was refuted by Feldstein (1982), as he claims that the variation in the graph is surprisingly small.

[23]These were criticized by Feldstein (1982). He claims that Leimer and Lesnoy simply introduce errors-in-variables bias.

cross-country and the time-series dimensions. The individual intercept specification, in contrast, has to rely on an average across countries time-series variations.

The social security effect on consumption was significantly negative in the common-intercept specification, but actually changed sign for the individual country intercepts specification[24]. Henceforth, in the common intercept specification, Barro and MacDonald are in stark contrast with Feldstein's original paper, and in the individual country intercept case, they would agree with him. Barro and MacDonald interpret this as a possible indication that the social security produces a positive relation to consumption spending (and, hence, a negative one to the savings) in the time series, but a negative relation in the cross-section.

Leimer and Lesnoy (1982) in their critical paper also showed the sensitivity of Feldstein's 1974 estimates to the estimation period. Feldstein argues that independent variation in the social security wealth, in the postwar period alone was not sufficient to merit powerful inferences. In contrast, the longer period included a number of years pre-social security, as well as more variation in income, value of wealth and retained earnings.

**Criticism and Alternatives on the Underlying Life-Cycle Consumption Function** Barro (1974) claimed that as long as there is a connection between the current and future generations, introduction of the social security doesn't necessarily lead to a fall in savings. In Feldstein's model, saving during the working years was solely directed to the consumption in retirement. In Barro's framework there are private voluntary transfers between the generations. The introduction of the social security has an impact on the intergenerational transfers. In practise this is observed, for example, by the disappearance of the extended family structure. Children do not support their parents in the old age as in the "old days". Another example of intergenerational transfers is the bequest motive by the elderly.

Kotlikoff and Summers (1981) tried to get some empirical verification on the importance of the intergenerational transfers. They constructed age-earnings and age-consumption profiles on the US data. With specified rates of return they then constructed measurements on the stock of a life-cycle wealth, using

[24]The common intercept hypothesis was actually rejected by the data.

the estimated profiles. Comparing their constructed life-cycle wealth level to the actual aggregate wealth holdings in the US, they derived estimates for a stock of net received transfers. They also confirm that the growth rate of consumption exceeding the growth rate of income - the assumption, necessary to the life-cycle theory - is strongly reject. Most of the wealth accumulation is actually accounted by the intergenerational transfers. The intergenerational transfers should, therefore, not be ignored in assessing the process of capital accumulation (and henceforth, the nature of savings).

Koskela and Virén (1983) used Deaton's "disequilibrium" savings hypothesis and tested this specification with sixteen OECD countries[25]. Their results, with a number of alternative specifications, produced no evidence on the negative impact of the social security on savings. They gave cautious support to the 'induced retirement' effect cancelling out the 'asset substitution' effect. Yet, they stated that a dynastic cross-generation view or liquidity constraints were also not ruled out as explanations for the lack of a negative effect on savings.

### 2.3.2 Individual Retirement Savings Accounts

Early research on retirement savings concentrated on the PAYG based social security. In the US, however, additional pension system coverage and savings in the individual retirement savings accounts are high and their importance is growing. These schemes are generally fully funded and based on defined contributions. Their economic implications can, therefore, be totally different from those of the PAYG, defined benefit social security. The data for the new systems, however, is still scarce, allowing little more than descriptive analysis and simple regressions.

Wise (1988) claimed that savings for retirement by individuals were minimal and by corporations, on behalf of the individuals, modest. He also found no evidence that the rapid increase in private pension plan coverage lowered other savings. Corporate pension plans seemed to actually increase savings, as did the Individual Retirement Accounts (IRAs).

[25] Due to the System of National Accounts classification that differed from the one relevant to most of the earlier studies, they were also able to purge the definition of saving free of the compulsory insurance saving. This naturally implied greater accuracy in estimating the true effect of the social security on savings.

Since the late 1980s, contributions to 401(k) plans overtook the popularity of the Individual Retirement Accounts (IRA) contributions. 401(k) plans differ from the IRA's in a sense that they allow for employer matching to the employee savings. Moreover, some 401(k) plans enable individuals to also borrow in a case of an emergency, as well as withdraw their funds when changing jobs.

Poterba et al. (1993) and Papke et al. (1996) found no evidence that the 401(k) saving replaces any other type of saving - including the IRA's. Participation rates on the 401(k) plans, conditional on the eligibility, exceeded sixty per cent in 1993. Success of the 401(k) could not totally be explained by the employer matching. Kusko et al. (1994) and Papke et al. (1996) claimed that the matching has an effect, but this a rather small one. They show that contributions are concentrated on the "kinks" (nothing or the maximum matched by the employer, or the maximum allowed by the scheme). There is also a strong inertia in the 401(k) participation. Poterba et al (1993) denote that a participation in an IRA was strongly related to both the age and income. In 401(k), in contrast, the participation was unrelated to the age and over sixty per cent in all income groups.

Samwick and Skinner (1996) showed that people who are eligible for 401(k)s and don't contribute to them and have no alternative pension plan, make up only two to four per cent of the work force. They also point out that allowing withdrawals of the 401(k) contributions, once a worker changes jobs, has a large impact on the retirement pension security.

Thaler (1996) noted that this line of research has so far tended to take a short-term perspective. He calls for research addressing questions like whether these savings programmes accumulate long-term saving (rather than addressing the short-term issues like where the savings came from). He also stresses factors like peer pressure, firm pressure, ease of joining and payroll deduction as reasons for the 401(k) popularity.

# 3 FINNISH DEMOGRAPHICS, PENSION SYSTEM AND RETIREMENT

This chapter reviews first some demographic changes in Finland. Thereafter, there is a description of the main features of the Finnish pension system and a descriptive elaboration of labour force participation trends at the macro level. The section is closed with a description of some specific features of the Finnish pension system, describing their financial incentive implications for the individuals.

## 3.1 Demographics

The double crunch of aging is evident also in Finland. On one hand, fertility is below the replacement rate. On average, 100 women give birth to only 175 children[26]. On the other hand, the life expectancy has risen significantly, and is still expected to rise. Compared to fifty years ago, Finnish men and women live, on average, fifteen years more. It is expected that in fifty years to come, women's life will be extended by another five years, and men's, by seven years. Even with a shorter time horizon, the structure of the age pyramid is undergoing a considerable change. The largest age cohorts were born in 1948 and 1947, whereas, the smallest were born in 1973[27].

Figure 1 demonstrates these trends. It shows both the past and the expected trends in the total population, the working age population, the number of children, those above the official retirement age, and, the focus group of this study, those eligible for early retirement (the age group of 55 to 64 years, indicated as the dotted grey area at the bottom of the graph).

The graph shows that the *working* age population starts to fall around 2010. Concurrently, there will be an addition of 250,000 people to the age group of the early retirement (currently there is about 500,000 early retirees). After 2010, the number of people at the age of the early retirement, falls, shifting the pressure to the age group of those above the official retirement age (65).

[26] Parkkinen (1998).

[27] In Finland the biggest cohorts are older than in other countries. Hence, the aging problem is more acute.

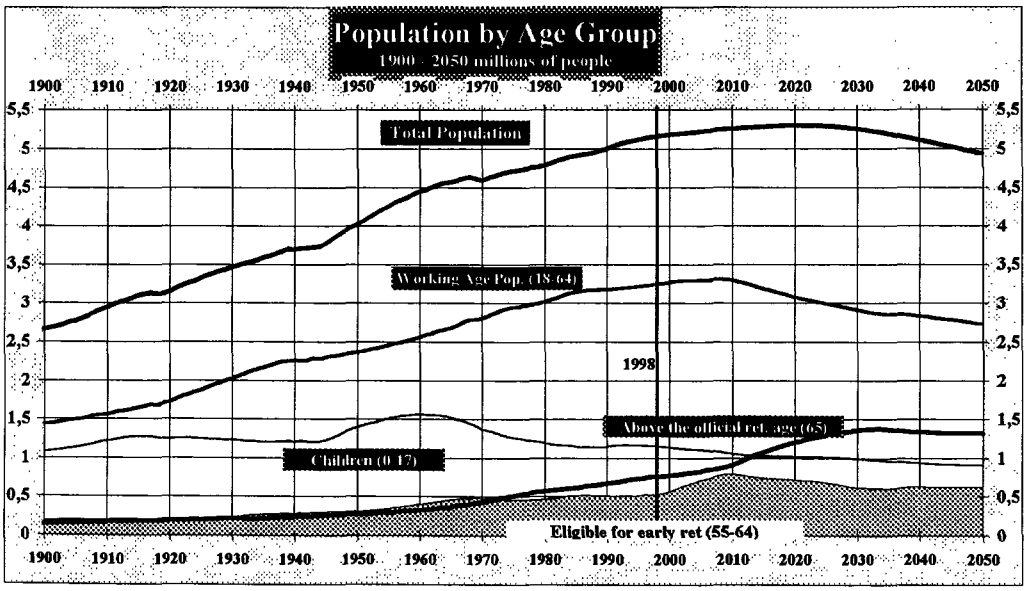


Figure 1: Demographic Development of the Finnish Population (Source: Parkkinen, 1998)

By 2030, the number of people above the official retirement age, has doubled. *Total* population starts to fall around the year 2020.

Dependency ratio gives the ratio of those without work (includes children, unemployed and retired) to those who are working. In essence, it specifies how many "non-workers" have to be supported by each working individual. Before the recession of the 1990's, this ratio was around 1[28]. As the unemployment skyrocketed during the recession, the dependency ratio rose to 1.5. In 1998, the dependency ratio had fallen back to around 1.3. It is expected to rise again (to about 1.37) as the bigger cohorts reach the age of retirement.

Even if the dependency ratio is useful in assessing the financing of the social welfare system as a whole, it is useful to break down this measure, in order to assess the impact of the elderly only. This is done in table 1. It gives the proportion of those at the working age to those above the official retirement age. The countries reported are those with the most "disadvantageous" ratios in the year 2030 in the OECD. The Finnish demographic change seems to be one of the most dramatic ones. The ratio (a reverse of the dependency ratio with only the old age considered as the dependents) seems to change from the third most advantageous among these ten, to the third most disadvantageous. The expected percentage fall in this ratio between 1990 and 2030, in Finland, is the third, following Canada and Switzerland.

## 3.2 Pension System

### 3.2.1 Description of the Pension System

The Finnish pension system has two major components. The Employment Pension (Työeläke) is of the primary importance for the people who have a work history. The second component, the National Pension (Kansaneläke), is universal in its coverage and independent of people's career. The National Pension today acts as a provision of the basic security - similar to the function of the social security provisions in the US. If incentives are to be evaluated, the main emphasis lies on the Employment Pension, as it accounts for the greater part of the financial retirement compensation for most of the people.

[28] Parkkinen (1998).

| *Country* | *1990* | *2010* | *2030* |
|---|---|---|---|
| Switzerland | 4.6 | 3.2 | 2.1 |
| Germany | 4.5 | 3.3 | 2.3 |
| *Finland* | *5.2* | *4* | *2.5* |
| Austria | 4.6 | 3.7 | 2.6 |
| Netherlands | 5.4 | 4.5 | 2.6 |
| Canada | 6 | 4.7 | 2.7 |
| Denmark | 4.4 | 4.1 | 2.7 |
| Luxembourg | 4.7 | 3.6 | 2.7 |
| France | 4.8 | 4.1 | 2.8 |
| Italy | 5 | 3.9 | 2.8 |

Table 1: Proportion of the Working Age Population (15-64) to Those Above the Age of Retirement (65+) in Ten OECD Countries

Source: World Health Organization (WHO), 1993.

The Finnish Pension System consists of a number of different retirement schemes. These schemes, their date of introduction and some of the key conditions are given in the table 2.

All the 65 year olds generally convert to the old-age pension, even if they have used another scheme to retire earlier. The most common routes of the early retirement are the disability pension (työkyvyttömyyseläke), the unemployment pension (työttömyyseläke) and the early disability pension (yksilöllinen varhaiseläke). The early old-age pension (varhennettu vanhuuseläke) and the part-time pension (osa-aikaeläke) are used to a lesser extent, and the rest of the pension schemes, given in the table 2, are related to very specific circumstances.

An individual who receives a disability pension is an employee who suffers from reduced work capacity because of an illness, a handicap or an injury. The incapacity is expected to last at least for one year. For a full pension, the work capacity has to be reduced at least by 3/5s - partial pension can be obtained by a 2/5s of a reduction. The disability pension is considered 'fully effective'. This implies that the time between the pension-qualifying event (that is, the onset of the disability) and the official retirement age, is also

| Pension Scheme | Date of Introduction | Key Conditions |
|---|---|---|
| Old-age pension | July 1962 | 65 years of age |
| Disability pension | July 1962 | Age 16-64, incapacity to work |
| Unemployment pension | July 1971 | Age 60-64 (55-64 before 1986), long-term unemployed |
| Early disability pension | January 1986 | Age 58-64 (55-64, before 1994), reduced work capacity |
| Early old-age pension | January 1986 | Age 60-64, pension benefits permanently reduced |
| Part-time pension | January 1987 | Age 58-64 (60-64, before 1994), work only part-time (16-28 hours per week) |
| Farmer's pension | January 1974 | Age above 55 |
| War veterans' pension | 1982 (male)-1983(fem) | Veteran of 1939-45 wars |

Table 2: Employment Pensions in the Private Sector

Source: Lilja, 1996 (with some updating by the author)

accrual time for the old-age pension. The earnings limit for the disability pension is a third out of the remuneration on which the pension is paid[29].

The qualifying age for the unemployment pension scheme was 55 in 1985. The eligibility age was gradually increased to 60 by 1990. Unemployment pension is also paid as a fully effective pension. There is a yearly specified earnings limit for the participation in the labour force (in 1992, around FIM 2,100).[30] The unemployed aged more than 55 (53, if born before 1944), even if they are not directly eligible for the unemployment provision, are currently not expected to find employment before retirement. When laid off, they are entitled to 500 days of unemployment benefit linked to their previous employment. Those that qualify the age limit and the limit on the duration of the unemployment benefits, can apply for an extension of the unemployment benefits until the age of 60. At the age of 60, they can retire due to a long-term unemployment[31]. This is the so-called 'unemployment retirement tunnel' (työttömyyseläkeputki).

[29] Lilja (1996).
[30] Lilja (1996).
[31] Pentikäinen et al. (1996).

The early disability pension scheme was introduced in 1986 in the private, and in 1989, in the public sector. It was aimed at those in the age group of 55 to 64 with a long working career (qualifying age has since been increased to 58, and will possibly be increased more in the future). Candidates for this pension were supposed to suffer from a permanent reduction in their work capacity - to such an extent that the person cannot be expected to continue in the same job. Illness, aging, physical and/or mental strain of the job and working conditions are taken into consideration in the assessment of the work capacity. Even if the pension calculations specifying the level of the pension benefits in this scheme, are the same as those for the ordinary disability, the 'medical requirements' for the eligibility in the early disability scheme, are less stringent. Yet, the threshold for other earnings is so low (about FIM 1,100 in 1992) that it effectively bars participation in the labour force.[32]

The Finnish pension system is a defined benefit system - with all of the regulations well-specified in sector specific pension laws[33]. Due to the existence of a limited number of the pension schemes, modelling the retirement from an economy-wide perspective is far simpler than in the US, where firm-specific plan provisions can vary wildly. Furthermore, the Finnish pension system is all-encompassing in a sense that there are no comparable difficulties to capture entire economic incentives, as there are with the US social security in one hand, and the private pension system on the other. In Finland, each individual's complete work history is registered at the national level, determining accurately his pension benefit level.

Due to the compulsory public pension system, the alternative use of other savings mechanisms for the old age, is rather limited. Thus far, the main source of income for the elderly has been (and most likely continues to be) the public pension. Savings, for example, via the stock market or property markets are assumed to be relatively limited. The most significant asset of the elderly, is likely to be, as in the US, the ownership of their own dwellings.

The biggest caveat for modelling the Finnish pension system, is its openness for discretion in approvals. At the age of 65, anyone can start withdrawing

[32] Lilja (1996).

[33] For example, there is a law regulating the long-term employees in the private sector (tel), another one for the short-term and temporary employees (lel), two for the public sector (vel, kvtel) etc. These laws tend to resemble each other even if they came to the effect in different years, and govern different "types" of employees.

the accrued benefits. Yet, the focus of this study is on the *early* exit routes. These are governed by an application-approval procedure. The uncertainty in converting the *willingness* to retire to the *actual* retirement is by no means a unique feature to the Finnish pension system, but rather, it is common to most of the pension systems based on disability[34]. In Finland only the actuarially reduced early old-age pension (varhennettu vanhuuseläke) - which is not very common - is freer from this exogenous uncertainty[35].

### 3.2.2 Pensions and Budgetary Expenditure

As stated in the introduction, pension expenditures form a significant part of the total social welfare expenditure. The first columns (columns two and three) of the table 3 give the time series on how the pension expenditure has evolved in the past twenty years. Pension expenditure in proportion to the gross domestic product increased slightly until the early 1990s. The increases thereafter have been contained by the reforms implemented after the recession of the 1990s.

The two final columns of the table shows a projected increase in the pension expenditure by the Ministry of Social Affairs in 1994. In their calculations, the GDP growth from 1994 to 2030 was assumed to be 2.3% per year and pension expenditure growth 1.9%[36]. The years of overlap show that there is some difference in measurement or indexing between the figures by the Statistics Finland and those by the Ministry of Social Affairs (see the figures for 1990 and 1994). The projections by the Ministry of Social Affairs, before some major reforms, show huge increases in the overlays - specifically in the year 2010 when the number of the early retirees is expected to reach its

[34]There is a growing literature in rejection of pension applications as a control measure of retirement rates.

[35]Some papers attempt to control for the approval uncertainty by calculating expected benefits - taking into account the possibility of rejection of the application. This approach, however, does not provide a full-fledged solution. The probability of rejection is unlikely to be independent of other features of the individual, and, the probabilities are, therefore, still necessarily open to the researcher's discretion. Some control could be developed by the application rejections. These, however, were not available in the data set used in this study.

[36]Ministry of Social Affairs (Sosiaalitoimikunnan mietintö) (1994), p. 31.

peak[37].

In Finland the pension system, even if primarily a PAYG system, is partially funded. The main aim of the funding is to even out pressures of the demographic changes on the PAYG system, and specifically ease the pressure to increase the pension contributory payments. In 1995, funding constituted about 25% of the pension liability[38]. Before the recession of the 1990s, the aim was to increase the proportion of funding until the year 2010 and start using the funds while the population pressure is at its projected peak levels. In 1994, however, the use of the pension funds was extended also to bad cyclical downturns.

### 3.2.3 Voluntary Pensions

Finland has a so-called three-pillar -pension system. There are two mandatory pillars, one for the basic provision (national pension - kansaneläke) and one linked to the career (employment pension - työeläke). The third pillar consists of the voluntary pensions. This voluntary pillar contains both pensions provided by the employer and individual retirement savings accounts (private pension saving). Employer-provided pensions are generally schemes that were there before the mandatory public system. Their importance has, therefore, been on the fall. The importance of the individual retirement savings accounts, in contrast, has been on the rise. This is due to the tax incentives attached to them, (see section 3.4) as well as to the strong promotion by banks and insurance firms. From an individual's perspective the individual retirement savings accounts have served to a) raise the pension levels when the target level of the old-age pension benefits of sixty per cent (sixty-six for some of the public sector) of the retirement wage is not obtained, b) enable people to retire earlier, or c) function as a tax-favoured savings device.

Despite the huge public attention it has attracted, the voluntary pillar is still rather modest in Finland. Table 4 shows a fall in the cost of voluntary pensions out of the total expenditure on the pension schemes proper. This is a reflection of the fall in importance of the employer-provided pension

[37] Nominal increases would be even greater than those that are presented in the table.
[38] Lämsä et al. (1997).

| Year | Total Pension. Expenditure | % of GDP | Total Pension. Expenditure | % of GDP |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| | 1,000,000 FIM | % | 1,000,000,000 | % |
| 1982 | 24,080 | 9.9 | | |
| 1983 | 28,255 | 10.4 | | |
| 1984 | 32,228 | 10.6 | | |
| 1985 | 36,073 | 10.9 | | |
| 1986 | 39,894 | 11.2 | | |
| 1987 | 43,601 | 11.3 | | |
| 1988 | 47,150 | 10.9 | | |
| 1989 | 51,585 | 10.6 | | |
| 1990 | 56,855 | 11.0 | 57.2 | 11.1 |
| 1991 | 62,632 | 12.8 | | |
| 1992 | 67,742 | 14.2 | | |
| 1993 | 70,328 | 14.6 | | |
| 1994 | 72,436 | 14.2 | 73.0 | 14.8 |
| 1995 | 75,011 | 13.6 | 76.3 | 14.9 |
| 1996 | 78,039 | 13.6 | | |
| 1997 | 78,764 | 12.7 | | |
| 2000 | | | 87.2 | 15.0 |
| 2010 | | | 122.3 | 17.3 |
| 2020 | | | 153.4 | 18.1 |
| 2030 | | | 177.4 | 18.8 |

Table 3: Pension Expenditure

Notes: Columns 1-2: Statistics Finland (1998), columns 3-4: Ministry of Social Affairs (1994); For comparability, the Ministry of Social Affairs 1995 expenditure figure was inflated by cost of living index to 1995 prices; From the year 2000 onwards figures are retained, as they were reported, in 1994 prices. Nominal increases would therefore exceed these figures.

| Year | Pensions paid by Funds/Foundations Under Private Schemes 1,000,000 FIM | Out of Tot Exp on Pens Schemes Proper % | Individual Pension Insurance 1,000,000 FIM | Prop of Statutory Empl Pension Ins % |
|---|---|---|---|---|
| 1980 | | | 30 | 0.005 |
| 1981 | | | 23 | 0.004 |
| 1982 | 718 | 0.030 | 35 | 0.005 |
| 1983 | 825 | 0.033 | 56 | 0.008 |
| 1984 | 927 | 0.032 | 77 | 0.011 |
| 1985 | 1,014 | 0.031 | 140 | 0.016 |
| 1986 | 1,098 | 0.031 | 165 | 0.017 |
| 1987 | 1,161 | 0.030 | 434 | 0.038 |
| 1988 | 1,251 | 0.030 | 684 | 0.051 |
| 1989 | 1,334 | 0.029 | 1,280 | 0.081 |
| 1990 | 1,416 | 0.028 | 1,682 | 0.084 |
| 1991 | 1,365 | 0.024 | 2,643 | 0.135 |
| 1992 | 1,414 | 0.023 | 2,746 | 0.170 |
| 1993 | 1,300 | 0.020 | 1,685 | 0.089 |
| 1994 | 1,369 | 0.021 | 1,869 | 0.095 |
| 1995 | 1,324 | 0.019 | 1,186 | 0.053 |
| 1996 | 1,301 | 0.018 | 1,683 | 0.069 |
| 1997 | 1,300 | 0.018 | 2,125 | 0.084 |

Table 4: Voluntary Pensions

Source: Statistics Finland

schemes. The final two columns give the individual pension insurance, that is, the measure of individual retirement savings accounts. Their importance, in contrast, has been on the rise - presenting huge increases before the big recession of the 1990s.

It is good to note that the financing of the individual retirement savings accounts is fully funded and defined contribution. Therefore, this part of the pension system, per se, is not threatened by future imbalances. If, however, as is the case in Finland, the voluntary pillar is complementary to the main pillar (which is a PAYG system), the voluntary pillar cannot be viewed in

isolation. If the mandatory pillar presents a financing problem, and the voluntary pillar provides people an opportunity to withdraw earlier from the work force, those who withdraw early contribute less to the mandatory pension system. If the earlier withdrawal were fully taken into account by actuarial adjustments to the pension benefits from the mandatory pension system, the effect should be neutral. Currently, this, however, is not the case of most of the retirement channels from the mandatory pension system. Major early retirement schemes actually make no adjustment to an early withdrawal. So far the individual retirement savings accounts, however, are likely to have had little effect on the people's behaviour in the labour markets. Their importance is likely to grow in the future, and should be considered in future research.

## 3.3 Labour Force Participation

Figure 2 gives the total labour force participation rates for the age groups of 55-59 and 60-64[39]. The most noticeable feature in the graph is a continuous and rather large drop in the labour force participation for the older age group. The younger age group, however, presented only a slightly falling trend until the end of the 1980s and since then, a rising one.

Labour force participation is actually a sum of the employed and unemployed over the total population in that age group. As the aggregation of the employed and the unemployed to the same category can hide some interesting trends or short-term changes, it is useful to view also the age-classified employment and unemployment rates. These are given in figures 3 and 4, respectively. As most of those who are neither employed or unemployed in these age categories, are retired, the proportion of retired to the age group is also given - in figure 5.

The employment rate shows an almost continuous fall for both of the age groups. In the beginning of the 1980's, more than 65 per cent (almost 67%) of the 55-59 year olds were still working. In 1996, this was already under 50% (48.5%) of the age group. The fall in the 60-64 age group was even more

[39]The rates are given only until 1996, because the classification criteria was changed in 1997 by the Statistics Finland producing an illusory jump this year. Adjusted rates were available only for shorter time series.

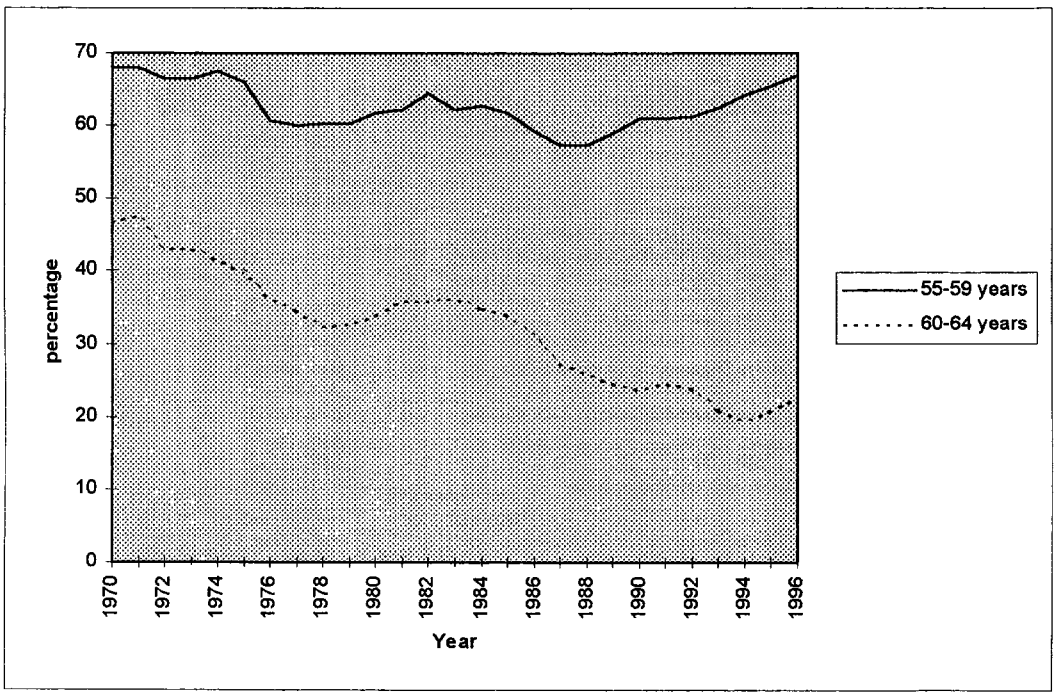


Figure 2: Labour Force Participation (Source: Labour Force Statistics, Statistics Finland)

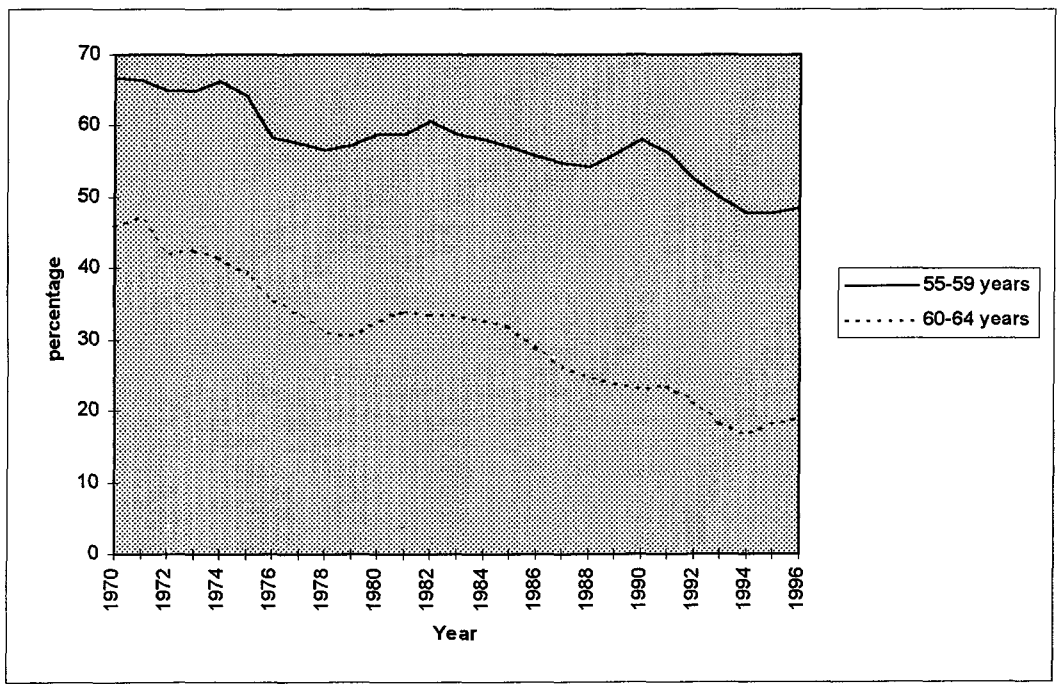


Figure 3: Employment Rate (Source: Labour Force Statistics, Statistics Finland)

severe. From almost 46% to less than 20% of the age group.

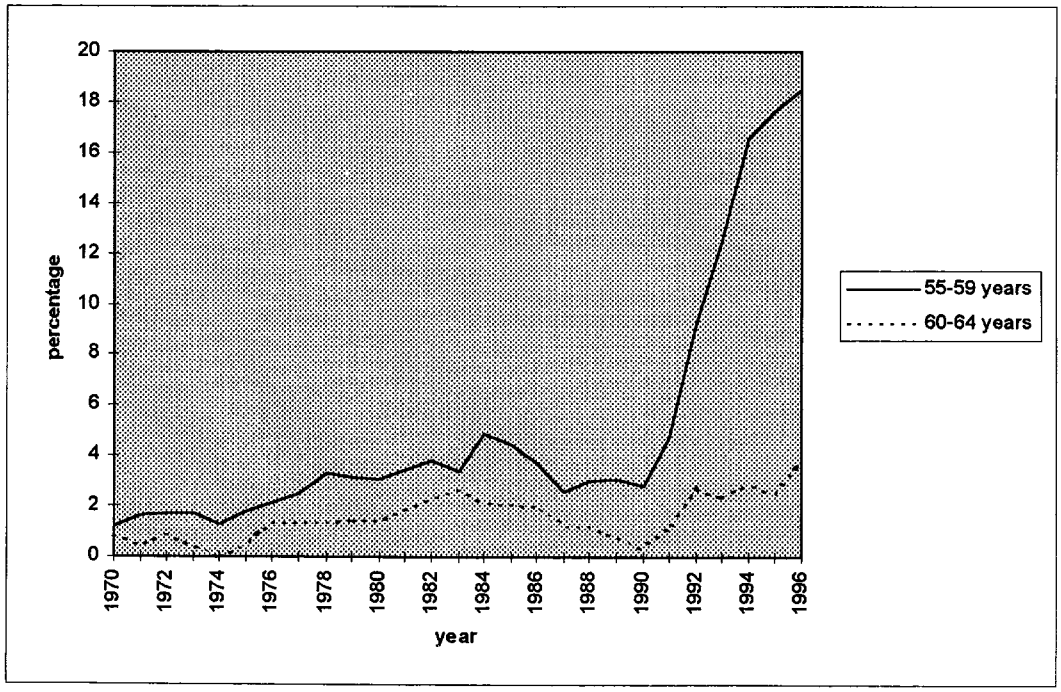


Figure 4: Unemployment Rate (Source: Labour Force Statistics, Statistics Finland)

The graph on the unemployment rate reflects changes in the eligibility criteria for the unemployment pension (as well as the economic cycles naturally). Severe recession set in Finland in the beginning of the 1990s. This sent unemployment rates soaring practically for all age groups. As individuals in the younger age category of the graph could not apply for the unemployment pension, the rise in the unemployment rate was huge. The rate for those over 60 was not affected as radically, as they could be converted from the unemployment to the unemployment pension. The bottom of the recession was reached in 1993 - marking a change in the unemployment *rate* growth.

The OECD (1998) reports the rates of unemployment and long-term unemployment (defined as twelve months or more) for the labour force as a whole and for the age group of 45 to 64 years in 1996. According to this, the general unemployment rate in Finland was 16.2 per cent of the labour force and the rate for the aged, was 16.4. Hence, there seemed to be no significant differ-

ence between the two. The long-term unemployment rates, however, were 39.3 per cent and 61.8 per cent of the unemployed, respectively. Henceforth, according to the OECD, the long-term unemployment in Finland is specifically a problem with the aged. Similarly, in the un-weighted averages for North America, European Union and the OECD countries, the proportion of the long-term unemployed of the aged is significantly above the rate for the whole population. The long-term unemployment problem for the aged is also reflected in the hiring intensities. The hiring intensity is defined by the OECD as the share of the new hires of the specific age group out of the total hires, divided by the share of employment of the same age group to the total employment. For the age group of 45-64 years, the hiring intensity was considerably lower than for any other age group[40].

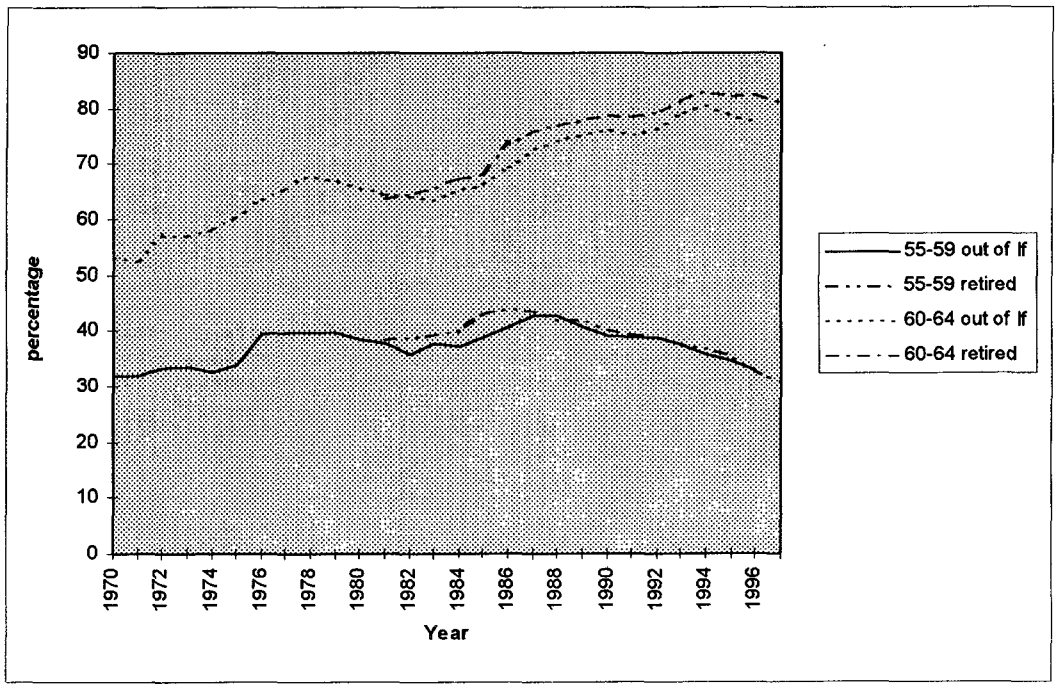


Figure 5: Out of the Labour Force and Retired (Source: Labour Force Statistics, Statistics Finland; Statistical Yearbook of Pensioners in Finland (1980-1997), The Central Pension Security Institute and The Social Insurance Institution)

[40] OECD (1998), p.142, 144.

The final graph shows the proportion of those out of the labour force to their age group. As there was no continuous time series, available for the whole time period, on the proportion of the retired in the specific age groups it was assumed that the rate of those out of the labour force approximates the retirement rate fairly closely. The rate of retirement for the age groups required was available since 1980 (included in the graph from then onwards), and comparing this rate to that out of the labour force, confirms the assumption of closeness of these rates.

Since the 1970s, the proportion of those outside the labour force has continuously risen in the older age category. Changes in the unemployment pension regulations are reflected also in these rates. The rate on "those out of the labour force", however, reflects also changes in the regulations for the other pension schemes. For example, in 1986, new, flexible early retirement schemes were introduced (in 1989 in the public sector). Maybe somewhat surprisingly, however, the proportion out of the labour force actually falls for the younger age group since the mid-80s. As it was shown earlier this fall, since 1990, can be attributed to the rising rates of unemployment. The fall is, therefore, partly due to the tightening of the eligibility criteria for the unemployment pension for this age group. After the recession (in 1994), also the age limit for the early disability pension was raised - gradually to 58.

Today virtually no one works until the official retirement age. The average age of retirement at the moment is 60, plus or minus one year, depending on the exact definition[41]. In the data used for this study, with the base group of those aged 55 to 74, the mean age of retirement was 60.9.

## 3.4 Economic Incentives and the Social Security System

Description of the pension calculations is in the sub-section 5.2.2. In this sub-section there is a brief description of some features which can have an impact on the financial incentives implicit in the pension system.

[41] For example, depending on how "retirees by birth" are treated.

| Gross Wage | Gross Pension | Gr Replacement Ratio | Disposable Wage | Disposable Pension | Net Repl Ratio | Net/Gr Repl Ratio |
|---|---|---|---|---|---|---|
| 8,000 | 4,960 | 62% | 5,580 | 4,217 | 75.6% | 1.22 |
| 9,000 | 5,527 | 61.4% | 6,103 | 4,289 | 70.3% | 1.14 |
| 10,000 | 6,094 | 60.9% | 6,587 | 4,494 | 68.2% | 1.12 |
| 11,000 | 6,661 | 60.6% | 7,080 | 4,773 | 67.4% | 1.11 |
| 12,000 | 7,228 | 60.2% | 7,572 | 5,067 | 66.9% | 1.11 |

Table 5: Gross and Net Replacement Rates

Source: Viitamäki, 1995. Notes: The gross replacement ratios can exceed the general limit of sixty per cent because of deductions.

**Progressivity of Taxation** The basic guideline for the taxation of the social security benefits is that compensations for the loss of earnings are taxable income and social assistance benefits, as well as expense compensations, are usually tax-free[42]. Accordingly, pensions are subject to an income tax (both the state and the municipality income tax), and henceforth, are essentially taxed in the same way as wages.

Taxation, however, can have an impact on the incentive structure. Because of the progressivity of income taxation, an individual earning a wage pays a higher tax than he would, were he to receive a pension benefit, based on the same income level. Table 5 gives some exemplary calculations for certain wage levels. Taking into account tax deductions, state, municipal and other taxation, tax-like payments, housing allowances (different between those working and those retired), the table provides estimates for disposable income for wages and pension benefits[43]. With the five income categories that are presented, it seems that there is some additional redistribution through the pension system and the allowances. To make this claim conclusively, however, more research is needed.

**Tax Deductions** Despite the fact that pension benefits are subject to income taxation, those who receive only a national pension (see section 3.2.1.) do not actually end up paying any tax. The pension related tax deduction

[42]The Central Pension Security Institute, 1991.

[43]Viitamäki (1995).

is set in such a level that the minimum pension is obtained tax-free.

In 1991 trade unions agreed on a special deduction on wages in municipal taxation[44]. The deduction had a lower threshold - at 15,000 FIM per year in 1997. After the lower threshold, the deduction falls progressively until the upper threshold. The deduction is, therefore, specially targeted to low and medium income classes (peak of the deduction was a bit above 6,000 FIM per month in 1997)[45]. The effectiveness of this targeted incentive change is still open for research.

Both employee and employer pension contributions are fully deductible by the contributing party, both in the state and the municipal taxation. The same applies to the individual retirement savings accounts - as long as the individual retirement saving is complementary to the other pension contributions. If the voluntary saving is above "the complementary level", that is, the target pension is above 66% of the reference wage (in the age of 65 or less if earlier) or the targeted retirement is scheduled before the age of 58, only 60% of the contributions are tax deductible. Taxation authority, however, allows a maximum of 15,000 FIM per year and less than 10% of the income without the 60% restriction. Henceforth, in 1997 voluntary pension insurance contribution of 1,250 FIM per month was fully tax-deductible[46]. There has been great public pressure to change this incentive structure as it has been seen as "too advantageous".

**Indexing** Relative financial attractiveness of the wages versus the pension benefits can also be changed by changing the indexing structures of the pension system. Indexing for the pensions is needed to determine *both* the level of the total pension that an individual obtains if he has had several employers in his career *and* the yearly increase in his pensions while retired. The Ministry of Social Affairs confirms special indices for these purposes. Employment pension index (tel-indeksi) used to be tied to the wage inflation. The wage inflation, however, has been faster than the price inflation. Because of this, pension accruals based on the wages of the jobs in the early career tended to grow considerably faster[47]. In 1977, the indexing base was

[44] tupovähennys, myöhemmin ansiotulovähennys tai epävirallisesti kannustinvähennys

[45] I am thankful for Heikki Viitamäki for the exact details.

[46] Pentikäinen et al (1996).

[47] Pentikäinen et al (1996).

changed to the price inflation (50%) and the wage inflation (50%).

In 1996, indices for the pension determination and for the yearly pension increase while retired where separated. The former is determined as before, but the latter is 80% prices and 20% wages. If the wages continue to rise faster than the prices (as it is likely), this will reduce the value of the existing pension benefits in comparison to the wages.

# 4 THEORY AND METHODOLOGY

This chapter defines the theoretical and econometric framework of this study. These two aspects are treated respectively in subsections 4.1 and 4.2.

## 4.1 The Life Cycle Approach and the Option Value Concept

In the underlying microeconomic framework, each individual, who has not retired before the current period, maximises the rest of his expected lifetime utility. This study takes the conventional[48] approach by assuming that his utility consists solely of consumption and the leisure is reflected in the term assessing the relative importance of the wages and the pension benefits (as well as the additional control variables). As consumption is not observed, it is proxied by income[49].

The lifetime utility function for an individual (for the rest of his life) is divided into two parts. These consist, on one hand, of the utility derived *before* the retirement, and on the other, the utility derived *thereafter*. When an individual is still working, his utility can be evaluated by his wages. The relevant time span is then that from today until the year prior to the retirement. After the retirement, the utility of an individual is evaluated by his pension benefits. These need to be considered from the year of retirement

[48] Conventional by the standards of the current empirical retirement literature.

[49] This naturally implies that the savings behaviour cannot be taken into account. The use of the income proxy is very common in the literature, as the data on consumption is generally not available, and the attempts to construct a variable for consumption have generally not been successful (See Rust (1990)). It is true, however, that ignoring the savings behaviour can be problematic. Specially this can be an issue in a period of high turbulence when wide-ranging changes in the economic behaviour are presumed to take place.

Yet, as noted in the sub-section 3.2, the mandatory public pension system in Finland, has not induced people to specifically save for the retirement (even if the individual retirement savings have been growing). It is possible that the belief in the functioning of the social welfare system did not induce huge changes in the savings behaviour even if numerous individuals experienced changes in the labour market status during the sample period. This claim, however, is open to empirical verification, and is naturally way beyond the scope of the current study.

until the end of his life expectancy.

Utility is first estimated periodically, and these utilities are all discounted to the current period. Then, assuming additive separability over time, the period specific utilities are added up to produce lifetime utility. This can be expressed as follows:

$$V_t(r) = \sum_{s=t}^{r-1} \beta^{s-t} u(Y_s) + \sum_{s=r}^{T} \beta^{s-t} u[kB_s(r, Y_{s-1})], \quad (1)$$

where $V_t$ is the lifetime utility evaluated at the time t, u(.) the period specific utility, t the current period, r the period of retirement, $\beta$ the discount factor, Y the wage, B the pension benefit, and k the relative utility of the pension benefits to the wages. The amount of the pension benefits is a function of the period of retirement and the wage level prior to the retirement (see the sub-section 5.2.2).

In the equation 1, the parameter k indicates the relative assessment of the type of income that an individual receives. This could be interpreted as a way to incorporate leisure into the lifetime utility function without evaluating the importance of the leisure period specifically. If k is greater than one, the utility derived from a unit of income from work (hence, out of wage) is less than that while retired (hence, out of the pension benefits). Moreover, it is conceivable to think that the k could be derived from individual-specific attributes. For example, k might increase with the age, if leisure were to become more important as the individual ages. Henceforth, the aim should be to make the k a function of those attributes that are deemed relevant. This is not done in this study, but a simpler model structure has been used.

The measure of the economic incentives used in this study, an option value[50] for an individual, is a difference between the expected lifetime utility if the individual *postpones* his decision to retire and the expected lifetime utility if he retires *today*. The reference period for the income value if he postpones his retirement, is the maximum of the expected values that he could obtain by retiring later.

[50] The presentation here follows a famous article by Stock and Wise (1990).

The option value, that is, the opportunity cost of retiring today (or the bonus of retiring later), is noted as follows:

$$G(t) = V_t[R^*(t)] - V_t(t), \tag{2}$$

where R* is the optimal age of retirement if the worker postpones his exit decision. The rest of the notation is as above.

If the individual behaves as a rational utility maximizer, he retires if and only if

$$G(t) \leq 0. \tag{3}$$

Otherwise he continues to work.

In the probit framework the equation 3 simply implies that the testable hypothesis is whether the option value variable gets a statistically significant negative coefficient.

In order to find a closed form solution for the empirical model that follows, some kind of a functional form is needed. Use of the constant relative risk aversion is fairly standard, as the formula is relatively simple to implement[51].

Functional forms for the utilities derived from work and pension benefits, respectively, are then the following:

$$u(Y_s) = Y_s^\gamma \tag{4}$$

$$u(B_s) = k(B_s)^\gamma \tag{5}$$

[51] Taking a logarithm of the utility function is a simple transformation of an ordinal function (that is, utilities can only be ordered - the underlying values, utils, cannot be evaluated explicitly). Henceforth, the function can straightforwardly be linearized.

, where [-($\gamma$-1)] is the relative risk aversion. Other parameters and variables are as above.

Combining equations 1, 2, 4, and 5, and augmenting them by the probability of survival, an option value variable can be parameterised as follows:

$$G_t(r) = \{[\sum_{s=t}^{r-1} \beta^{s-t}\pi(s/t)(Y_s^\gamma)] + [\sum_{s=r}^{T} \beta^{s-t}\pi(s/t)k[(B_s)^\gamma]]\} \quad (6)$$
$$-\{\sum_{s=t}^{T} \beta^{s-t}\pi(s/t)k[(B_s)^\gamma]\}$$

[52] where $\pi(s/t)$ is a probability to survive until the period s, given that the person is alive at the period t (today)[53].

The option value, therefore, optimizes *the balance of* the cost of retiring immediately and losing the net income stream as well as the higher pension benefits in the future, *and* retiring later and missing the leisure time meanwhile.

**Option Value** In finance, a stock option gives its holder a right (but not the obligation) to buy or sell his asset. The right to buy an asset is called a call option, whereas the right to sell, is a put option. The *value of an option* is dependent on a) the inherent value of the asset (for example, the value that is under the managerial control), b) a random factor (outside the managerial control, but instead dependent on some external circumstances) and c) the strike price[54]. Black and Scholes derived a differential equation in the 1970's for pricing the European call and put options[55]. Their formulation has been applied to a number of fields in economics.

[52] The model should be appended by error terms that produce a stochastic structure. However, as the model is currently not estimated in a structural form, the error terms are left out from this presentation.

[53] It could be argued that there is no need to incorporate probability of survival separately, as it could be implicitly included in the discount factor. Yet, distinguishing the two seems to be standard in the literature - possibly because life tables are generally available.

[54] See Lazear (1998) p. 340-342.

[55] See Hull (1997) p. 228-254 or Black and Scholes (1973), The Pricing of Options and Corporate Liabilities, Journal of Political Economy, 81, p. 637-654.

In investment theory, for example, Dixit and Pindyck (1994, 1995) pointed out that traditional theory had overlooked some key features. Namely, the traditional investment theory did not take into account that investments are (in addition to the expected present value due to the fund flows) also governed by irreversibility, uncertainty and the choice of timing. Mere calculation of the present values tends to, according to Dixit and Pindyck, give misleading information. They pointed out that investment is much like a financial call option - a right, but not an obligation, to buy an asset at the chosen future time. Traditionally investments were considered reversible or now-or-never -actions. Neither of these assumptions generally holds. There is usually an attached sunk cost to the investment (or at least the option to wait for more information is lost) and, in most cases, investments can actually be delayed. Uncertainty about the future price of a stock option is crucial in its pricing. Greater volatility increases the value of an option, creating greater incentive to wait and keep the option alive. The same analogue can be applied to the investment decisions. Delaying an investment decision can bring the company more information about the market conditions even if an immediate investment were also economical. The decision to whether to invest or not, is governed by, or complemented with, the timing of the investment.

The option value thinking was first applied to the retirement decision by Lazear and Moore (1988)[56]. They pointed out that the financial incentive variable that was traditionally used in the retirement models was not continuous enough, nor was it forward-looking. In the US, certain pension schemes give a right to an individual to withdraw benefits only after a specified number of contributing years. In other words, an individual is vested only after a certain time. Before this time is fulfilled, the system attributes zero benefits to the individual. Henceforth, there is a clear discontinuous jump from zero to some positive level. It is unlikely, however, that the actual incentive jumps from no effect to a significant effect. This problem was somewhat alleviated with the option value measure.

The criticism by Lazear and Moore (1988), on the lack of forward-looking measure, comes close to Dixit and Pindyck criticism of the traditional investment theory (1994, 1995). Lazear and Moore pointed out that even if the

[56]Since Lazear and Moore (1988), the concept has been widely used by numerous authors. See, for example, Stock and Wise (1989, 1990), Börsch-Supan (1992, 1997, 1998), Samwick (1998) and the OECD (1998).

pension accrual up to date is relevant, it is not sufficient as a financial incentive statistic. "The pension available three years hence may exert a stronger influence on this year's work decision than the current pension accrual."[57] In their simple model, they also account for the uncertainty, and show the importance of timing.

Following Dixit and Pindyck, it is possible to claim that their three features, irreversibility, uncertainty and the choice of timing can be distinguished in the people's retirement decisions. Retirement is often irreversible. Even if it weren't[58], there is a sunk cost attached to the decision to retire. It is not guaranteed that the individual can get the same, or even comparable level of a job if he wants to return to the labour force[59]. There is uncertainty attached also to the wages that can be earned. Labour markets for the elderly do not favour high turn-over[60]. So, even if people with a permanent job have highly predictable wage development, those who lose their job don't (if they can obtain any job). Wage uncertainty increased radically in Finland during the recession in the 1990's. Because pension benefits are a function of previous wages, the wage uncertainty carries through also to the pension benefits[61]. Recent changes and contemplations on the financial feasibility of the pension system have actually increased the uncertainty attached to the pensions. If there is variation in the financial compensation for an individual, depending on the retirement date, it is likely that also for retirement, the timing matters.

## 4.2 Panel Probit with the Random Effects

To use the economic incentives as an explanatory variable in a comprehensive framework modelling the labour market transitions, it was possible to choose a model either from a family of discrete choice models or duration models.

[57] Lazear and Moore (1988), p. 164.

[58] Empirically it was verified from the sample that very few people actually reverse their retirement decision.

[59] Individuals have accumulated firm-specific capital that is possibly non-transferable to any other job.

[60] See OECD (1998).

[61] The uncertainty related to the pensions has been reduced in Finland by a) extending the number of years of which wages are used as a basis for the calculation for the pension benefits, and b) insuring that the wage used for calculating the pension benefits is not lower than the wage obtained at the age of 45.

Both of these model groups try to capture the same phenomenon - explain the probability to retire. They are both well-established in the empirical literature, and have been implemented to model the early exits[62]. The results should differ only marginally. A discrete choice model is able to deal better with the unobserved heterogeneity. A duration model, on the other hand, would enable easier extension of the model to the multiple exit channels. As this study doesn't deal with the multiple exit channels, a model was chosen from the discrete choice models. The third possibility, a dynamic programming variant, was left for the future. Even if this type of a structural specification would produce a "cleaner model", empirical results have been shown to be qualitatively similar to the simpler models (see Quinn et al, 1990).

The choice between a panel probit and a panel logit was highly influenced by the way these can incorporate unobserved heterogeneous individual effects into the estimation. Therefore, the main guiding principle in the model selection was not the distribution (normal vs. logistic), but rather the nature of the unobserved heterogeneous individual effects. These effects refer to the unobserved individual-specific characteristics that are constant over time for one individual, but vary across individuals.

The unobserved heterogeneous factors are modelled either by the fixed or the random effects. The fixed effects estimation adds a dummy variable for each individual in the sample. In contrast, the random effects specification considers heterogeneity through the error term (see equation 7). In linear specifications, both of these extensions are rather straight-forward. Yet, the non-linear estimations are more complex. It is not possible to wash out the unobserved individual heterogeneity by simply differencing the data, as can be done in the linear models. Nor can one write the joint likelihood function as a product of the marginal likelihoods. Therefore, in the case of the fixed effects, it is necessary to rely on a conditional distribution. This has currently been resolved only for the logit model. The random effects specification, however, is resolved also for the probit model[63].

[62] For a panel probit with the random effects see, for example, Samwick (1998), and for a duration model see, for example, OECD (1998), annex 4 on the Netherlands by Lindeboom.

[63] See for example Chamberlain (1980), or Hsiao (1986, 1996a, 1996b, 1996c) for details. Quick reference is also provided by Baltagi (1997) or Greene (1997).

The most important reason in leaning towards the random effects probit rather than the fixed effects logit specification, was the fact that the latter requires changes over time in the values of all of the explanatory variables. If there is no variation in the explanatory variables, there is perfect collinearity between the non-time-varying explanatory variables and the individual dummies, and, consequently, the equation cannot be estimated. As in the model that was estimated, some of the interesting explanatory factors were variables with no changes over the time period[64], the estimation was done in the random effects framework. This, therefore, pushed the specification to the probit framework[65]. It is well-known, however, that the random effects probit model requires a problematic assumption of the independence of the error term from the explanatory variables of the model.

The random effects probit model, that was used in this study, can be written as:

$$
\begin{aligned}
y_{it}^{*} &= \delta_0 + \delta_1 G_{it} + \nu_{it}, && (7)\\
\nu_{it} &= \mu_i + \theta_t + \varepsilon_{it} \\
y_{it} &= 1 \text{ if } y_{it}^{*} \geq 0 && (8)\\
y_{it} &= 0, \text{ otherwise} && (9)
\end{aligned}
$$

$$
\begin{aligned}
\varepsilon_{it} &\sim N(0, \sigma^2) \\
\mu_i &\sim N(0, \sigma_i^2)
\end{aligned}
$$

$G_{it}$ is the option value variable as defined in the previous section. The dependent variable $y_{it}^{*}$ is the unobservable limited dependent variable as con-

[64] For example, the industrial field had to be treated constant for one individual over the whole period.

[65] Moreover, most of the other a priori recommendations tended to point towards a random effects approach in this analysis:

a) The number of the individuals in the sample was large with the small number of the time periods, yielding more reliable estimates for the random effects model which does not try to estimate the individual-specific differences.

b) The sample was clearly non-exhaustive but the attempt was to produce inference for the whole Finnish population.

See Baltagi, 1997.

ventional. In the estimations, it was proxied by $y_{it}$. This $y_{it}$ takes values 0 or 1, depending on whether the $y_{it}^*$ crosses a specific threshold[66]. In the model applied to the retirement, the $y_{it}^*$ can be thought of as the willingness to retire. $y_{it}$, therefore, equals one if the individual retires, and zero, if he doesn't.

The error term in the random effects specification is divided into two components: a) an individual-specific, time-invariant ($\mu_i$), and b) a truly random error term ($\varepsilon_{it}$). The third possible component, a time-specific, individual-invariant error, is here assumed to equal zero. Both, the individual-specific and the truly random error term, (and hence, their sum) have expected values of zero. Both of them also have constant variances in time. The truly random error ($\varepsilon_{it}$) is independently and identically distributed across the time and the individuals, and has a normal distribution. The individual specific error ($\mu_i$) is independently and identically distributed across the individuals, but is constant over time for each individual.

In practise, the individual specific error term could be, for example, a reflection of a fact that there are some individuals who hate work always - irrespective of the period in question. This unobserved heterogeneity factor would, in this case, yield a positive value for the error term (assuming that an increase in y* equals an increase in the willingness to retire). The person's willingness to retire is greater, in each period, than would be deduced on the basis of the explanatory factors of the equation.

### 4.2.1 Inclusion of Other Control Variables

As it is not obvious that leisure effect can be fully controlled by one structural assumption (k), and the retirement willingness is subject to the shocks also from the labour demand side, it is useful to append the basic model by other explanatory variables. It is conceivable that the utility of leisure is a function of some individual specific variables. For example, higher age, worse health or retirement by the spouse could be conjectured to increase the utility value of leisure. Other control variables that are often used in the retirement literature consist, for example, of gender, years of education,

[66] For more information in the static limited dependent variable models, see for example Maddala (1985).

wealth and employment by the public sector[67].

Because the actual retirement does not depend only on the labour supply decisions, it is useful to attempt to control also for some labour demand side effects. In the basic model, these can be thought to be present in the error structure. A supply shock (negative value of $\varepsilon_{it}$) reduces the right hand side of the equation 7, and brings it further from the threshold.

It is important to note also that an exclusion of the explanatory variables that should be in this non-linear model, is a source of a bias and an inconsistency. Henceforth, addition of the other control variables is essential in order to obtain reliable estimates.

[67]See for example, Samwick (1998), OECD (1998), Börsch-Supan (1998) etc. More references in the section for the literature review.

# 5 DATA, ESTIMATION RESULTS AND SIMULATIONS

This section gives first the basics of the microdata that was used in this empirical part. The second sub-section gives the estimations and calculations that were needed in constructing the economic incentive variable. This is then followed by the results from the probit framework and simulations of the pension system.

## 5.1 Data

The data section gives first a very brief overview of the data that was used. As the work consisted of a construction of microeconometric variables from the raw data, some of these are described in the sub-section 5.1.2.

### 5.1.1 General Description of the Data

Data for the study was provided by the Government Institute of Economic Research (VATT). The data is a sample generated from the Employment Registry of the Statistics Finland. The Employment Registry was created by the Statistics Finland in 1987. It combines information from a number of existing registries, from a variety of sources[68]. Altogether, about thirty different registries are brought together to provide wide-ranging information on economic activity and employment.

The underlying population for the data was all individuals between the ages 13 and 65, in 1990 - a slightly extended working age population. The sample consisted of about 12,000 individuals with approximately 150 variables for each individual. Most of the variables were reported from 1987 to 1994.

[68] Data is gathered from the Population Census of the Finnish Bureau of Census; Tax Registries of the Finnish IRS; Employment Registries of the Central Pension Security Institute (ETK), the Municipal (Kunnallinen Eläkevakuutus) and Government Pension Institutes (Valtiokonttori); Registry of the job seekers by the Ministry of Labour; Pension registries of the Central Pension Security Institute (ETK) and the Social Insurance Institution (KELA); as well as numerous other registries held by the Statistics Finland.

Considerations for the early retirement in Finland limited the analysis to those individuals aged 55 to 64 (hence, people in the age bracket of 48 and above, in 1987[69]). Individuals in this age bracket were considerably fewer (around 2,000 - out of which for about a half, no economic incentive variable could be constructed).

### 5.1.2 Construction of Some Key Variables

**Retirement** The variable that was used to indicate retirement reflected a change in the employment status from one year to the next. The "raw data" included information on whether an individual was classified as a) working, b) unemployed, c) retired, or d) retired through the unemployment pension system. It was assumed that if a person in year t was either in the category a) working, or b) unemployed, and in the following year, t+1, he was either in the category c) retired, or d) retired through the unemployment pension system, he had retired that year.

Classification by the Statistics Finland in the original data set is based on several criteria. It is based on the Social Insurance Institution's classification on retirees, age and the amount of pension benefits that an individual obtains. It has also been cross-checked that those in the retired category didn't belong to any other category.

**Years of Work** Perhaps the greatest shortcoming of the data was the fact that the sample did not include information on the total number of years of work. As this is essential for the pension benefit calculations, the number of years of work needed to be somehow derived from the combination of other variables.

Construction of the years of work was done by the means of current age, level of education and the age of the school entry. It was assumed that when the years of schooling required to obtain a specified educational degree, and the

[69] As the individuals don't enter the sample symmetrically, it was necessary to "intentionally truncate" the data. Because the basis of truncation was age which is deterministic, the rule of the truncation is ignorable and should not affect the estimates. For a brief elaboration on this, see the appendix (7.1.).

age of the school entry (7 years) were subtracted from the current age, the remainder consisted of the work experience.

years of work= age of individ - years of educ - 7

These calculations naturally assumed an uninterrupted working career from the entry to the work force. As the individuals in the relevant age bracket entered the work force any time between 1923 and 1946, the assumption of an uninterrupted work career was not necessarily a bad one for most of the men. For women in these cohorts, however, the assumption was likely to be more problematic. If there is a total withdrawal from the labour force, there is naturally no accrual of pensions in this period. The sample for the final estimations, however, was restricted to those individuals who had a reasonable wage quote during the sample period. Those individuals who had fully withdrawn from the labour force did not enter the estimations. Therefore, only those who had temporary longer withdrawals were likely to cause a problem.

Some of the individuals were likely to have experienced periods of unemployment rather than have a continuous career. Yet, pension benefits accumulate also when an individual is unemployed, but receives employment related unemployment benefit. Breaks in the career due to unemployment were therefore not considered too serious in the view of the pension benefit calculations.

**Health** For the variable on health, the current data set contained information on the sick allowance, the individual was reimbursed for by the Social Insurance Institution[70]. This information was used to construct a dummy variable indicating a health problem (1 if the individual received some allowance during the year, and 0 otherwise).

It is important to note that measuring the individual's true health status with the sick allowance can be problematic. In order to receive pension

[70]The allowance doesn't accrue for the first ten days of the illness, so short illnesses are therefore excluded. The allowance is granted only if the individual has worked for three months before the illness.

benefits through the disability pension channels, it is required that the person has received a specified amount of the sick allowance. Hence, incentives to "find an illness" in the case of a strong willingness to retire, are clearly there. Moreover, this "dependency problem" can exacerbate the econometric problem of the random effects probit (see the section 4.2.). An individual who hates work is likely to have a correlation between his individual-specific error term and his health status indicator.

**Productivity** The data that set did not contain variables on productivity. Therefore data from the macroeconomic model used by the Ministry of Finance in Finland (Kessu) was used in deriving productivity by the industrial sectors (production divided by the hours of production). This productivity measure was matched with the industrial sector for each individual (when the industrial sector could be identified). Industrial classes that were considered were based on the SIC 1988 by the Statistics Finland[71].

**Probability of Survival and the Life Expectancy** Probability of survival was obtained from the probability of death statistics by the Statistics Finland. Probability of death is given yearly for the age groups with a five year grid, for men and women separately. These statistics were matched with the age and gender of each individual, in the sample, for each year that was analysed. The values for the years outside this sample period were obtained by taking the value for 1994 to the appropriate power (the final year of life expectancy for the youngest individuals in the sample was 2020).

Values for the life expectancy were also obtained from the Statistics Finland. These statistics were also matched for each individual by the age and gender.

[71] Industrial classes that were identified were agriculture, forestry, food manufacture, textile and wearing apparel manufacture, wood and wood products, pulp, paper and paper products, publishing and printing, chemicals and chemical products manufacture, petroleum and coal products and nuclear fuel manufacture, basic metal industries and fabricated metal products, machinery and equipment manufacture, electrical products and instruments manufacture, transport equipment manufacture, energy and water supply, construction, wholesale and retail trade, hotels and restaurants, transport, communication, finance and insurance, real estate, cleaning and rental services,and other services

**Assumptions for the Structural Parameters** In order to undertake the estimations, it was necessary to make a number of assumptions for the structural parameters - the discount factor, the relative utility of pension benefits to wages, and the indicator for the risk aversion. Table 6 gives the values that were tried in the equations[72]. The parameter values for the most complete model were chosen by maximising the value of the likelihood function.

| *Parameter* | *Values* | *Comments* |
|---|---|---|
| Discount Factor ($\beta$) | 0.97, 0.98 | Implied Rates of Interest 3%, 2% |
| Relative Utility of Pension Ben to Wages (k) | 1, 1.5, 2 | k=1 Implies Leisure Carries no Value |
| Indicator for Risk Aversion ($\gamma$) | 0.6, 0.75, 0.9, 1 | $\gamma$=1 Implies Risk Neutrality (others risk averse) |

Table 6: Structural Assumptions

[72]The discount factor of 0.98 implies an interest rate of 2%. Older people, however, have possibly a higher discount interest rate than the whole population. Yet, this study takes the probability of survival separately into account - this being one of the major determinants on the difference between the discount factors of the young and the elderly.

Stock and Wise (1980) estimate and impose personal discount factor values below 0.9. Börsch-Supan's (1992) estimated/assumed value was 0.86, and the consequent rate of interest would then be 16%. As his model also takes separately into account the probability of survival, the value is surprisingly high.

The value for the marginal utility of leisure is assumed to be somewhere between one (no value for leisure) and two. The highest estimate for a one-period model, obtained by Stock and Wise (1990), was 1.76. Most of the values used in the literature, however, are about 1.1-1.2.

Stock and Wise (1980) impose neutrality for the relative risk aversion, and with a structural model, they estimate relative risk aversion to be 0.4 ($\gamma$ value of 0.6). Börsch-Supan (1992) gets a value 1.011 for the $\gamma$, and henceforth, his agents would be risk loving, in contrast to the rather normal assumption of a risk aversion.

## 5.2 Construction of the Variables for Economic Incentives

Construction of a meaningful economic incentive measure required values for *both* wages (actual or potential) until the age of official retirement *and* pension benefits (actual or potential) until the end of the life expectancy. Therefore, it was necessary to impute values for wages and pension benefits when they could not be observed. This included values both during the sample period and outside (the youngest individuals that were analysed, reach the age of official retirement by 2003, and the end of their life expectancy by 2020).

### 5.2.1 Wage Forecasting

Wage forecasting was done by running a regression on a dynamic panel and then projecting the wage levels on the basis of the regression results and the existing information.

**Forecasting Regression** The basis for the forecasting regression was derived from the human capital theory. Following Mincer (1974), it was assumed that logarithmic wages are a function of individual attributes and the error term (see function 10). The individual attributes in this model consist of age, gender, schooling and an industrial sector[73].

$$\log w_{it} = \beta_0 X_{it} + \beta_1 Z_i + v_{it} \tag{10}$$

, where $w_{it}$ indicates wages, $X_{it}$ time-varying explanatory variables and $Z_i$ time-unvarying explanatory variables.

The Mincer equation was furthermore appended by variables that are more macroeconomic in nature. This was considered important because the period under estimation presented exceptionally strong macro-volatility. Henceforth, the $X_{it}$ term also includes measures on unemployment (regional unemployment) and productivity (by industrial sector).

[73] See, for example, Uusitalo (1999) and Asplund (1993).

Individual wages are highly persistent over time. This phenomenon can be captured by assuming that development of wages follows a partial adjustment process (given in equations 11-15).

$$
\begin{aligned}
w_{it}^{*} &= a + \beta_0 X_{it} + \beta_1 Z_i + v_{it}, && (11)\\
\Delta w_{it} &= \theta(w_{it}^{*} - w_{it-1}) + \in_{it} && (12)\\
w_{it} &= \theta w_{it}^{*} + (1-\theta) w_{it-1} + \in_{it} && (13)\\
w_{it} &= \theta(a + \beta_0 X_{it} + \beta_1 Z_i + v_{it}) + (1-\theta) w_{it-1} + \in_{it} && (14)\\
w_{it} &= \theta a + (1-\theta) w_{it-1} + \theta\beta_0 X_{it} + \theta\beta_1 Z_i + \in_{it} + \theta v_{it} && (15)
\end{aligned}
$$

, where $w_{it}^{*}$ indicates the optimum wage for period t, $X_{it}$ includes the time varying explanatory variables, $Z_i$ the time invariant explanatory variables, and $\in_{it}$ is the error term of the partial adjustment process. The error term $v_{it}$ of the Mincer equation is a sum of a time-invariant ($\mu_i$) and time-varying error components ($\varepsilon_{it}$). Other variables are self-explanatory.

As the panel data consist of an individual-specific, time-invariant error component ($\mu_i$ of $v_{it}$), there is a correlation between the error term ($v_{it}$) and the lagged dependent variable ($w_{it-1}$). Hence, in order to retrieve a consistent and unbiased coefficient $(1-\theta)$, it is useful to transform the equation into differences. This transformation, where the constant variables drop out, is given in the equation 16.

$$\Delta w_{it} = (1-\theta)\Delta w_{it-1} + \theta\beta\Delta X_{it} + \Delta \in_{it} + \theta\Delta v_{it} \qquad (16)$$

Note that by differencing the time invariant error term ($\mu_i$ of $v_{it}$) is removed, and this is no more a source of bias in the estimation. The differencing, however, introduces another problem of bias, as there is now a correlation between the remaining (differenced) error term ($v_{it} - v_{it-1}$) and the (differenced) lagged dependent variable ($\mathrm{w}_{it-1} - \mathrm{w}_{it-2}$). Following Arellano-Bond (1991) the lagged dependent variable is therefore instrumented, among other things, with the wage level, lagged two periods ($\mathrm{w}_{it-2}$). This instrument is highly appropriate, as it should be independent of the error term ($v_{it} - v_{it-1}$) and highly correlated with the variable that it instruments ($\mathrm{w}_{it-1}$-$\mathrm{w}_{it-2}$).

Differencing introduces a second problem. Because the $Z_i$ matrix consists of time-invariant explanatory variables (gender, schooling and industrial sectors), these coefficients cannot be retrieved with the Arellano-Bond estimator. Henceforth, following Hausman & Taylor (1981), the equation 15 is transformed into equation 17 (error terms are left out to avoid clutter).

$$w_{it} - (1-\theta)w_{it-1} - \theta\beta_0 X_{it} = \theta a + \theta\beta_1 Z_i \tag{17}$$

In estimating this transformed regression (Hausman-Taylor), coefficient values from the Arellano-Bond regression (16) are inserted in forming the dependent variable. Henceforth, the Hausman-Taylor transformation is essentially a cross-section estimation on the variation that could not be explained by the time-varying explanatory factors of the Arellano-Bond estimation. Together these two techniques give consistent and unbiased coefficients for all of the variables.

Arellano-Bond estimation (equation 16) is performed in a linear random effects panel. In the Hausman-Taylor transformed regression (equation 17), time-varying variables are valued at their mean, in order to produce the needed cross-section structure. Individuals who were not classified as working were removed from the sample. Furthermore, some individuals didn't have data on income or these figures were very low (less than 2,500 FIM per month). Also these individuals were removed.

Table 7 gives out the results. It lists the Arellano-Bond estimation and Hausman-Taylor transformed regression separately, in order to highlight the two phase structure, and show the regression statistics for each regression. The first stage of the Arellano-Bond estimator (the instrument phase) is not reported but the estimation results are available from the author.

The table gives results for four different specifications in order to show the robustness of the estimates and compare some alternative specifications. The first specification uses only the lagged dependent variable, months worked, the age terms and the regional unemployment as independent variables. The second specification adds the productivity measure to the Arellano-Bond equation. The third specification removes the productivity terms from the Arellano-Bond part, but instead, adds yearly dummies to the Arellano-Bond and industrial sector dummies to the Hausman-Taylor part. The final specification, the fourth, includes the productivity measure and the yearly dummies

in the Arellano-Bond part, but no industrial dummies in the Hausman-Taylor part. As there is no joint test for the two phases (Arellano-Bond & Hausman-Taylor), the best specification was chosen on the basis of the ability of the "system" to forecast. The forecasting criteria that was used, a root mean squared error, is explained in the following sub-section.

Table 8 converts the short run coefficients to the long-run coefficients. The long-run coefficients are simply obtained by multiplying each of the explanatory variables by 1/(1-the coefficient of the lagged dependent variable).

It is useful to compare these results to pre-existing work on the Finnish microdata, even if exactly comparable models have not been estimated. There are no previous wage estimations on the panel data with lagged dependent variable, and very little work with panel techniques in general. Yet, there is a significant body of microeconometric research, mostly with cross-section techniques, that can be compared to the long-run coefficients.

Returns to schooling have been extensively researched in Finland. Some studies, however, use a non-continuous classification (educational dummies) which makes the direct comparison difficult with this study. Uusitalo (1999) uses a continuous schooling measure and gets estimates in the range of 7 to 10 %, or even as high as 12 to 15%, depending on the exact model. Yet, Uusitalo's data was exceptional, as it allowed control of the ability bias. Therefore, his estimates seem to differ somewhat from the earlier studies. Lilja & Vartia (1980) and Ingberg (1987) get estimates of 9% and 9–12%, respectively. The closest comparison with this study, is that of Kyyrä (1999). He used the same data base, but partly a different sample. He got an estimate of 0.076 in what he calls a general wage model (those who did not experience unemployment), and considerably lower, 0.048, for his starting wage model (those who had experienced a period of unemployment). The general wage model is indeed very close to my long-run schooling estimate. This is hardly surprising because this part of Kyyrä's study uses the same data set.

Gender effect on wages has also been a focus of a number of studies. Asplund (1993) got a negative coefficient with the magnitude of 19% for female wages. Vartia & Kurjenoja (1992) tested gender difference for both the factory and the clerical workers. These gender gaps were found to be 5% and 9-14% respectively. Koev (1996) tested the gender wage difference for the manufacturing sector in 1993. His results were consistent with the Vartia &

| *Regressor* | *Coef (S.E.)* | *Coef (S.E.)* | *Coef (S.E.)* | *Coef (S.E.)* |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Arellano-Bond | | | | |
| lagged wage | .564 (0.05) | .586 (0.05) | .567 (0.05) | .583 (0.05) |
| months worked | .010 (0.0006) | .010 (0.0006) | .010 (0.0006) | .010 (0.0006) |
| age | .024 (0.005) | .016 (0.005) | .017 (0.005) | .013 (0.005) |
| age squared/10,000 | -1.91 (0.56) | -1.78 (0.56) | -1.79 (0.53) | -1.64 (0.53) |
| regional. unempl % | -.032 (0.003) | -.026 (0.003) | -.015 (0.005) | -.015 (0.005) |
| productivity | | .093 (0.01) | | .090 (0.01) |
| yearly dummies | | | | |
| d89 | | | ref | ref |
| d90 | | | 0.012 (0.002) | .011 (0.002) |
| d91 | | | 0.008 (0.002) | .009 (0.002) |
| d92 | | | -0.019 (0.003) | -.022 (0.003) |
| d93 | | | ref | ref |
| d94 | | | 0.004 (0.007) | -.004 (0.007) |
| groups (obs.) | 3614 (16917) | 3613 (16913) | 3614 (16917) | 3613 (16913) |
| R-sq overall | .032 | .035 | .061 | .061 |
| chi2 (d.f.) | 578.2 (4) | 616.1 (5) | 1109.7 (8) | 1151.7 (9) |
| Hausman-Taylor | | | | |
| female (ref: male) | -.127 (0.005) | -.098 (0.005) | -.116 (0.005) | -.097 (0.005) |
| years of education | .035 (0.001) | .033 (0.001) | .033 (0.001) | .032 (0.001) |
| industrial groups | | | | |
| 16+1 groups | | | see the appendix | |
| constant | 4.05 (0.01) | 3.58 (0.01) | 4.26 (0.02) | 3.74 (0.01) |
| groups (obs.) | 3590 | 3589 | 3588 | 3589 |
| Adj R-sq | 0.34 | 0.30 | 0.36 | 0.28 |
| F (k, df) | 919.1 (2, 3587) | 784.7 (2, 3586) | 96.6 (21, 3566) | 711.9 (2, 3586) |
| RMSE | .154 | .148 | .147 | .153 |

Table 7: Income Forecast Regression (Dependent Variable: Log Wage)

Notes: Lagged wage, rate of home community unemployment and productivity are in the logarithmic scale. All observations were indexed to 1990 by the index for living costs (constructed from CPI, Statistics Finland). Estimates were corrected for heteroskedasticity by the Huber-White sandwich matrix.

| *Variable* | *LR Coef* | *LR Coef* | *LR Coef* | *LR Coef* |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Months worked | .023 | .024 | .023 | .024 |
| Age | .055 | .039 | .039 | .031 |
| Age Squared/10,000 | -4.38 | -4.30 | -4.13 | -3.93 |
| Home Comm.Unempl. | -.073 | -.063 | -.035 | -.036 |
| Productivity | | .225 | | .216 |
| Female | -.291 | -.237 | -.268 | -.233 |
| Schooling | .080 | .080 | .076 | .077 |

Table 8: Long-run Coefficients for the Forecasting Equation

Kurjenoja findings. All of these studies seem to report considerably (with the exception of Asplund) lower coefficients (in absolute terms) than my long-run coefficients. As all of the studies mentioned, were able to control for the number of hours worked, some of the difference in the magnitude with my estimates can be explained by the fact that women tend to work less hours. Vartia & Kurjenonja and Koev seemed to be able to control also for a number of other job specific factors. Women tend to have "less demanding" jobs with less responsibility. This provides a further explanation for the difference in the magnitude of the coefficients.

Kyyrä's study (1999) is possibly the only one that uses the same classification for the home community unemployment rate. His estimate was somewhat lower, -0.0248, for the general wage model and, for his starting wage model (those who actually experienced a period of unemployment), the coefficient, even if statistically insignificant, was actually positive. As his model also includes other measures of unemployment, it is possible that there is collinearity in some of his variables, and therefore, his coefficient for the home community unemployment rate can be unreliable. Wage curve estimations by Pekkarinen (1997) and Parjanne (1997) were able to use a more refined area classification for their area unemployment variable. Parjanne's estimations range from -0.05 to -0.15 and Pekkarinen's preferred estimate is -0.09.

As the specification with the industrial sector dummies (3) was not the one that produced the best forecast, in the interest of saving space, these coefficients are not reported in the main body of my text. These coefficients,

however, with some previous results on the Finnish data, can be found in the appendix of this study.

**Actual Forecasting** All of the parameters with the actual variable values were inserted into an iterative formula. The iterative formula for the prediction of the 1989 wages is given in the equation 18, and of the 1990 wages, in the equation 19.

$$w_{i89} = \theta a + (1-\theta)w_{i88} + \theta\beta_0 X_{i89} + \theta\beta_1 Z_i \tag{18}$$

$$\begin{aligned} w_{i90} &= \theta a + \pi\hat{}\, w_{i89} + \theta\hat{\beta_0} X_{i90} + \theta\beta_1 Z_i \\ &= \theta a + \pi[\theta a + \pi w_{i88} + \theta\beta_0 X_{i89} + \theta\beta_1 Z_i] + \theta\hat{\beta_0} X_{i90} + \theta\beta_1 Z_i \\ &= \theta a(1+\pi) + \pi^2 w_{i88} + (1+\pi)\theta\beta_0 X_{i89} + (1+\pi)\theta\beta_1 Z_i \end{aligned} \tag{19}$$

, where the second equality is an approximation, as $\hat{}\, X_{i90}$ is close to $\hat{}\, X_{i89}$.

The generalization of these equations yields a geometric series (given in the equation 20). The equation 21, in contrast, gives the values into which the series converges, when the time goes to the infinity.

$$\begin{aligned} w_{it} &= \theta a(1+\pi+\pi^2+...+\pi^j) + \pi^{j+1} w_{i,t-j-1} \\ &\quad +(1+\pi+\pi^2+...+\pi^j)\theta\beta_0 X_{i,t-j} + (1+\pi+\pi^2+...+\pi^j)\theta\beta_1 Z_i \\ &= \theta a[(1-\pi^j)/(1-\pi)] + \pi^{j+1} w_{i,t-j-1} \\ &\quad +[(1-\pi^j)/(1-\pi)]\theta\beta_0 X_{i,t-j} + [(1-\pi^j)/(1-\pi)]\theta\beta_1 Z_i \end{aligned} \tag{20}$$

$$w_{it} = \theta a[1/(1-\pi)] + [1/(1-\pi)]\theta\beta_0 X_{i,t-j} + [1/(1-\pi)]\theta\beta_1 Z_i \tag{21}$$

Yearly wage predictions are subject to the information that was available when the prediction was made. Henceforth, for example, the prediction for

the 1994 wages can differ, depending on whether the information that was used in making the prediction, was from 1989 or 1993. Therefore, several wage estimates were provided, using the information available in each year of the sample. Final wage expectations use only one predicted value for each year. As re-optimization by each individual is performed every period when the new information becomes available, the last available estimate for each individual was considered. In other words, if the 1994 wage level could be predicted on the basis of the information that existed in 1994, that value was used. If the individual did not receive any new information in 1994 (for example, he retired in 1993, and therefore, he would not know how his wage would have developed in 1994), he used the prediction based on the previous year's information if that was available. If the individual did not receive new information in 1993, he used the information available to him prior to that, and so forth. Less information he had, that is, further he was from the decision period, more likely he was to err on his expectation.

Even if it is important to note that because the estimations are supposed to yield values for the wage *expectations*, *rather than* predict the *materialized* wage values[74], it is worthwhile to assess the accuracy of the wage forecasts. This can be done, for example, by a root mean squared error (RMSE)[75]. This criteria was also used as a means to distinguish between the different specifications of the forecasting equation (see table 7). The formula for the Root Mean Squared Error is given in the equation 22.

$$RMSE_t = \sqrt{(1/n_t) * \sum_i (w_{i,t} - \hat{w_{i,t}})^2} \tag{22}$$

, where i refers to an individual, n to the number of individuals and t to the time period.

Table 9 gives the RMSE values for each year, for all regression specifications in the table 7. There seems to be a big deterioration in the accuracy of each of the forecasting regressions in 1991. This is not too surprising, as this was the start of the historically deep recession. It is very likely that people's

[74]The predicted wages contain only the value for the permanent income, whereas the observations contain both the permanent and the transitory (the error) components.

[75]See Greene (1997), p.372.

expectations, like those of the official forecasters, were considerably off the mark in this period. None of the regression specifications seems to do much better than the others in equating the predictions to observations in 1991, compared to the other years.

| *Year* | *RMSE* (1) | *RMSE* (2) | *RMSE* (3) | *RMSE* (4) |
|---|---|---|---|---|
| 1989 | 4.28 | 3.61 | 3.68 | 3.60 |
| 1990 | 4.30 | 3.71 | 3.83 | 3.70 |
| 1991 | 4.93 | 4.48 | 4.49 | 4.47 |
| 1992 | 4.78 | 4.44 | 4.42 | 4.42 |
| 1993 | 4.74 | 4.43 | 4.48 | 4.42 |
| 1994 | 4.88 | 4.62 | 4.69 | 4.60 |

Table 9: Root Mean Squared Error in Income Predictions

As the aim is naturally to get as little variation between the prediction and the observation, the specification 4 seems to perform the best. It is, however, only marginally better than the specification 2 which doesn't include the yearly dummies (or even 3 which doesn't include the productivity measures, but instead incorporates the industrial sector and the yearly dummies). In what follows, the specification 4 will be used (i.e. the specification that includes both the yearly dummies and the productivity, but no industrial dummies).

### 5.2.2 Pension Calculations

The second aspect of the formation of the economic incentive variable was that of the pension benefits. Pension values were evaluated by straightforward calculations, as this made simulations more realistic. Calculations were done by following the rules and regulations of the pension system during each year in question. As estimates for the pension benefits were needed until the end of the life expectancy, projections forward were made using a prediction of the special index applied to the pensions (TEL-index).

This sub-section gives the basics of the pension calculations.

**Employment Pension Scheme** The level of the pension benefits in the employment pension scheme is essentially determined according to the following, rather universal, formula:

$$\text{Pension Benefit} = \text{years}_{empl} * \text{multiple} * \text{wage}_{ret} \quad (23)$$

Pension benefits are a function of the years of employment, multiplied by the accrual percentage of the sector of employment (the multiple), and by the retirement wage. Benefits, accrued by each job, are calculated separately and at the end of a person's career, all of the job specific, index-inflated accruals (vapaakirjaeläkkeet) are added up to the total benefit. The data set used in these calculations did not yield information on the whole career, and hence, it was necessary to make a strong assumption of a life-time job. Moreover, as explained earlier, there was no information on the total number of years worked. Hence, it was necessary to assume that this lifetime job had continued without any breaks. Both of these assumptions are strong, and likely to cause bias for the calculations on the high side.

Construction of the first variable in the formula, that of the years of employment, was already discussed in the section 5.1.2. Some further minor modifications, however, were made. The pension benefits don't accrue before the age of twenty-three, so the work experience before those years, was excluded. If retirement takes place before the age of the mandatory retirement, there exist some basic requirements, which determine whether the years between the actual retirement and the mandatory age of retirement, count for the accrual (the so-called "future time", tuleva aika). Eligibility for the future time is required both for the unemployment pension and the disability pension benefits. As these systems are currently the two major avenues of the early exit, accrual for the remaining years was added to all calculations in this study. This is also a very strong assumption, and likely to produce further upward bias to the calculations.

The second term of the equation, the pension multiplier, for these cohorts that could be used for the estimations was generally 1.5% in the private sector. In contrast, in the public sector the multiplier was 2.5%. Yet, if the work took place before the appropriate pension law was passed, the multiplier was only 0.5% for these years. Multiplier for the years beyond 1994 was set

equal to the value in 1994. Even if there have been changes in the accrual system - some of them which might actually affect also these individuals - it was assumed that the individuals could not foresee these changes, and therefore, assumed continuity of the 1994 accrual percentage.

Retirement wage in this period, was the average of the two median values of wages from the final four years on the job (dropping the maximum and the minimum). Hence, for example, for the year 1994, the reference wages are those of 1994, 1993, 1992 and 1991. In estimating the retirement wage for the early years of the sample (1987, 1988, 1989), there was no information on wages for all the three previous years, and therefore, only the years that were available could be used. For 1987, only that year's wage was used, but it was insured that this amount reflected the full twelve months of work. All wages were indexed to 1990 prices (see last part of this section for the determination of the index).

**National Pension Scheme** The second component of the system, the national pension scheme, consists, in itself, of two separate parts. First, there is a monthly lump sum, received by everyone who meets the minimum standards[76]. Secondly there is a supplement, received by the people with very low income.

In the pension calculations both the lump sum and the supplement, conditional on the income level, were taken into account using the figures given in the yearbooks of the Social Security Institute (KELA). These figures were furthermore indexed to 1990. Currently the national pension security system is being changed from a universal system to a minimum security provision only. It is unlikely, however, that the individuals would have seen these changes during the sample period. Therefore, no phasing out of the national pension security system was implemented in these calculations.

The base lump sum calculations incorporated some adjustments, depending on the civilian status and other characteristics of an individual. The lump sum was reduced if an individual exited through an early old age pension. In contrast, it was increased if an individual had under-aged children, served in the war, was married (two categories, depending on the municipality) or

[76] According to the rules of the sample period, the requirement is living in Finland for the minimum of three years.

was widowed.

The supplement is granted (or rather not granted) if the sum of the employment pension benefits and the lump sum of the national pension scheme together add up to more than yearly specified limits. It also is further adjusted if the individual is married, has under-aged children, or served in the war. The amount of the adjustment takes into a consideration the individual's home community. All of these were taken into account in the pension system specifications.

**Total Pensions** The total pension benefit is the sum of the benefits from the employment pension scheme and the national pension scheme. This amount, however, needed to be further adjusted in order for the final pension benefit not to exceed 60% (private sector) or 66% (public sector) of the highest of the four wages underlying the final retirement wage. If this amount was exceeded, the total amount was adjusted down accordingly. It was also ensured that the minimum level of 38% of the same reference wage was received.

Table 10 gives the Root Mean Forecast Error for the pension calculations.

| *Year* | *RMSE* |
|---|---|
| 1989 | 1.70 |
| 1990 | 1.38 |
| 1991 | 1.19 |
| 1992 | 1.20 |
| 1993 | 0.58 |
| 1994 | 0.57 |

Table 10: Root Means Squared Error in Pension Benefit Calculations

Logarithmic pensions (both estimated and predicted) are around 10 to 11. Hence, there is some error in the estimation (or the prediction by the individuals).

**Pension Growth with Indexing** As stated in the section 3.4, pensions that have been granted, grow yearly, following a special pension index (tel-index). Forecasting the tel-index into the future would normally require

forecasting both price and wage developments. Equations 24-25 show, however, that as both wages and pension benefits were considered at their real values[77], the yearly real pension growth can be approximated on the basis of the real wage growth only.

$$\begin{aligned} \Delta B_t &= \Delta TEL_t && (24) \\ &= \Delta[\theta * W_t + (1-\theta) * P_t] \\ \Delta B_t - \Delta P_t &= \Delta TEL_t - \Delta P_t && (25) \\ &= [\theta * \Delta W_t + (1-\theta) * \Delta P_t] - \Delta P_t \\ &= \theta * (\Delta W_t - \Delta P_t) \end{aligned}$$

, where TEL refers to tel-index, W to nominal wages, P to prices and B to nominal pension benefits. $\Delta$ indicates a change and $\theta$ the proportion of the index change that is attributed to the wages.

Real wage growth was calculated from the growth of the means of the real wage predictions (as in the equation 20) for the whole working population. In an attempt to maintain the representability of the sample for the calculations of the average real wage levels, however, older individuals needed to be dropped out as the sample aged. Hence, each year those who reached the mean retirement age (61), were excluded from the real wage growth calculations. As the forecast was needed until 2022, the representability of the sample was insufficient in the later years[78]. The real wage growth was, therefore, assumed constant from 2002 onwards. From there the growth seemed to more or less stabilize (around 1.5-1.8 %), and the representability of the data set beyond this year was questionable.

Table 11 gives the forecast of the "real tel-index", as given in the equation 25, until year 2002. Due to the fact that the sample period includes strong recessionary years, there is a clear dip in the generally rising trend. This is

[77] Wages were inflated/deflated by the cost of living index, as stated in section 5.2.1. Pension benefits are calculated from the average of the median wages from the past four years (See section 5.2.2.). These wages were first converted to nominal wages by the cost of living index, and then reconverted to real wages by using the tel-index forecast.

[78] Youngest individuals in the first year of the sample - 1987 - were 15 years old. Henceforth, in 2022, they were to be fifty. The sample is clearly unrepresentative for the whole labour force in these later years.

| *Year* | *Index* |
|---|---|
| 1989 | 98.5 |
| 1990 | 100 |
| 1991 | 101.1 |
| 1992 | 101.7 |
| 1993 | 102 |
| 1994 | 102 |
| 1995 | 98.2 |
| 1996 | 94.1 |
| 1997 | 93.1 |
| 1998 | 92.4 |
| 1999 | 93.5 |
| 2000 | 95.6 |
| 2001 | 97.1 |
| 2002 | 98.9 |

Table 11: Tel-index Forecasts

shown by the fact that the index forecast falls from 1994 to 1998. Even if the predicted fall seems rather strong in the view of looking today how the index developed in the period, it is consistent to include it also in the progression of the pension benefits because it is present also in the forecasted wages.

Because the sample finishes in 1994, two years prior the introduction of the split index, the only division between the wage and price level contribution that was considered here is 50-50 (see section 3.4 for formation of the index). If, however, the formation of the index in the calculations had been done according to "the 1996 formula" (80% prices, 20% wages, in formula 24 $\theta = 0.2$), the index forecast would fall, and hence, also the future pension benefits. As the option value variable is a difference between the pension benefits obtained if retired sometime later *and* the pension benefits if retired today, a change in the index affects both positively and negatively the option value variable. If the index falls, the fall in the benefit flows obtained if retired today is greater than the fall in the benefit flows if retired later, and the option value is also lower. Yet, it was tested that the fall in the option value variable was not sufficient to refute the qualitative results that are given in the next sub-section[79]. If the nominal wage and price developments differed

[79]These results are available upon request.

from the forecasts given above, this would also be reflected in the option value variable. Faster wage growth (or slower price growth) favours more work, and would increase the opportunity cost to retire, that is, the option value. The final results, presented in the next sub-section, however, hold qualitatively even if there are rather large changes in the indexing. It was tested that the results hold even when the tel-index was based on the price index alone ($\theta = 0$ in equation 24)[80].

### 5.2.3 Option Value Variable

The option value variable, explained more carefully in the section 4.1, combines two previous sets of calculations (the income estimation and the pension calculations), appending these furthermore by a) the probability of survival, b) the personal discount factor, c) the coefficient of the risk aversion, d) the relative preference of the income versus the pension benefits, and e) the life expectancy for each individual.

In the first phase, each individual gets an estimate of the utility function (repeated below) for every period when he has a possibility to retire (which here is defined as the age of 55 and above).

$$V_t(r) = \sum_{s=t}^{r-1} \beta^{s-t} u(Y_s) + \sum_{s=r}^{T} \beta^{s-t} u[kB_s(r, Y)], \qquad (1)$$

For a 48- year old, it is, therefore, necessary to estimate the income and the pension flows from 1994 to 2004. The income flows are simply an appropriately weighted sum[81] of the income values each year the individual is deemed working prior to the retirement (the equations 26 and 28). Hence, if a 48-year-old retires in 2004, his income flow is a sum of the weighted yearly incomes from 1994 to 2003. As his "window of exit" is ten years, he gets ten different income flow estimates, depending on the year of retirement. Pension flows, on the other hand, are a sum of the pension benefits that the individual is deemed to receive "for the rest of his life expectancy", after his year of retirement (equations 27 and 29).

[80] These results are available upon request.

[81] Weights included the structural parameters given above.

The first value of the summation of the pension flows is the value of the pension benefits that an individual would get were he to retire that year. The rest of the terms, until the end of the life expectancy, are projections of the first term using the private pension system index (tel-indeksi).

Therefore, if a 48-year-old (in 1987) male "chooses to retire" in 1999, his pension flow was a sum of the pension benefit payments from 1999 all the way up to 2015. In contrast, his income flow, in this case, consists of the values for the income from 1994 up to 1998. The two flow functions (the wage income and the pension benefit one) are then added up and weighed by the comparative value coefficient, k (equation 30).

The same in equations reads as follows:

$$u(Y_s) = \pi_{at} * \beta^{s-t} * Y_s^{\gamma} \quad (26)$$

$$u(B_s) = \pi_{at} * \beta^{s-t} * B_s^{\gamma} \quad (27)$$

$$yflow(r) = \sum_{re}^{r-1} u(Y_t) \quad (28)$$

$$bflow(r) = \sum_{r}^{T} u(B_t) \quad (29)$$

$$U(r) = yflow(r) + k * bflow(r), \quad (30)$$

where $u(Y_s)$ denotes the utility value of income for the year s, $u(B_s)$ utility value of pension income for that year, $Y_s$ is the money value of income, $B_s$ is the money value of pension benefits, $\pi_{as}$ is the probability of survival for an individual at the age a in the period s, $\beta$ is the personal discount factor, s is the period to be assessed, t is the current period, $\gamma$ indicates the risk aversion, yflow(r) the income flow if retirement takes place at the period r, re is the first year of the retirement eligibility, bflow is the pension flow, U is the total utility value of a specific retirement option, and k is the relative evaluation of the pension benefits versus the wages.

In order to construct the option value variable, the utility value of an immediate retirement is subtracted from the maximum utility value of the rest of the subsequent years of the retirement eligibility. Our 48- year old, therefore, gets a value for each of his years of eligibility for the early exit, from 1994 to

| | *Mean of the Option Value* | *Median of the Option Value* |
|---|---|---|
| Retire | 0.002 | -0.083 |
| Don't Retire | 0.425 | 0.030 |

Table 12: Option Value by Retirement

Notes: Figures are in 100,000 FIM (utils).

2003. In the final year (at the age of 64), he only has two values to compare - the value for the immediate retirement and the value of the pension flow that he obtains by retiring at the age of the "mandatory" retirement (65 years).

$$OV(r)=\max[U(r=t+1),...,U(r=\text{year when } 65)]-U(r=t) \qquad (31)$$

, where OV is the option value, r is the year of retirement and U is the utility in that year.

The option value variables that enter the final probit regression are naturally only those that fall within the sample period.

## 5.3 Results

Table 12 shows the mean and median values of the option value variable for those who retire and those who don't, respectively. The option value is significantly higher for those who did not retire. As the option value is the opportunity cost of retirement, this cross-tabulation confirms the expectation that the financially more attractive opportunities to continue in the work life, are faced by those individuals who actually continue longer in the work force. This result holds across the years and across the age groups[82].

With cross-tabulation, however, it is difficult to assess the direction of the impact and its magnitude while keeping other relevant factors constant. Table 13, therefore, reports the values for the most restricted version of the

[82]This result also holds with different indexing as they were described at the end of the section 5.2.2. Means of the option value with no real growth in the pension benefits ($\theta$=0) were 0.033 and 0.331, for those who retire and for those who don't, respectively.

random effects probit equation. Due to the importance of the structural assumptions, the same regression was performed while altering the values for the structural parameter assumptions (see section 5.1.2). These structural assumptions are the values for the factors reflecting the relative value of the leisure (k), the risk aversion ($\gamma$) and the discount factor ($\beta$). The models with different sets of structural assumptions are numbered in the first column of the table.

Regressions in the table 13 contain the most restricted version of the panel probit model that could be estimated. This version included a constant, the option value variable, and yearly dummies. Age and yearly dummies were essential as additional controls because the likelihood function for the random effects probit model could not be maximised with the option value variable only. Without the controls, the fraction of the variance due to the time-invariant unobserved individual effects fell below zero. As this is not feasible, it is concluded that the random effects panel specification is inappropriate for the very restricted model which has only one variable and a constant[83]. Results of the pooled cross-section binomial probit model for the option value variable *only* are given in the appendix 7.3. The pooled cross-section marginal effects for the option value variable are about double the marginal effects of the model in table 13. Other model specifications[84] confirmed that the difference in the magnitude between the panel probit (table 13) and the pooled cross-section probit estimates (in the appendix) is largely due to the different variables that are included in the regressions.

Columns two to four of the table 13 give the assumed values for the structural parameters. The fifth column gives the value of the maximum likelihood function. In altering the values for the structural parameters, the maximum value of the likelihood function changes. The specification which maximises

[83]The maximum likelihood function could be estimated without the random effects error term (results for the pooled cross-sections are given in the appendix). Changing the starting values, grid steps of the search or the number of the quadrature points for the Gaussian-Hermite approximation for the integral of the error function (See Butler and Moffit, 1982) did not solve the maximization problem for the option value variable only. The option value variable was also included in its time average over the whole period for each individual, in case there was correlation between the error term and the independent variable (See Chamberlain, 1984). Also this, however, could not solve this specific maximization problem.

[84]Pooled cross-section was estimated with more explanatory variables. Regression coefficients are rather close to the panel estimates. Estimates are available upon request.

the likelihood value, was chosen to be the most appropriate for the data. This specification is the first one, where the relative utility derived from the pension benefits and wages is equal (hence, k equals one), the individuals are risk neutral and the discount rate is equal to 2% (and the discount factor consequently equals 0.98).

As the coefficients of the non-linear models cannot be interpreted as straightforwardly as the coefficients of the linear models, the table 13 also gives the marginal effects of these reported probit models. The marginal effects are in the second last column. The marginal effect ($dF(\beta X)/dX$) gives the effect of an infinitesimal increase in the option value on the probability to retire[85]. In evaluating the marginal effect, it is necessary to choose a point where the effect of the explanatory variable is evaluated. It is customary to give the marginal effects at the mean values of the explanatory variables.

The results show that the model is somewhat sensitive to the structural assumptions. Yet, all the specifications indicate that an increase in the option value, as measured by the marginal effect, lowers the probability of retirement (the coefficient of the option value variable is significant in all of the model specifications). Henceforth, also on the basis of these results, it is possible to conclude that the economic incentives matter in assessing the probability of retirement.

Leaving out variables from a regression that "should be there", causes a bias and an inconsistency in *linear* regression models only if the excluded variables (now in the error term) are correlated with the included ones. In non-linear models, however, any exclusion of the relevant variables is already a source of a bias and an inconsistency - even if they are orthogonal to the included variables[86]. It has been empirically verified by numerous studies (see the referenced papers) that retirement is also affected by other factors, not only those related to the economic incentives. Moreover, predictive capacity of the model improves considerably when more explanatory variables are introduced.

Naturally it is impossible to know which variables should be in the model for the retirement. Yet, it is important to try variables that are deemed relevant *directly* to the retirement decision. Tables 14 and 15 give estimation

[85] See Greene (1997).
[86] See Greene (1997).

| | k value | $\gamma$ value | $\beta$ value | Likel. Val. | OV Coeff. (s.e.) | Marginal Effect | Mean OV |
|---|---|---|---|---|---|---|---|
| (1) | k=1 | $\gamma$=1 | $\beta$=0.98 | -915.35 | -1.046 (0.26) | -0.106 (0.03) | 0.038 |
| (2) | k=1.1 | $\gamma$=1 | $\beta$=0.98 | -918.16 | -0.816 (0.25) | -0.077 (0.02) | 0.018 |
| (3) | k=1.5 | $\gamma$=1 | $\beta$=0.98 | -920.98 | -0.433 (0.19) | -0.039 (0.02) | -0.384 |
| (4) | k=2 | $\gamma$=1 | $\beta$=0.98 | -921.36 | -0.304 (0.15) | -0.027 (0.01) | -0.094 |
| (5) | k=1 | $\gamma$=0.6 | $\beta$=0.98 | -920.85 | -66.27 (26.3) | -5.86 (2.30) | 0.00005 |
| (6) | k=1 | $\gamma$=0.75 | $\beta$=0.98 | -919.05 | -15.14 (4.8) | -1.38 (0.45) | 0.001 |
| (7) | k=1 | $\gamma$=0.9 | $\beta$=0.98 | -916.95 | -3.099 (0.84) | -0.301 (0.09) | 0.009 |
| (8) | k=1 | $\gamma$=0.75 | $\beta$=0.97 | -921.07 | -11.31 (4.78) | -1.007 (0.43) | -0.0005 |

Table 13: Random Effects Probit Model with Option Value Variable as an Explanatory Factor (Dependent Variable: Probability to Retire)

Notes: The dependent variable is the binary indicator on retirement (1=retire this period, 0=do not retire); FIM values in 1/1,000,000 FIM (utils); The option value reflects the maximum utility obtained from retiring later minus the utility obtained from retiring immediately; The model also includes age and yearly dummies. The individual specific error terms are statistically insignificant.

results for three more model specifications, adding more control variables. The variables that have been added in the models 9-11, are, what Börsch-Supan (1998) calls the "usual suspects". Some of the added variables affect *also* indirectly via the financial incentives (for example, age), but some of them can carry an impact directly on the retirement probability only (for example, wealth[87]). Model (9) adds a health indicator, model (10), the public sector indicator, and model (11), an unemployment indicator to the regression.

In table 14, one of the most interesting results, from a perspective of testing the random effects probit model, is reflected in the rho values. Rho indicates the variance of the individual specific, time-constant error variance divided by the total variance of the random effects probit regression. Rho estimate should pick up the unobservable individual-specific factors that cannot be controlled by the explanatory variables that are included. Adding the health indicator in the model specification (9) lowers the estimated rho value considerably. Major part of the unobservability between the individuals seems to be, therefore, due to the differences in the health status. Even if the rho

[87] Not in the table 14, because it didn't yield a statistically signficant coefficient.

| Regressor | Coef (s.e.) | Coef (s.e.) | Coef (s.e.) | Coef (s.e.) |
|---|---|---|---|---|
| | (1) | (9) | (10) | (11) |
| Option value | -1.046 (.26) | -1.009 (.23) | -.910 (.22) | -.933 (.21) |
| Age | .109 (.030) | .119 (.03) | .116 (.02) | .115 (.02) |
| Health | | .882 (.14) | .883 (.14) | .867 (.14) |
| (ref: no health problem) | | | | |
| Unemployed prev year | | | | .357 (.15) |
| (ref: not) | | | | |
| Public sector | | | .144 (.07) | .154 (.07) |
| (ref: non public sector) | | | | |
| Yearly dummies | | | | |
| d90 | -.141 (.17) | -.150 (.15) | -.140 (.15) | -.092 (.14) |
| d91 | -.136 (.13) | -.117 (.12) | -.111 (.12) | -.073 (.12) |
| d92 | -.044 (.10) | -.039 (.10) | -.035 (.10) | -.012 (.10) |
| Rho | .113 (.23) | .058 (.19) | .035 (.19) | .014 (.19) |
| Constant | -7.59 (1.78) | -8.26 (1.55) | -8.12 (1.49) | -8.13 (1.46) |
| Groups | 1,010 | 1,010 | 1,010 | 1,010 |
| (Obs) | (2,724) | (2,716) | (2,716) | (2,716) |
| LR (Chi2) | 4.75 (1) | 4.69 (1) | 4.60 (1) | 4.56 (1) |

Table 14: Panel Probit (Dependent Variable: Probability to Retire)

Notes: Option value equals maximum utility obtained if retirement postponed minus utility if retired now; Option value is given in 1/1,000,000 FIM (utils). LR (Chi2) gives the improvement when the estimation is done in the random effects probit, rather than binomial probit framework.

| Regressor | Marg. Effect | Marg. Effect | Marg. Effect | Marg. Effect |
|---|---|---|---|---|
| | (1) | (9) | (10) | (11) |
| Option value | -.106 (.03) | -.094 (.02) | -.088 (.02) | -.091 (.02) |
| Age | .011 (.001) | .011 (.001) | .011 (.001) | .011 (.001) |
| Health | | .082 (.02) | .085 (.02) | .085 (.02) |
| (ref: no health problem) | | | | |
| Unemployed prev year | | | | .035 (.016) |
| (ref: not) | | | | |
| Public sector | | | .014 (.007) | .015 (.007) |
| (ref: non public sector) | | | | |
| Yearly Dummies | | | | |
| d90 | -.014 (.014) | -.014 (.01) | -.014 (.01) | -.009 (.01) |
| d91 | -.014 (.011) | -.011 (.01) | -.011 (.01) | -.007 (.01) |
| d92 | -.004 (.010) | -.003 (.01) | -.003 (.009) | -.001 (.01) |

Table 15: Marginal Effects for the Panel Probit

value is not statistically significant in any of the models in table 14, likelihood ratio test statistics indicate that there is a considerable improvement in all of them when the random effect structure is introduced, and the model is allowed more flexibility.

The interpretation of the results should be done from the marginal effects. These are in table 15. An increase in age, as expected, tends to increase the likelihood to retire. The health indicator asserts a strong impact on the likelihood to retire. If an individual has received a health allowance, he is much more likely to retire. As mentioned before, retirement due to a disability requires a period of a health allowance recipiency. Henceforth, the strong effect of the health indicator is no surprise. The option value variable stays negative and significant with all the added variables. Its magnitude is not much affected when more control variables are added.

The additional variables in models 10 and 11, yield coefficients that are of the expected sign and are significant at the conventional significance levels. The unemployed can, with certain age restrictions (see section 3.2.1), obtain

unemployment pensions. This shows up as a greater propensity to retire, if one has experienced unemployment in the previous year. The pension system for the public sector employees differs from the one for those in the private sector. The public sector employee pension systems (includes both the government and the municipal employees) tend to have lower retirement age restrictions. This is reflected in the greater likelihood to retire, if an individual is in the public sector.

Excluding the public sector employees from the data rendered a significant sign also to the variable that reflected the size of the firm where the employee had been employed[88]. More specifically, if an individual had been employed in a firm with less than 50 employees, he was more likely to retire than otherwise. This conforms with incentives provided for firms. For bigger employers it is more cost-effective to lay-off the older workers (and "push the employees to the unemployment pension channel", see section 3.2.1.) than to allow them to retire directly. The cost-effectiveness of the disability retirement route (and almost immediate retirement) is actually more cost-effective for smaller employers. Attributing a role to the labour demand side, however, did not affect the sign and the statistical significance of the option value coefficient.

A number of other variables[89] were also included in the model, but they did not yield statistically significant coefficients at the conventional levels and are, therefore, not reported in the table. Their addition did not alter any of the coefficients in the reported models by any significant magnitude. Some of the additional variables did not yield statistically significant coefficients because they were already used in constructing the option value variable. Some of them did not yield statistically significant coefficients because their effect seem to reverse itself in different years.

[88] These results are in the appendix.

[89] Indicators for firm size, gender, self-employment, spouse's labour market status, house-ownership and geographical location, as well as the years of education, wealth and debt values provided no statistically significant coefficients.

## 5.4 Simulations

From a policy point of view, the most interesting exercise of the current study, were the policy simulations. These were done by altering the values for the controllable variables of the pension system. First, the performed simulations are described in more detail, and this is followed by the results of the simulations.

### 5.4.1 Pension System Alterations

This section gives two simulations; 1) an increase in the value for the multiple; and 2) an eradication of the future time, coupled with a reduction of the multiple. The reforms alter individuals' lifetime income profiles.

**Simulation 1: Increase of the Multiple** First of the simulations tried to capture the effects of the reform implemented in 1994. Since then, the multiplier for those of the age of sixty and above, continuing to work, was raised to 2.5%.

This simulation, simulation 1, is a straightforward interplay between a positive income effect and a negative intertemporal substitution effect after the age of sixty. The positive income effect should increase the demand for leisure, that is, induce a higher probability to retire. In contrast, the negative intertemporal substitution effect induces people to demand less leisure early, and therefore, lowers the incidence to retire. The policy reform naturally hoped to obtain the dominance of the substitution effect over the income effect.

The fact that there is no data on the employment status after 1994, forces to make a problematic assumption. Those that are working in 1994 are assumed to continue work, with a higher accrual, until the age of 65 (when everyone retires). This is naturally not necessarily the case, as not all the individuals react to the change in the incentive structure. Therefore, the policy simulation is not as reliable as it was hoped.

**Simulation 2: "Double Crunch" - Eradication of the Future time and Actuarial Reduction for an Early Exit** The second simulation attempted to bite into a reform model that has been much contemplated. Currently very few people use the actuarially reduced exit channel of the early old age retirement (varhennettu vanhuuseläke). Instead people get to use the early exit routes that guarantee them full old age pension at the age of 65. Yet, there exist rules according to which, an individual can start withdrawing early his old age pension - the one he'd be entitled to, were he to retire at the age of 65. This pension, however, is actuarially reduced[90]. In addition, the individual would not, in this case, be entitled to the "future time" (tuleva aika); that is, there would be no pension accrual between the age of his early retirement and the age of 65, the age of the mandatory retirement.

The eradication of the future time produces a possible negative income effect. Due to a loss in the retirement wealth, it is possible that people have to work longer than they would have preferred. There is also a possible negative the substitution effect because the financial value of the leisure increases, people will demand less leisure. The effect of the actuarial reduction of the multiple depends on the "actuarial fairness" of the scheme. If the scheme is actuarially neutral, both the income and substitution effects should be zero. Therefore, only considerations of the future time should drive the results. If the scheme is not neutral, there is also naturally an interplay between the income and the substitution effects.

### 5.4.2 Results of the Simulations

Table 16 gives the mean and the median predicted probabilities to retire from the sample. These are given for the base case and the two simulations. Both simulation one and two are designed to affect the individual's retirement decision by making it financially more attractive to retire later. As seen from the table, both simulations lower the individual's probability to retire, and therefore, affect to the desired direction. The magnitudes of the differences, however, seem small.

Graph 6 gives means of the decreases in retirement probabilities between

[90]The tables can be found for example in ETK, Työeläkkeen Laskentaopas 1998, liite.

| *Given value* | *"True"* | *Sim 1* | *Sim 2* |
|---|---|---|---|
| Probability to retire | | | |
| mean | 0.114 | 0.110 | 0.110 |
| median | 0.089 | 0.087 | 0.084 |
| (s.d.) | (0.086) | (0.086) | (0.087) |

Table 16: Pension System Simulations
Notes: Simulations assume that the individual error component equals zero.

the base case and the simulations. These differences are furthermore broken down by the age. The simulation one has a bigger impact on the age groups below sixty - indeed as designed. The impact of the simulation two is more even at the different age groups, even if it also affects more the "younger age group". Actuarial reduction affects more, longer is the time of its impact.

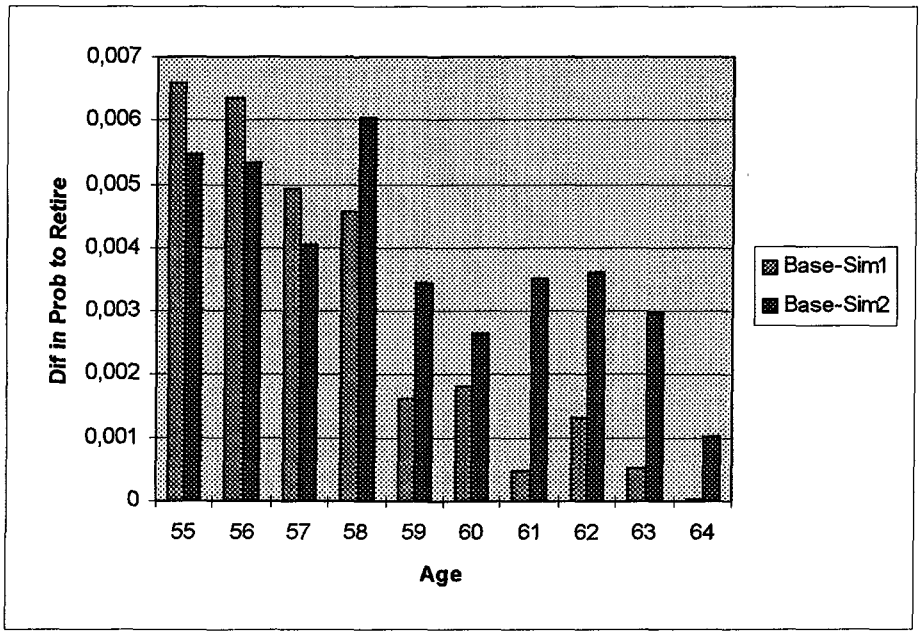


Figure 6: Means of Decreases in Retirement Probabilities

# 6 CONCLUSION

This study showed that there will be an increasing pressure in the first two to three decades of the next millennium on the financing of the Finnish pension system. The demographic changes will continue to exert pressure on the Pay-As-You-Go part of the pension system. More alarming, however, are the labour market developments and their expected impact on the financing of the pension system. It was shown that the employment rates have fallen continuously for the elderly. There is also a big backlog of the unemployed waiting for the unemployment pension. The current Finnish unemployment pension tunnel does not obligate the unemployed to search for work after a certain age (currently 55). Even if they were obligated, however, the hiring intensities for the aged are low (OECD, 1998a).

Maturing of the pension system[91] and increases in the income levels have left the current generations better off than the previous ones. Assuming that leisure is a normal good, increased demand for leisure at the end of the life-cycle, is a natural follow-up of the increased income levels. Pension systems can also create (and have created[92]) implicit incentives favouring the early retirement. Some of the pension regulations do not reward the late retirement or even penalize for this.

This study set out to produce some empirical results on whether the economic incentives, provided by the pension system, matter for the retirement probabilities in Finland. It was emphasized that the economic incentives should be viewed with a long-term perspective by the individuals. The measure for the economic incentives was based on the option value concept. The concept was defined as the maximum of the expected financial flows (wage-pension benefit combinations), if the retirement is postponed, minus the expected financial flows if the individual retired immediately. The concept of the option value essentially measured the opportunity cost of the immediate retirement.

For assessing the retirement likelihood probabilities, the study used the random effects probit model. Non-linear panels produce a highly efficient and a straightforward methodology for transition likelihood estimations. They can, with their error structure, account for the unobserved, time-constant

[91] "Full pensions", that is 60% of the reference wage, will be obtained in the near future.
[92] See NBER (1998).

heterogeneity effects between the individuals.

The study produced empirical evidence that the economic incentives matter also to the Finnish labour force. The option value variable got an unmistakably statistically significant coefficient in all the specifications of the probit model (altering the structural assumptions, and the number of the other control variables). It is clear, however, that the economic incentives are not the sole determinants explaining the probability to retire. A more comprehensive model asserted a role also, at least, to the age, the health indicator, the employment status, firm size and the public-private sector employee status. Other variables were also tested in the model, but as they didn't produce statistically significant coefficients for this model, at the conventional levels, they were not reported in this study.

Two system simulations were also produced with the view to establish the effectiveness of the policy changes. The first simulation attempted to capture the effect of a policy change undertaken in 1994. The second simulation tested the consequences of an even more radical reform: an eradication of the future time, complemented with an actuarial reduction. Broken down by age, there seemed to be evidence that both of the reforms had at least some of the desired impact, lowering the probabilities to retire.

The current study left open a number of issues that should be taken up in the further research.

The random effects probit model was not able to maximise the likelihood function in all of the model specifications. More specifically, problems were encountered when the model included only the constant, the financial incentive variable and the random error structure. Whether the problem was data- or model-specific, could not be convincingly demonstrated. As the model, however, could be resolved in other variants, one suspect cause of the failure, was the specific correlation structure between the error term and the explanatory variable. Chamberlain's (1984) method to control for this possible correlation did not yield a solution in this particular case.

Even more plausible explanation for the maximisation problems, however, could be attributed to assessing whether the model is appropriate to this problem-setting altogether. As retirement in Finland tends to be a one-way decision, it is also left for the further research to verify whether a discrete panel framework should be used to analyse this problem at all, or whether

a duration model is more appropriate. A discrete choice model for a panel (like this random effects probit model) does well in correcting for a weighting of several observations for one individual in the likelihood function. Where it possibly fails, however, is in treatment of the transitions. Duration models would weather better in modelling this type of transitions. Discrete choice panels also force the researcher to make rather restrictive distributional assumptions. There are, in contrast, an increasing number of semi-parametric duration models where distribution restrictions apply only to part of the model. Yet, treatment of the unobserved heterogeneity in duration models has been a lot harder to implement, and generally also requires distributional assumptions.

In model selection, it could also be useful to apply a dynamic programming model to retirement. These models have been demonstrated to hold a better predictive power than the duration models[93]. Even if the qualitative results have tended to remain much the same in the dynamic programming models as in the other model specifications, the use of more dynamic models could be desirable for the greater accuracy in retirement probability predictions. Moreover, dynamic programming models are able to maintain a tighter structural specification also in the estimation.

Other specification changes that could be undertaken consist, for example, of the consideration of the several early exit channels that exist currently in Finland. This would have to be done either in the competing risks duration model or the multinomial logit with the fixed effects (the latter implies a loss of time-constant explanatory variables). It is also desirable to take into account the problem of the uncertainty in the application-approval procedure that actually governs the pension system. This can be done by using the information on the pension applications rather than the actual transitions[94].

The aim should also be made to render the "leisure indicator", the k, a function of some individual-specific attributes. The model specification in this study allowed no role for the leisure indicator when tested from the data. This result, however, should be more extensively tested. One possibility is to alter the model structure by making the leisure indicator a function of the observable individual-specific attributes. Moreover, this change in the

[93]See Lumsdain et al. (1990).

[94]The data including application rejections has become available only recently.

functional specification would yield a structurally more attractive model.

This study also reviewed some of the literature on the savings impacts of the pension system. Even if the effects of the pension system 'solely' on the labour market (if these can be isolated) hold an interest on their own, savings regressions could also be a natural continuation for the framework. Currently there is no micro data available in Finland enabling the savings effect estimation with a panel structure. If the rotating panel of the Finnish Household Surveys can be linked to the Employment Registry data[95], it would be interesting to evaluate the pension system effects on savings, taking into account the 'induced retirement effect', estimated in this study.

Finally, in this study it was also shown that the retirement savings accounts so far have had a minor importance in financing retirement in Finland. It was also shown, however, that their importance has been growing. Therefore, the future research on the impacts of the economic incentives on retirement, should take into account, in addition to the two mandatory pillars, also the voluntary pillar. This, however, also requires new data that was currently unavailable.

[95] This matching is currently under construction.

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# 7 APPENDIX

## 7.1 Truncation and Selectivity

**Left Censoring** The need to adjust a stock of individuals to a flow of time, implied asymmetricities in the relevant number of observations for each individual. For example, as the earliest age of eligibility for the early retirement is 55 years, a 48-year-old in 1987 was not eligible for the early retirement in the beginning of the sample. In contrast, in 1994, he became eligible. The earlier values were, therefore, irrelevant to his retirement contemplation. This asymmetry was resolved by forming an unbalanced panel for the final probit model. Henceforth, it was necessary to intentionally "truncate the sample".

Sampling selectivity, comparable to the "intentional truncation" in this study, can be divided into two categories - ignorable and non-ignorable. A selection mechanism is ignorable if, and only if, the selection rule can be ignored without affecting the consistency of the estimators. In other words, conditioning on the selection mechanism does not affect the outcome. This can be expressed as follows:

$$f(y,x|\theta)=f(y,x|r;\theta), \tag{32}$$

where f(.) is the density function, y and x the variables of interest, $\theta$ the parameter vector and r an indicator variable. The indicator variable takes a value of 1 when both y and x are observed, and 0, if only one of them is observed.

To illustrate ignorability in the unbalanced panel probit model of this study, it is useful to view the truncated random probit model as follows:

$$
\begin{aligned}
y^*_{it} &= x'_{it}\beta + u_{it} && (33)\\
u_{it} &= \mu_i + v_{it} \\
r^*_{it} &= \text{age} && (34)\\
r_{it} &= 1 \text{ if } r^*_{it} \geq 55 && (35)\\
r_{it} &= 0 \text{ otherwise}
\end{aligned}
$$

The first two lines, the equation 33, give the model for the random probit (assuming that the errors are normally distributed). The equation 34 gives the function for the conditioning variable. The last two lines (the equation 35) give the conditioning indicator, taking into a consideration the indicator function. The value for the period t, for an individual i, is taken into account only if the conditioning function gives a value higher or equal to 55. As it is obvious, the conditioning function (the equation 34) is fully deterministic because there is nothing random about the age. The basic condition for the ignorability of the selection mechanism in estimating $\beta$, states that the stochasticity in the selection mechanism needs to be independent from the stochasticity in the final probit model. As there is no stochasticity in age, this condition is clearly full-filled[96].

[96]See Verbeek and Nijman (1996) for the theory on attrition in survey data.

## 7.2 Industrial Sectors - Coefficients of the Wage Forecasting Equation

Table 17 gives the coefficients for the industrial sector dummies in the specification (3) of the table 7 in the main text. The first column gives the short-run, and the second, the long-run, coefficients.

Asplund (1993) analyses inter-industrial wage differences extensively. As her classification categories and the reference group differ somewhat, accurate comparison with my study is difficult. Industrial classification in my study was dictated by the need to follow the classification of the macro-model used by the Ministry of Finance (Kessu). The reference group, in turn, was chosen to be the industrial sector with most of the individuals.

Sectors with the lowest wage estimates in Asplund's (1993) study (see page 237, figure 1) consisted of textile industries, furniture, sanitary services, retail trade, personal services, food manufacturing, wood products and restaurants. Out of the categories that can be compared to those in my study, the results for the textiles and food manufacturing seem consistent. My study combines both the retail and the wholesale trade (former being a high wage, and the latter, a low wage, industry in Asplund's study). My estimates for the wage coefficients for the restaurants and wood products seem somewhat contradictory to Asplund's study. The coefficient for the restaurants, however, can be explained by the fact that I hold services as a reference group, and some services in Asplund's study seem to attract very low wages. Moreover, when Asplund adds other controls to her estimations, the wages in restaurants etc. seem to get higher estimates. The difference in the wood and wood products coefficients is more alarming. Asplund notes (see page 264, footnote 9) that she has not aggregated the wood products and manufacturing of furniture and fixtures because of the difference in the nature of these industries. As the productivity measures of these two sectors could not be obtained separately for my data, these needed to be aggregated. The percentage of individuals in this industrial sector in my data is less than two. Henceforth, a more accurate classification seemed unnecessary for the purpose of the wage forecasting.

The sectors with the highest wage levels, according to the Asplund's study, are other manufacturing, insurance, printing, basic metal, paper, financing and wholesale. The paper and financing industry coefficients seem to indicate

| *Industrial Sector (ref: services)* | *Coef (SE)* | *Coef (SE)* |
|---|---|---|
| | SR | LR |
| agriculture | -.134 (.018) | -.309 |
| forestry and logging | .009 (.015) | .021 |
| food, beverage and tobacco | -.031 (.072) | -.072 |
| textiles manufacture, wearing apparel, leather g's, footwear | -.111 (.030) | -.256 |
| wood and wood products manuf. | .198 (.027) | .457 |
| pulp, paper and paper products | .094 (.031) | .217 |
| publishing and printing | .019 (.034) | .044 |
| chemicals and chemical products | .112 (.088) | .259 |
| petroleum, coal and nuclear fuel and rubber and plastic | .020 (.031) | .046 |
| glass, clay and stone products | .095 (.040) | .219 |
| basic and fabricated metal | -.047 (.023) | -.109 |
| machinery, equipment, electrical products and instruments | .004 (.023) | .009 |
| transport equipment | .066 (.034) | .152 |
| energy and water supply | -.031 (.020) | -.072 |
| construction | .001 (.026) | .002 |
| wholesale and retail trade | -.016 (.008) | -.037 |
| hotels and restaurants | .036 (.023) | .083 |
| transport and communication | -.003 (.022) | -.007 |
| finance and insurance | .028 (.009) | .065 |
| F (k, df) on joint significance | 11.1 (18, 3567) | |

Table 17: Industrial Sector Coefficients for the Wage Forecasting (Dependent variable: Log Wage Growth) Equations

Notes: Rest of the variables are given in table 7, model 3.

high wages in these sectors also in my study. High wages in the paper and financing industries are also confirmed by Kyyrä (1997).

## 7.3 Pooled Cross-Section Probit Model for the Option Value Variable Only

Table 18 gives the pooled cross-section estimates for the basic model containing the option value variable only as an explanatory variable. The results in the table are given for the different assumption structures.

| | k value | $\gamma$ value | $\beta$ value | Likel. Val. | OV Coeff. (s.e.) | Marginal Effect | Mean OV |
|---|---|---|---|---|---|---|---|
| (1) | k=1 | $\gamma$=1 | $\beta$=0.98 | -953.67 | -1.111 (.02) | -.210 (.045) | .038 |
| (2) | k=1.1 | $\gamma$=1 | $\beta$=0.98 | -958.22 | -.820 (.22) | -.156 (.042) | .018 |
| (3) | k=1.5 | $\gamma$=1 | $\beta$=0.98 | -962.84 | -.386 (.18) | -.074 (.034) | -.038 |
| (4) | k=2 | $\gamma$=1 | $\beta$=0.98 | -963.61 | -.249 (.13) | -.048 (.026) | -.094 |
| (5) | k=1 | $\gamma$=0.6 | $\beta$=0.98 | -962.09 | -63.83 (26.27) | -12.23 (5.02) | .00005 |
| (6) | k=1 | $\gamma$=0.75 | $\beta$=0.98 | -959.29 | -15.21 (4.59) | -2.901 (.869) | .001 |
| (7) | k=1 | $\gamma$=0.9 | $\beta$=0.98 | -956.05 | -3.231 (.78) | -.613 (.147) | .009 |
| (8) | k=1 | $\gamma$=0.75 | $\beta$=0.97 | -963.03 | -9.704 (4.64) | -1.863 (.889) | .0005 |

Table 18: Pooled Cross-Section Probit Model for the Option Value Only (The Dependent Variable: Probability to Retire)

Notes: The regression includes also a constant. Standard errors were corrected for heteroscedasticity.

As it is noted, the marginal effects are higher than those for the random effects (panel) probit model in the table 13. This is mainly due to the difference in the number of included variables. Comparable pooled cross-section estimates (same explanatory variables as in the table 13) yielded coefficients that are close to the random effects panel estimates. The panel structure (and the ability to control for the unobserved heterogeneity) yields a bit lesser role to the option value variable. The differences in the marginal effects, however, are only marginal, and the option value coefficients are statistically significant in all of the model specifications.

## 7.4 Random Effects Probit for the Private Sector

Potential pension liabilities of an aged employee are structured differently for big and small private sector firms. For the unemployment pension, firms with less than 50 employees, are liable for the funded part of the unemployment pensions (0.7 per cent of wages in 1996). Firms with more than 300 employees, in contrast, pay half of the awarded pensions if the employee has remained in the same firm for the minimum of five years. The liability of the medium size firms (with more than five years of employment) grows linearly with the number of employees[97].

Disability pensions, on the other hand, lead to a full liability for the big firms. "A big firm" for the disability pension liability determination, however, is 1000 employees. The disability liabilities can be very large. Small firms (under 50 employees as in the case of the unemployment liability determination) in contrast, pay a fixed amount per retired employee[98]. Liability in the medium size firms grows also linearly with the number of employees.

As the maximum liability for the big firms is 100% in the case of disability pension liabilities, and 50%, for the unemployment pensions, it is more cost-effective for the big firms to lay the aged workers off, rather than let them retire directly. Both coefficients for a dummy on employment in a firm with more than 300 employees and a dummy on employment in a firm with more than 1,000 employees attracted a negative,even if statistically insignificant, sign, giving some indication of a possibly smaller probability to retire from a big firm.

The per employee pension liability for the small firms has favoured the disability pension. Table 19 reports the results which include an explanatory dummy variable on small firm employees, setting the limit on 50. Statistically significant, positive coefficients, however, could be obtained for dummies where the limit is set higher (up until 265). Switch from the firm point of view in the cost-effectiveness between disability and unemployment routes falls somewhere in the medium sized employer area. As this limit can be somewhat data-specific, only the results with a dummy on less than 50 employees are reported.

[97] Lundqvist, 1996.

[98] Sosiaalimenotoimikunnan mietintö, 1994.

| Regressor | Coef (s.e.) | Marginal Effect |
|---|---|---|
| | (13) | (13) |
| Option value | -1.060 (.315) | -0.702 (.204) |
| Age | 0.124 (.044) | 0.010 (.003) |
| Health | 1.060 (.251) | 0.081 (.032) |
| Unemployed prev year (ref: not unempl) | 0.517 (.216) | 0.040 (.023) |
| Firm <50 employees (ref: not) | 0.429 (.246) | 0.033 (.015) |
| Yearly dummies | | |
| d90 | -0.529 (.266) | -0.004 (.019) |
| d91 | 0.382 (.209) | 0.003 (.017) |
| d92 | 0.403 (.159) | 0.003 (.013) |
| Constant | -9.167 (2.78) | |
| Rho | 0.138 (.305) | |
| (const error var/total var) | | |
| Groups (Obs) | 514 (1,384) | 514 (1,384) |
| LR Chi2 | 2.59 (1) | |

Table 19: Random Effects Probit for the Private Sector Employees

Despite the significance of the coefficient indicating labour demand effects on the retirement probability, the option value variable retains a significant negative coefficient, indicating also the importance of the incentives for the labour supply.

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