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89
VATT-RESEARCH REPORTS

Tuulia Hakola

ECONOMIC INCENTIVES AND LABOUR MARKET TRANSITIONS OF THE AGED FINNISH WORKFORCE

Valtion taloudellinen tutkimuskeskus
Government Institute for Economic Research
Helsinki 2002

ISBN 951-561-406-6

ISSN 0788-5008

Valtion taloudellinen tutkimuskeskus

Government Institute for Economic Research

Hämeentie 3, 00530 Helsinki, Finland

Email: tuulia.hakola@vatt.fi, tuulia_hakola@hotmail.com

Oy Nord Print Ab

Helsinki, June 2002

HAKOLA, TUULIA: ECONOMIC INCENTIVES AND LABOUR MARKET TRANSITIONS OF THE AGED FINNISH WORKFORCE (Taloudelliset kannustimet ja ikääntyneiden työmarkkinasiirtymät Suomessa). Helsinki, VATT, Valtion taloudellinen tutkimuskeskus, Government Institute for Economic Research, 2002 (B, ISSN 0788-5008, No 89) ISBN 951-561-406-6.

ABSTRACT: This PhD thesis is a collection of studies on retirement in Finland. The main purpose is to assess labour market transitions of the aged and focus on the effect of the economic incentives. All of the studies are empirical and use large micro panels.

The first study describes the main features of the pension system, and tests whether economic incentives have an effect on how long individuals stay at work. The second study takes a deeper focus on disability and unemployment, and analyses the effect of the disability application rejections. The third study assesses part-time retirements. Financial incentives for full-time work, part-time pension and full-time pension are compared, and estimates are provided for the most likely labour market choice in case the part-time pension is not available. The fourth study considers the effect of the incentives to the firm to displace their elderly workers.

Keywords: Early retirement, disability pensions, disability applications, unemployment, part-time pensions

TIIVISTELMÄ: Väitöskirjassa on koottu yhteen Suomen eläkkeelle siirtymistä käsitteleviä tutkimuksia. Tutkimusten tavoitteena on analysoida ikääntyneiden työmarkkinasiirtymiä. Pääasiassa tutkimuksissa pyritään keskittymään taloudellisten kannustimien vaikutuksiin. Kaikki tutkimukset ovat luonteeltaan empiirisiä, ja niissä käytetään laajoja suomalaisia mikroaineistoja.

Ensimmäinen tutkimuksista kuvailee suomalaisen eläkejärjestelmän pääpiirteitä, ja testaa, onko kannustimilla vaikutusta siihen, kuinka kauan ihmiset jatkavat töissä. Toinen tutkimus keskittyy työkyvyttömyyteen ja työttömyyteen. Tutkimuksessa arvioidaan myös työkyvyttömyyseläkehylkäysten vaikutuksia. Kolmannessa tutkimuksessa arvioidaan sitä, mitä sama henkilö olisi ansainnut täyspäivätyössä, osa-aikaeläkkeellä ja täyspäiväisellä eläkkeellä. Lisäksi tutkimuksessa ennustetaan osa-aikaeläkkeen todennäköisintä vaihtoehtoa nykyisille osa-aikaeläkeläisille. Neljännessä tutkimuksessa arvioidaan työn-antajien kannustimia ajaa työntekijöitä varhaiseläkkeelle.

Avainsanat: Varhaiseläkkeet, taloudelliset kannustimet, työkyvyttömyyseläkkeet, työttömyyseläkkeet, osa-aikaeläkkeet

Foreword

The Finnish Pension Reform Group has just finished its work. The group suggested a number of comprehensive reforms to the Finnish early retirement system in order to reduce the number of early retirements. These reform suggestions have been and will be turned into pension laws this year. The main intention of the reforms is to support the government's goal to increase the retirement age in Finland. Comparatively low retirement age has generated worries on how the pension system will weather the financial pressures of the ageing population.

In order to change the retirement behaviour, policy makers can either change work incentives or eligibility conditions for different retirement schemes. We have, however, so far very little information on how different types of policy measures affect retirement. This assessment can only be properly done by empirical research. Therefore, this thesis is more than well timed. I hope that it will be followed by increased research interest in this field.

The Government Institute for Economic Research (VATT) has in recent years attempted to increase its know-how in microeconometric research. Our strategy has been to provide young researchers with good research facilities while working on their PhD and Licentiate thesis. We believe that this will both improve the quality of our research, as well as provide young post-graduates an opportunity to put their research effort into a meaningful use. We are proud of the results. This thesis provides an excellent example by combining a highly policy relevant research questions with an approach that is worthy of an academic merit.

Helsinki, May 2002

Reino Hjerppe

Acknowledgments

A PhD thesis is a long journey into the unknown. In order to ease the way, it is crucial to have a good topic. I have been extremely lucky to enjoy my topic from the beginning to the end. I therefore wish to thank Erkki Koskela and Pasi Holm who turned me to study this particular topic. My initial interest in the pension system and savings was more timely focused on retirement.

Throughout the thesis, the Government Institute for Economic Research (VATT) provided great infrastructure. Empirical researcher ceases to be useful without appropriate computing facilities and data sets. In VATT, the computing facilities and data sets are of a standard that can match any research institute. Yet finding the balance between the short-run demands of a research institute and finishing an academic piece of research is surprisingly difficult. I was very lucky to work with Seija Ilmakunnas who understood the value and demands of microeconometric research. Because of her, I was able to work at VATT while finishing my thesis.

There are a number of senior academics who have had a positive influence on my thesis. Maarten Lindeboom provided encouragement from the very beginning. Bob Haveman gave me his support and introduced me to Peter Gottschalk in Boston. As I told Peter a number of times, I should have taken his econometrics course at the beginning of my studies, not at the end. Nevertheless, his influence is visible particularly in the third study of this thesis, and his comments on a preliminary version of the fourth study were also rather influential. Markus Jäntti and Erkki Koskela examined the whole manuscript and provided a number of suggestions which undoubtedly improved this thesis. Roope Uusitalo's views have been highly influential. I've learnt a great deal from him on how empirical research should be conducted.

I wish to thank Yrjö Jahnsson foundation and the Ministry of Social Affairs and Health for financing parts of this thesis. The third study was written as a part of the ageing project by the Academy of Finland. Finally, I am grateful to Boston University for hosting me in the fall of 2000.

On a more personal note, I want to thank Kiisa, Roope, my parents and other family and friends. My parents have backed me up in all of my ventures around the world. Kiisa and Roope taught me that I don't have to go anywhere to find my dreams. I have already found them.

Uppsala, May 2002

Tuulia Hakola

Yhteenveto

Suomen eläkejärjestelmä perustuu laajalti jakojärjestelmään. Sen mukaan työssä käyvät maksavat jo eläkkeelle jääneiden eläkkeet. Jos työssä käyvien ja eläkeläisten lukumäärien suhde muuttuu merkittävästi, eläkkeiden rahoitus vaikeutuu. Siksi eläkkeelle siirtymisen ajankohdalla (tai keskimääräisellä eläkkeelle siirtymisiällä) on suuri merkitys.

Eläkkeelle siirtymiseen vaikuttavat sekä taloudelliset että muut seikat. Tässä väitöskirjassa keskitytään taloudellisiin kannustimiin siirtyä eläkkeelle. Väitöskirjassa muodostetaan taloudellisia kannustimia suomalaiselle väestölle käyttäen laajoja paneeliaineistoja. Väitöskirjan tavoitteena on arvioida, paljonko kannustimet vaikuttavat eläkkeelle siirtymisen todennäköisyyteen. Väitöskirja jakautuu neljään erilliseen tutkimukseen ja esittelykappaleeseen.

Ensimmäisessä tutkimuksessa eläkkeet jaetaan työkyvyttömyyseläkkeeseen, työttömyyseläkkeeseen ja vanhuuseläkkeeseen. Korkeampi korvaussuhde kohottaa eläkkeelle siirtymisen todennäköisyyttä. Vaikutus ei kuitenkaan ole yksiselitteisen lineaarinen. Korvaussuhteen kasvu kymmenellä prosentilla kasvattaa eläkkeelle siirtymisen todennäköisyyttä selvimmin korkeiden korvaussuhteiden kohdalla. Useiden korvaussuhteiden kohdalla sen sijaan vaikutusta eläkkeelle siirtymisen todennäköisyyteen ei ollut. Selkeimmin korvaussuhde korottaa työttömyyseläkkeelle siirtymisen todennäköisyyttä. Vastaavasti riippuvuussuhdetta ei havaittu todennäköisyydessä siirtyä vanhuuseläkkeelle.

Toisessa tutkimuksessa paneudutaan tarkemmin työkyvyttömyyden ja työttömyyden kautta eläkkeelle siirtymiseen. Tutkimuksessa käsitellään myös työkyvyttömyyseläkehylkäyksiä. Tutkimuksessa testataan erilaisten elinkaaritulokäsitteeseen perustuvien kannustimien vaikutuksia eläkkeelle siirtymisen todennäköisyyteen. Aikavaihteluun nojautuvat tulokäsitteet osoittavat, että taloudellisilla kannustimilla on selkeä vaikutus eläkkeelle siirtymisen ajankohtaan. Muut tulokset ovat kuitenkin kertoimiltaan ristiriitaisia.

Kolmannessa tutkimuksessa käsitellään osa-aikaeläkkeitä. Siinä arvioidaan taloudellista korvausta henkilölle, jos hän on kokoaikatyössä, osa-aikaeläkkeellä tai täydellä eläkkeellä. Tulosten mukaan osa-aikaeläke on ollut rahallisesti paras vaihtoehto niille, jotka ovat osa-aikaeläkkeellä. Vastaavasti sekä kokoaikatyössä olevat että kokoaikaeläkkeellä olevat olisivat pärjänneet osa-aikaeläkeläisiä keskimäärin suhteessa paremmin, jos he olisivat myös siirtyneet osa-aikaeläkkeelle. Osa-aikaeläkkeen suosion vähyys on siis taloudellisten kannustimien valossa yllättävää. Tutkimuksessa arvioidaan lisäksi, että noin puolet osa-aikaeläkeläisistä olisi valinnut täyden eläkkeen, jos heillä ei olisi ollut osa-aikaeläkevaihtoehtoa.

Neljännessä tutkimuksessa otetaan huomioon myös työnantajiin kohdistuvat kannustimet. Tutkimuksessa käytetään yhdistettyä työnantaja-työntekijä –paneelia testaamaan mallia, jossa työntekijät ja työnantajat sopivat muun muassa irtisanomisehdoista. Tulosten mukaan yhteiskannustimilla (sekä työnantajan että työntekijän) on eniten väliä, silloin kun taloudellinen tilanne on yrityksessä vaikein. Irtisanomiset kohdistetaan silloin selvimmin työntekijöihin, joiden taloudellinen tilanne on työttömyys- ja eläketurvan myötä parhaiten turvattu. Tutkimuksessa näytetään myös, että firmojen eläkevastuilla on kuitenkin vaikutusta yritysten irtisanomiskäyttäytymiseen. Mitä suu-remmat ovat firmojen eläkevastuut, ja vastaavasti mitä vähemmän yhteiskunta vastaa eläkkeistä, sitä haluttomampia ovat firmat siirtämään työntekijöitään ennenaikaiselle eläkkeelle.

Contents

[1] Joint work with Maarten Lindeboom.

[2] Joint work with Roope Uusitalo

1 Introduction

The average retirement age in Finland is around sixty years, even if the official old-age retirement age is sixty-five. About a fifth of the fifty-five year olds received a pension at the end of 1999[3], and only thirteen per cent of the aged work force worked until the official old age retirement.[4] Adding up the unemployed and the unemployment pensioners, unemployment was most prevalent in the age group of sixty to sixty-four -year-olds.[5] Employment rates of the sixty to sixty-four -year-olds fell from forty-six per cent in 1970 to about twenty-three per cent in 2000.

These facts show that the aged labour force exits from the labour market relatively early. At the same time, the population is ageing because people are living longer, fewer babies are being born and, most acutely, the baby-boom cohorts of the late 1940s are approaching retirement age. Most pension systems are designed so that the working cohorts pay the pensions of the retired. If the ratio of pensioners to workers increases markedly, the financing of the current pension system can become problematic. Therefore, there is an increased interest in how to keep the ratio of retirees to the workers as low as possible by extending the work life of the aged.

The extension of the work life of the aged requires an increase in the average retirement age. This raises questions on what determines the timing of retirement. If the government wishes to change the average retirement age, the main pension policy focus is on the economic incentives and eligibility restrictions. We are interested in how much an increase in incentives to stay at work or an additional eligiblity restriction delays retirement decisions. The incentives to stay at work can be changed by numerous different policy changes. We would like to know which of these incentive changes are the most effective.

Defining and measuring an economic incentive is not straightforward. Even as a theoretical abstraction, there is no single measure of the economic incentives. We do not know whether people who approach their age of retirement consider their financial situation through their potential wages and their potential pension benefits when they before and after retirement. They could also be comparing the two. Theoretically, the most convincing measure of the eco-

[3] Statistical Yearbook of Pensioners in Finland, Central Pension Security Institute and Social Insurance Institution, 2000.
[4] Statistic Finland, Labour Force Survey, 2000.
[5] Lilja (1999).

nomic incentives is defined over the life-cycle. If we are willing to accept the life-cycle view for consumption and leisure, the economic incentive can be defined by expected streams of wages and benefits until the end of the expected lifetime. Empirical estimations of the life-cycle incentives are highly complicated. It is necessary to make a number of assumptions on the formation of the expectations, and use a variety of techniques to forecast the expected streams of wages and benefits. Moreover, often there are additional complications due to the data. A number of key variables can be completely missing or poorly measured. Empirical approximation of the incentives and their effects on the labour market transitions is therefore a rather tedious task.

This thesis undertakes the task of constructing a set of empirical economic incentive measures for Finnish early retirees. The thesis analyses all the major retirement channels and a number of economic incentives in the four essays that follow this introductory chapter. The first essay deals with old-age retirement, disability retirement and retirement due to the unemployment. The second essay more closely inspects early retirements due to the disability and the unemployment. The third essay deals with partial retirement, and the fourth essay also takes the firm incentives into account. The study uses large micro data panels on the Finnish labour force. These data have not been used before to study the timing of retirement.

Before the essays, this introductory chapter is continued with a few more sections as a background for the thesis. First, in order to get a better grasp of why the timing of retirement matters for the financing of the pension system, there is a short description of the interaction of the pension system and the labour markets. This section also reviews some trends of the age structure in Finland. In the second section, I sketch a theoretical framework that underlies most of the empirical estimations and incentive definitions of this thesis. The models are presented as a way to structure the research questions. They are therefore rather basic. Retirement and disability literature is reviewed in the third section. This section also contains a summary of the findings of this thesis. As the main contribution of this thesis is empirical and the data sets mainly come from the same source register, the fourth section discusses this data source more in depth. It is concluded that even if the data are the best that are currently available for the analysis of retirement in Finland, and even if the usefulness of the data for this type of analysis was further enhanced by extra register mergers, there are still a number of problems with these data. Pointing out these data problems, I will also give some examples on what can be done to mitigate these problems. Finally, as the retirement literature and the pension system descriptions are cluttered with a highly specialized vocabulary, I attach a key to the most common pension and labour market terminology to the end of this chapter.

1.1 The Pension System and the Labour Markets

The pension system has an effect on the labour markets. The primary function of the pension system is to enable a financially secure withdrawal from the labour market at the end of the career. The labour supply of the older workers is therefore naturally affected. Social security (pension) contributions can provide work disincentives, because they are the main payroll tax imposed on labour.

The effects of the pension system on the labour supply of the elderly are not necessarily limited to those individuals who have reached the official retirement age (65 in most countries). Early retirement schemes provide an opportunity to retire before obtaining the pension benefits for the old-age. These "windows of withdrawal" generally give individuals an opportunity to retire in an approximately ten-year period prior to the official retirement age. These early retirement schemes have led to a continuous and dramatic fall in the labour force participation rates of the fifty-five to sixty-four -year-olds in the past thirty years. Some pension systems do not appropriately reward, or even penalize for retirement at a later age. Early retirements are therefore sometimes implicitly encouraged by the pension systems (Gruber and Wise, 1999).

Early retirement increases individual welfare. Yet as early retirement feeds into an increase in the social security expenditure and a decrease in the tax revenues, early retirement can be undesirable for the society as a whole. Most public pension schemes function primarily on a Pay-As-You-Go (PAYG) principle. In a PAYG pension system, the current working population pays the pension benefits of the already retired population. The PAYG pension system can be described concisely by a simple formula (equation 1).

$$\begin{aligned} & [\#\ in\ the\ labour\ force] \times [average\ wage] \times [ss\ contrib\ rate] \\ = \ & [\#\ of\ retirees] \times [benefit\ per\ retiree] \end{aligned} \tag{1}$$

Because there is no saving or borrowing, the pension system must collect what it distributes.[6] Revenues are collected from the population that currently works. Hence, the amount that can be collected depends on the number of individuals in the labour force, the salaries that they earn, and the social security contributions that they pay. In contrast, the amount of benefits depends on the number of retirees, and the level of benefits that they receive.

PAYG pension systems face demographic and labour market related risks. Re-organizing equation 1, we get equation 2:

$$ss\ contrib\ rate = [dependency\ ratio] \times [replacement\ rate]. \qquad (2)$$

The rate of the social security contribution (tax rate) depends on the old-age dependency ratio of the population and the replacement rate. The old-age dependency ratio gives the number of retirees per worker, and the replacement rate, the level of benefits per wage.

Most pension systems 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 can be a function of the individuals' years of work, but otherwise they are detached from the amount of contributions that are paid into the system.[7] The DB scheme introduces inflexibility into the replacement rate in equation 2. The replacement rate is then fixed by pre-specified rules that do not account for any change in the circumstances. Consequently, in a DB scheme, if there is a shock to the dependency ratio, the social security contributions have to increase (equation 2).

Most OECD countries - Finland being no exception - have an ageing population. Compared with the situation of fifty years ago, Finnish men and women live fifteen years longer. 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.[8] Even with a shorter time horizon, the structure of the age pyramid is undergoing a considerable change. Fertility has been below the replacement rates for quite some time already. The largest age cohorts were born in 1947 and 1948, whereas the

[6] In an alternative, Fully Funded (FF) pension system, each generation saves for its own pensions in pension funds. These funds are then invested - often in the capital markets.

It is also possible to have a combination of the two systems. For example, currently about one fourth of the pension funds in Finland is funded.

[7] In the alternative, Defined Contribution (DC) scheme, the pension promises are not tied to the benefit levels. Instead, they are tied to the contributions (or the investment yields of these contributions).

[8] Statistics Finland, Population Statistics, 1998.

smallest cohort was born in 1973.[9]

As is shown in Figure 1, the dependency ratio in Finland is expected to rise in the future. The old-age dependency ratio contrasts those above the official old age retirement age (65) to those at the working age (18-64). The dependency ratio includes also the early retirees, children and unemployed into the dependents, which are then compared to the working age population. Both ratios are projected to rise rather steeply from 2010 to 2030.

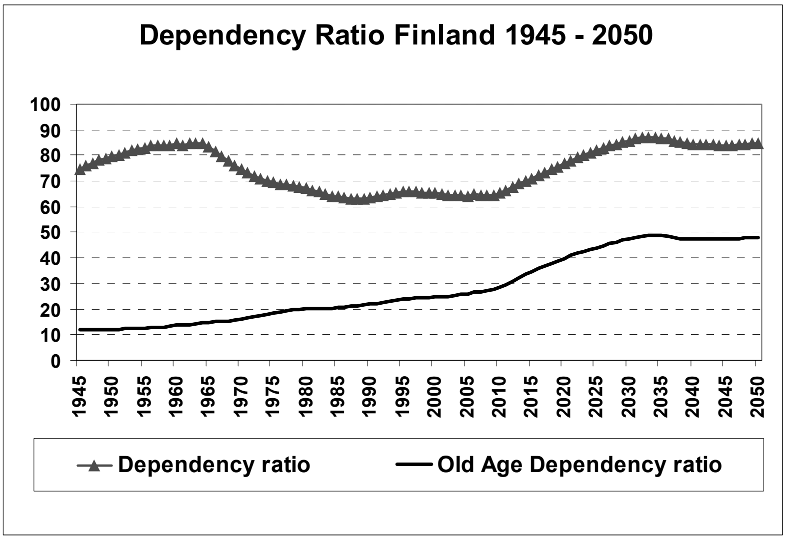

Figure 1: Dependency Ratio and Old-Age Dependency Ratio in Finland (sources: 1945-1999 Statistics Finland and 2000- Eurostat Population Projections Revision 2000)

Lassila and Valkonen (1999) estimate that, if no other parameters were to change in the Finnish pension system, the social security contributions would need to rise from twenty-one per cent in 2000 to forty per cent by 2030. This would be a huge increase in the payroll tax, that is rather high to start with. Hence, it would be preferable to change either the dependency ratio or the replacement rate or both.

The dependency ratio could be reduced, for example, by increasing the average retirement age. Klaavo et al. (1999) estimate that if the average retirement age in Finland could be raised by three years, pressures to increase the social

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

security contributions would greatly be alleviated.[10] They estimate that the required increase in the social security contributions would be about four percentage points lower by 2050 than without this delay in retirements. Lassila and Valkonen (1999) obtain similar results. According to their overlapping generations model, one year's increase in the average retirement age would reduce the need to increase the social security payments by one and a half to two percentage points. Regardless of the exact estimates, both studies show that the pressures on the pension systems could be quite considerably alleviated if the average retirement age could be increased.

1.2 Utility Maximization and Economic Incentives

As we will see in the following section, there is a large body of empirical literature that examines the effect of economic incentives on retirement decisions. This literature builds on the assumption of a utility maximising consumer. Structural retirement models (e.g. the dynamic programming model of Rust and Phelan, 1997, and the option value model of Stock and Wise, 1990) even try to estimate the structural parameters of the utility function by fitting data to a theoretical model. This thesis, however, follows a reduced form approach. I therefore merely test some implications that follow from the assumption of a utility maximising consumer.

This section sketches how the assumption of a utility maximising consumer maps into empirically testable discrete choice models. The best way to do this "mapping" is to follow the Random Utility Maximization (RUM) model. This was demonstrated by McFadden (1973). Following the description of the RUM, I will also discuss the Life-Cycle view for the utility maximization. The Life-Cycle model can complement the RUM model. The Life-Cycle model merely affects the way the utility is defined. The utility levels of the RUM could well be defined over the life-cycle.

1.2.1 Random Utility Maximization

McFadden (1973) showed that discrete choices that are made by economic agents are best explained by a probabilistic theory of choice. If we observe that a certain choice was made, it must have maximized the utility of the individual.

[10] Klaavo et al. (1999) state that raising the average retirement age by three years is very hard (and actually unlikely). The change, however, is simulated to demonstrate the impact of the current government policy goal.

The probability of making a certain choice is therefore a function of the utility levels attributed to the available choices.

McFadden (1973) defines individual behaviour rules as the mapping of individual specific properties and choice specific attributes into a discrete choice alternative. There might be a set of different behaviour rules in a population, and all of them maximize some utility function. These utility functions need not be the same for different individuals. We might observe that some individuals with the same properties and the same set of choice alternatives make different choices. This could be due to the properties that we do not observe. (These can be either individual specific properties or attributes of the choice alternative.) Assuming that these unobservables are distributed randomly within a population, we have to rely on the Random Utility Maximization (RUM).

Assuming that the utility of an individual who chooses a specific alternative depends on observable and unobservable individual characteristics and choice attributes, we can present the total utility as follows:

$$U_{ij} = V_{ij} + \varepsilon_{ij}. \tag{3}$$

U is the total utility, V is the observable component (that depends on the observed individual characteristics and choice attributes) and ε is the random utility component (that is, it is not observed.) $i = 1, ..., N$ indexes the individual, and $j = 1, ..., J$ the choice alternatives.

If $U_{i,ret}$ were the utility of retirement to an individual i, then $V_{i,ret}$ could be, for example, a function of the health status and the pension benefit of the individual i. ε_{ij} could measure, for example, the work motivation (or any other explanatory variable that is not, or cannot be, measured.)

Retirement could also consist of three choices: say, full-time work, part-time work and full-time retirement. In a binomial setting (retire or work), we would have two equations corresponding to the two choices. In a trinomial setting, we would have three equations. These are given in equations 4-6.

$$U_{i,fret} = V_{i,fret} + \varepsilon_{i,fret} \tag{4}$$

$$U_{i,pret} = V_{i,pret} + \varepsilon_{i,pret} \tag{5}$$

$$U_{i,work} = V_{i,work} + \varepsilon_{i,work} \tag{6}$$

Here, $U_{i,fret}$ is the total utility of the full-time retirement to an individual i. $V_{i,fret}$ is a function of the full-time pension benefit, whereas $V_{i,pret}$ could be a function of the total financial compensation when the individual is partially retired. $V_{i,work}$ would then be a function of the salary. $\varepsilon_{i,fret}$, $\varepsilon_{i,pret}$ and $\varepsilon_{i,work}$ could measure, for example, the flexibility of the work hours (if these are not observed), and their effect on the total utility of an individual.

Total utility is not observable because of the unobserved random utility component. Yet the observation that an individual has chosen a specific alternative gives information on the ordering of the utilities of the different alternatives. For example, if we observe that an individual has retired, we conclude that the utility of retirement was greater than the utility of work (or the utility of the part-time work in the three-option setting). The probability of retiring is, therefore, equal to the probability that the utility of retirement is greater than the utility of work. This is given below (individual indicators are omitted to avoid the clutter):

$$\Pr(j = ret) = \Pr(U_{retirement} > U_{work}) \tag{7}$$

If I insert equation 3 into equation 7, and re-arrange the terms, I can reformulate the probability of retirement as follows:

$$\begin{aligned} \Pr(j &= ret) = \Pr(V_{ret} + \varepsilon_{ret} > V_{work} + \varepsilon_{work}) \\ &= \Pr(\varepsilon_{work} < \varepsilon_{ret} + V_{ret} - V_{work}) \end{aligned} \tag{8}$$

If ε_{ret} and ε_{work} are identically and independently distributed, I can write equation 9, and integrate over the error terms.

$$\Pr(j = ret) = \int_{-\infty}^{+\infty} \{F(\varepsilon_{ret} + V_{ret} - V_{work}) \times f_{ret}\} d\varepsilon_{ret}, \tag{9}$$

where $F(.)$ is the cumulative distribution function, and f_{ret} is the probability density function of the random utility components for retirement.

If there are several alternatives (full-time retirement, part-time retirement and full-time work), there are as many inequalities (equation 8), and correspondingly more unobservables. Hence, the three-option version of equation 9 is:

$$\Pr(j = fret) = \int_{-\infty}^{+\infty} \{F(\varepsilon_{fret}+V_{fret}-V_{work})\times F(\varepsilon_{fret}+V_{fret}-V_{pret})\times f_{fret}\} d\varepsilon_{fret}, \tag{10}$$

In his seminal work, McFadden (1973) showed that if the random components (ε_j) have a joint generalized extreme value distribution and the random utility maximisation assumptions[11] are met, the model can be resolved by a closed-form multinomial logit model. McFadden's empirical application in 1973 was on shopping travel behaviour. Yet the same model applies equally well to the retirement choice (or the choice among several retirement alternatives).

1.2.2 Life-Cycle Model

In the Life-Cycle (LC) view to the utility maximization each individual maximises his expected lifetime utility. I showed above that according to the Random Utility Maximization (RUM) each individual chooses the alternative that maximises his total utility. This utility might well be his expected lifetime utility.

The utility in the Life-Cycle model consists of consumption and leisure. Empirical studies on retirement proxy consumption by income, because it is hard to find reliable consumption data.[12] Leisure, in contrast, is taken into the account over the whole life cycle by the choice of the retirement period. Structural models (e.g. Stock and Wise, 1990) approximate the leisure implications by a parameter that compares the utility of wage income to the utility of income received as a pension. Preferences for leisure can differ between different "types" of individuals. Therefore, the empirical tests control for a number of observable characteristics.

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

The utility function is assumed to be additively separable. Period-specific utilities are all discounted to the current period and added up to produce the

[11] The RUM assumptions are as follows: i) there is a finite set of alternatives, ii) the probability of ties is zero, and iii) the choice is determined by the utility maximisation.

[12] This naturally implies that savings behaviour cannot be taken into account. The attempts to construct a variable for consumption have generally not been successful. See, for example, Rust, 1990. It is true, however, that ignoring savings behaviour can be problematic. In particular, this can be an issue in a period of high turbulence when wide-ranging changes in economic behaviour are presumed to take place.

lifetime utility. The lifetime utility function can be expressed as follows:

$$U_t(r) = \sum_{s=t}^{r-1} \beta^{s-t} u(Y_s) + \sum_{s=r}^{T} \beta^{s-t} u[kB_s(r, Y_{r-1})]. \tag{11}$$

U_t is the total lifetime utility evaluated at the time t, $u(.)$ is the period-specific utility, t is the current period, r is the period of retirement, β is the discount factor, Y is the wage, B is the pension benefit, and k is 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 retirement.

In equation 11, the parameter k indicates the relative assessment of the type of income that an individual receives. If k is greater than one, the utility derived from a unit of income from work (hence, out of wages) is less than that while the individual is retired (hence, out of the pension benefits). This difference in the utilities is due to the difference in the preferences for leisure.

The value of the total utility in equation 11 can be estimated with a set of assumptions. These consist of the assumptions about the functional form of the period-specific utility function, about the discount factor (β), about the relative marginal utility of income (k), and about the expected end of the lifetime (T).

The most simple functional form assumption of the period-specific utility function is to equate the utility to the income ($u(Y_s) = Y_s$ and $u[kB_s] = kB_s$). In a simple case, the relative utility of income from work to income from pension equals one ($k = 1$).[13] Then it is feasible to make a fixed assumption about the value for the discount factor (β). In this thesis, the discount factor equals 1.03, as this implies a real interest rate of three per cent. Finally, we need to make assumptions about the expected end of life (T). This could either be obtained from the life-tables (by gender and age)[14], or it could simply be fixed to some age (in this thesis 90 or 65).

The measurement of the utility value is not straightforward even with the gross simplifications of the structural parameters. First, the utility value needs to be constructed for each possible retirement age. If the individual is retired, it is necessary to estimate the income that the individual would have received had he continued at work. Moreover, the potential pension benefits for those years when he was working need to be calculated. Forecasting the future income is

[13] Hakola (1999) tried to find the best value of k by comparing the likelihood values of regressions that were otherwise identical, except for the value of k. She found that the k value of one was more likely than some greater values.

[14] See Hakola, 1999

very difficult. We observe only the wages of those individuals who are at work, so the data might be selective.[15] Techniques that correct for the selectivity are generally as good as their exclusionary restrictions. The exclusionary restrictions, in turn, are notoriously hard to find. Forecasting is also often made more difficult by problems with the data. For example, measurement errors or unit roots in wages can cause difficulties.

If one is unwilling to simplify the model with fixed assumptions on the structural parameters (the discount factor (β), relative utility of the pension income to the labour income (k) and other parameters of the utility function such as the coefficient of the risk aversion), these parameters can in a reduced form model be approximated by searching for the likelihood function maximum with different values for the parameters. This, however, is a tedious task, and because of a number of implausible results (see Hakola, 1999), the usefulness of this approach is not clear.

1.3 Retirement and Disability Literature

1.3.1 Social Security and Pension Plans - Behavioural Effects on the Labour Supply in the US

In the first phase of the microeconometric work on retirement (in the 1970s), the theoretical framework was based on a simple, single period, budget-constrained utility maximization. The first econometric contributions provide some evidence that economic incentives matter in the timing of retirement. Boskin (1975) is one of the earliest econometric contributors. Boskin's results indicate that the social security causes non-linearities in the budget constraint, and these non-linearities have a clear effect on the labour supply. Other papers, for example, Boskin and Hurd (1978) and Quinn (1977), followed with similar results.

The life cycle view on retirement started to develop gradually. Quinn et al. (1990) credit Burkhauser (1979, 1980) with 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). The pension right became viewed as an asset, the 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

[15] We observe only those wages that are sufficiently above the reservation wages.

economic incentives.

Because of a multitude of pension schemes in the US, researchers faced a trade-off between more representative data sets, such as, for example, the Retirement History Study and National Longitudinal Surveys, and more accurate information with possibly less representative samples. Only in the 1990s did it become possible to merge the financial statistics to nationally representative data sets (see Samwick, 1998). Lumsdaine and Mitchell (1999) claim that changes in the private pensions have a greater effect than the social security on the labour supply. Pension schemes can also counter the reforms in the social security (Lumsdaine and Mitchell, 1999). Therefore, ignoring the private pensions in the US is considered a serious deficiency, even if the data sets which have information on the private pensions tend to be unrepresentative for the whole population.[16]

A number of researchers investigate the effect of the window plans (e.g. Lumsdaine et al 1990a and b and Ausink and Wise, 1993). Window plan is an unexpected, exogenous change in the company pension plan offering an opportunity for certain, targeted age cohorts to retire early. It is then tested whether this plan causes a distinct behavioural change for those who are affected by the plan (distinct from those who are not affected). Lumsdaine and Mitchell (1999) note that the window plans of the 1990s can be considered "natural experiments" because they were adopted by firms that, historically, had not adopted such plans. It is possible, however, that because worker expectations have changed, it is harder in 2000 to find such natural experiments in the US.

Despite the claim that pension benefits have a greater influence on labour supply than social security (Lumsdaine and Mitchell, 1999), a large number of papers focus on the effects of social security (see Quinn et al. (1990) for references). Of the recently published papers, interesting examples are those by Rust and Phelan (1997), and Coile and Gruber (2000a and b). Rust and Phelan (1997) formulate a dynamic programming model where they explain the "peaks" in the retirement behaviour by the social security and the medical insurance status. They try to accommodate for the missing information on private pensions by concentrating only on the individuals at the lower end

[16] A number of researchers (Fields and Mitchell 1984 and 1985, Mitchell and Luzadis 1988 and 1989, Lazear 1990 and Stock and Wise 1990) focus on specific pension plans in their research, attempting to determine the true value of the whole economic incentive (pensions+social security).

of the income distribution. Individuals with low income are unlikely to have substantial private pension wealth.[17] Coile and Gruber (2000a and b) present a new incentive measure that might challenge the earlier result that the impact of social security on the labour supply is small. Their peak value measure abstracts from the effect of wages and tries to concentrate solely on the effects of social security. The magnitude of the incentive impact of social security in the US is considerably higher than what has been found in the earlier studies.

Some researchers simulate the impact of the social security reforms. For example, Fields and Mitchell (1984) and Gustman and Steinmeier (1985) consider the effects of some of the following policy changes: 1) an increase in the age of the normal benefit withdrawal, 2) a change in delayed/early withdrawal regulations, 3) a delay in the cost-of-living adjustments, and 4) an across-the-board drop in the pension benefits. Both of these papers yield only modest effects for the policy changes on the labour supply. Gustman and Steinmeier (1991) point out that simulations often mistakenly focus on labour force participation rather than on the time to apply for the benefits. Moreover, the financial incentives are generally deficient because there is an insufficient amount of information on private pensions.

In the late 1980s and in the 1990s, the models on retirement started to take uncertainty and individual expectations into account. Dynamic programming models tackle uncertainty directly. This is evident, for example, in Rust (1989, 1990), Daula and Moffitt (1995), Berkovec and Stern (1991) and in the option value model of Stock and Wise (1990). Rust and Phelan (1997) model labour force participation and the application for social security as separate processes, and allow for uncertainty in mortality, health status, health expenditures, marital status, employment and income. Individuals recalculate their optimal behaviour in each time period, updating their behaviour with the new information.

Because the US does not have a pension system on partial retirement, the literature on partial retirements concentrates on defining the extent and the nature of the part-time work at an advanced age. Ruhm (1990) highlights the importance of "bridge jobs". He shows that fewer than two-fifths of heads of households retire directly from career jobs, and over a half of them retire partially at some point in their working lives. Gustman and Steinmeier (1986) and

[17] Rust and Phelan (1997) state that only 40% of Americans have a private pension plan.

Berkovec and Stern (1991) consider partial retirements as a distinct alternative to full retirement. Consequently, they have three alternative labour market states: full-time work, part-time work and retirement. Gustman and Steinmeier (1984, 1985) find that ignoring part-time retirement in retirement models can yield erroneous conclusions in the analysis of full-time retirement. Quinn et al. (1990) find it somewhat ironic that the literature has been so focused on trying to define the financial incentive of retirement that it has paid less attention to what is on the left hand side of the regressions. Hence, part-time and other less traditional forms of retirement are often ignored.

Lumsdaine and Mitchell (1999) state that the labour demand side analysis of retirements is considerably less developed than the labour supply side analysis. Nevertheless, they refer to evidence which suggests that the long-term contract model is appropriate for the demand side (echoed, for example, in Lazear, 1979, 1986 and Kotlikoff and Gokhale, 1992).[18] Lumsdaine and Mitchell point out that wages do not fall with age, even if it is not clear what happens to productivity. Companies that provide private pensions are those with higher pay, which, in turn, is likely to prevent quits (Lazear, 1979). Long-term compensations are also provided by companies where the output is harder to monitor (Hutchens, 1988 and Parsons 1988). Moreover, companies with pension plans have only half of the turnover of young workers when compared to the companies without pension plans. The former are also less likely to fire their employees (Gustman et al, 1994). Companies with an early mandatory retirement age, prior to its prohibition in the US, adopted strong financial penalties for work beyond a certain age (Mitchell and Luzadis, 1988 and Luzadis and Mitchell, 1990).

Table 1 summarizes results of some of the papers mentioned in the text. As the papers use a number of different dependent variables, these are listed in the second column. Also, the economic incentives are measured in a number of different ways, so they are listed next. The effect of the economic incentive on the independent variable is listed in the final column. Elasticity figures could not be calculated, because the papers did not report all the necessary information for the calculations. Moreover, harmonization of the results with such a range

[18] Demand for older workers can be considered either in a static world of spot markets or as an implicit contract model. In a spot market model, demand for any particular demographic group is a function of compensation paid to all age groups, capital prices and output levels (Hamermesh, 1993). Implicit contract models often compare the expected present value of compensation over work life with the expected present value of marginal product over work life.

of dependent and the independent variables was considered infeasible.

1.3.2 State Disability Schemes and Labour Force Participation in the US

Disability schemes are practically only forms of early retirement in the US. Social security benefits can be drawn early (at the age of 62), but these benefits are then reduced. Disability benefits, in contrast, are available practically at any age. Social security, pensions and disability allowances are covered by separate insurance schemes. The literature on the behavioural effects of the disability schemes is therefore treated separately from the retirement literature (see Handbook of Labor Economics 3c 1999). Bound and Burkhauser (1999) point out that because the disability schemes have redistributive and insurance goals, and because the disability benefit application can be rejected, the behavioural effect of a disability scheme is more complicated than that of social security. Redistributive and insurance goals are also present in the European disability schemes. Yet in Finland the disability pension scheme is an intrinsic part of the early retirement system. The whole pension system (including disability) is governed by the same institutions. Separation of the schemes in Finland would therefore feel artificial.

There are two national disability schemes in the US, Social Security Disability Insurance (SSDI) and Supplemental Security Income (SSI). The influence of the SSDI on the labour market participation has attracted a considerable amount of research.

Research on disability tries to estimate either the effect of the entire disability scheme or the effect of specific program parameters and screening stringency on the labour force participation. I review here only some papers that analyse the effects of the specific programme parameters. These papers generally focus on the effect of the programme parameters either on the disability applications or on the labour force participation. It is only recently that researchers have been able to take into account several stages in the disability application-award-appeal process (see Benitez-Silva et al. (1999)).

Halpern (1979) estimates that the benefit elasticity of the applications is about 0.4. She concludes that an increase in the availability of benefits is more influential for the applications than an increase in the existing benefits. Parsons (1991) estimates that the elasticity of applications with respect to the initial

Author(s) (year)	**Dependent Variable**	**Incentive Variable**	**Effect**
Boskin (1975)[s]	retirement=less than quarter-time work (quasi-retirement=less than half-time work)	SS benefits, asset income, net earnings spouse's earnings	+ + - -
Parsons (1980)[s]	labour force participation	social security benefits (DI), local welfare generosity (both normalized by wage)	- -
Gordon and Blinder (1980)[s]	retirement	social security/wage, pension coverage, wages	0 (+) 0 (<65),+(65-) -
Hurd and Boskin (1981)[s]	retirement	SS wealth, private assets, wages	+ 0 (+) 0
Fields and Mitchell (1985)	age when leaves job that was held in 1969	PV of wages, pensions and soc.sec.	+
Gustman and Steinmeier (1986)[s,str]	full-time, part-time retirement	wages, pensions and social security benefits	ndec
Haveman, Wolfe and Warlick (1988)[s]	work, early retired or disability	expected household transfer and non-transfer income	0 (+) 0 (+)
Rust (1989, 1990)[s,str]	full-time, part-time work, retirement	earnings from employment, assets, social security pay, disability and medicare pay	ndec
Stock and Wise (1990)[str]	departure from the firm	option value (wages, pension and social security)	ndec
Lumsdaine, Stock and Wise (1990)	departure from the firm	option value, income, SS PV, pension PV, SS accrual, pension accrual, total accrual	-, -, +, +, -, -, -
Berkovec and Stern (1991)[s,str]	retirement, part-time, or full-time	full-time wages	ndec
Krueger and Pischke (1992)[s]	LFP in week of survey, self-reported ret. status, # of weeks worked	log(SSW), growth of SSW	0 (+/-)
Daula and Moffit (1995)[str]	retention rate in the military	military-civilian pay differential,	+
Rust and Phelan (1997)[s,str]	soc. sec. application, labour force participation	total family income, SS and health insurance eligibility	+
Samwick (1998)[s]	retirement (job change), departure from labour force	option value, retirement wealth, retirement wealth accrual, pension coverage	- + - -
Coile and Gruber (2000a)[s]	retirement	accrual, option value, peak value	0 (+/-) - -

Table 1: Selected Summary of the Retirement Literature

Notes: s=survey data; str=structural model. SS=social security, SSW=social security wealth, PV=present value. + indicates a positive response, - a negative response, 0 no significant effect, ndec=economic incentive effect not measured directly (structural model).

award is 0.45. Bound and Burkhauser (1999) claim that this might be an overestimate. Bound and Burkhauser argue that Parsons does not sufficiently take into account lags in the application responses, the award and the appeal rates, or the possibility of changes in the applicant pool. Halpern and Hausman (1986) assess both the screening and the benefit effects. They find that a twenty per cent fall in the acceptance rate decreases applications by about four per cent (an elasticity of 0.2). Moreover, a twenty per cent increase in benefits increases applications by about twenty-six per cent (an elasticity of 1.3). Their benefit elasticity is larger and their screening elasticity is smaller than is reported in the previous studies.

The retirement literature stresses the importance of the life-cycle incentive measure of benefits. It took considerably longer for the disability literature to adopt this framework. Kreider (1999) is one of the first to adopt the life-cycle view for the disability benefits. His paper also accounts for the probability of acceptance and the self-selectivity of the sample. His estimates imply that a ten per cent increase in the benefit levels increases the application probability by seven percentage points. A ten per cent increase in the probability of acceptance increases the application probability by six percentage points. Hence, his benefit elasticity is lower than that of Halpern and Hausman (1986), but his acceptance elasticity is higher.

Parameter effects on labour force participation are estimated, for example, by Parsons (1980a,b). He finds that the elasticity of labour force participation on the SSDI replacement rate is between 0.49 and 0.93. Bound and Burkhauser (1999) point out that, if these estimates were correct, SSDI would account for the entire post-World War II decline in the US labour force participation. Parsons does not have the entire work histories of the individuals in his data set, so he has to construct potential benefits from current wages. Slade (1984), in turn, has an improved data set that has the whole work histories. When she reproduces Parsons' estimations, she gets an elasticity estimate which is still close to the upper bound of Parsons' (0.81). Bound and Burkhauser (1999) argue that both of these estimates are likely to suffer from endogeneity.

Bound (1989) shows that even if he uses only those individuals who had never applied to the SSDI, he gets elasticity estimates that are as big as those of the earlier studies. Parsons (1991) responds that Bound does not account for all disability programmes, and, therefore, his comments and estimations lack credibility.

Trying to rectify the endogeneity problem, Haveman and Wolfe (1984) instrument for the replacement rate. They impute total expected income for both work and disability using the Lee technique.[19] Bound and Burkhauser (1999) calculate that the implied elasticity estimates of non-participation in the Haveman and Wolfe paper are in the order of 0.37 to 0.6. This range is slightly lower than that estimated by Parsons.

Gruber (1996) finds a natural experiment in Canada. There was a radical benefit change in all provinces except Quebec. Using a difference-in-differences estimation, Gruber finds that the elasticity of non-participation with respect to the benefit levels is lower than that found by earlier studies. (Gruber's estimate is 0.32.) His more parameterised model yields similar results. Bound and Burkhauser (1999) note that, because Gruber uses stocks rather than flows, his model captures only the short-term effects. Long-term effects could be higher.

Gruber and Kubik (1997) use a natural experiment to evaluate the effect of screening on the labour force participation. Rejection rates for the applications on the disability programmes in the US in the 1970s increased, but these rates of increase differed substantially across states. Gruber and Kubik (1997) find that a ten per cent increase in the initial denials lowered labour force participation by 2.8 percentage points. This is quite close to the estimates obtained by Halpern and Hausman (1986).

Most papers treat the disability programme and retirement schemes separately. The only major exception is a paper by Haveman et al. (1988). They estimate a trichotomous choice model where the choices are i) working, ii) accepting public early-retirement benefits and private pensions, or iii) seeking and accepting public disability benefits.[20] Their data stem from the 1978 Survey of Disabled and Non-disabled Adults. Using simulations, they find that a big decrease in the early retirement benefits has a small effect on the number of retirees, whereas a similarly large decrease in the income supplement has a large positive effect on the number of older men choosing to work. Therefore, disabil-

[19] Haveman and Wolfe (1984) have difficulties in finding good exclusionary restrictions. They use religious preference in the labour force participation equation, and education and age spline in the wage equation. Even if religious preference might provide the identification needed for the wage equation, dropping education from the labour force participation equation or using the non-linearity of age seems less plausible.

[20] The model is a multinomial logit where expected income flow in all of the options is corrected by the Lee selection model.

ity schemes have a greater effect than retirement schemes on the labour supply of older men.

Early disability studies used either aggregate time-series or cross-section data. Studies using time series cannot control, for example, for changes in the applicant pool. Cross-sectional estimations, in turn, tend to suffer from identification and endogeneity problems.[21] Bound and Burkhauser (1999) claim that there is still tremendous uncertainty about disability behaviour - considerably more so than in understanding retirement in the US. This is because there are fundamental estimation problems that have not been satisfactorily resolved. Screening and discretion in awards produce extra complications. The appeals process needs to be accounted fully, and there still is rarely enough data for this.[22] Uncertainty about wages has so far not been incorporated into the disability models in the same way as it is in the models for retirement (e.g. Stock and Wise (1990)). Natural experiments produce interesting new possibilities, but even they are not free of problems. As SSDI and SSI are federal programs, there is generally no variation across states. Therefore, finding a natural experiment in the US is hard. Moreover, if there is a regime shift, this shift should be unexpected, knowledge of the reform should be widespread and the effects of it immediate. To account for the deficiency in the last respect, Bound and Burkhauser (1999) stress the need to focus on flows rather than stocks.

Elasticity results of the disability literature are summarized in Table 2. Results of the various studies were harmonized in a survey by Bound and Burkhauser (1999).

1.3.3 Retirement and Financial Incentives in Europe (with an Emphasis on Finland)

European microeconometric retirement research on the economic incentives dates from a later period than the retirement research in North America. Some of the early contributors in Europe were Zabalza, Pissarides and Barton (1980) and Meghir and Whitehouse (1992) using UK data; Hansson Brusewitz (1992) on Swedish data; Börsch-Supan (1992, 1994) on German data; Lindeboom (1998)

[21] Variation in benefits across individuals is a function of past earnings. Because of the progressive benefit structure, replacement rates are higher for those with lower earnings. There is also a variety of reasons (e.g. lack of work motivation or poor working conditions) why those with lower earnings are more likely to apply for the benefits. Hence, there is quite clearly a correlation with one of the explanatory variables and the error term

[22] Benitez-Silva et al (1999) have data only on the first stage of the appeals. Yet this is one stage more than most of the other papers.

Author(s)	**Dependent variable**	**Independent variable**	**Elasticity**
Halpern (1979)	Application	Benefits	0.4
Parsons (1980)	Labour Force Participation (LFP)	SSDI repl. ratio	0.49-0.93
Haveman and Wolfe (1984)	Non-participation		0.37-0.6
Halpern and Hausman (1986)	Application	Acceptance rate	0.2
Halpern and Hausman (1986)	Application	Benefits	1.3
Parsons (1991)	Application	Initial award	0.45
Gruber (1996)	Non-participation	Benefit level	0.32
Gruber and Kubik (1997)	LFP	Initial denials	0.28
Kreider (1999)	Application	Probability of acceptance	0.6
Kreider (1999)	Application	Benefits	0.7
Benitez-Silva (1999)	Application, Award, Appeal, Award	Income	n.a.

Table 2: Result Summary of the Disability Literature

on Dutch data; Hakola (1999) on Finnish data; and Bratberg et al. (2000) on Norwegian data. All of them produced some evidence that economic incentives on retirement also matter in Europe.

In the late 1990s, there were at least two significant worldwide comparative retirement research projects: OECD (1998) and Gruber and Wise (1999). Both of them covered several European countries. The OECD reported results of cross-sectional studies on Italy and the UK (as well as the US), and panel studies on the Netherlands and Germany. These studies separated retirement channels into those due to unemployment, disability and old age. They confirmed that financial incentives matter. The Gruber and Wise project, on the other hand, included studies of Belgium, (Canada,) France, Germany, Italy, the Netherlands, Spain, Sweden and the United Kingdom. The idea behind these papers was to present the institutional features of each country's social security system, highlighting the implicit incentive system using comparable analytic calculations. All pension systems offered some economic incentives for retirement - incentives that were non-linearly increasing with the age of retirement.

Bound and Burkhauser (1999) reviewed the disability literature in the Netherlands and Germany. The Dutch use of the disability programmes is known to be widespread. Aarts and de Jong (1992) conclude that a one per cent increase in the lifetime disability benefits increases the probability of being on the disability roll by one percentage point. Hence, the effect is very high.[23] Riphahn (1995) finds that a ten per cent increase in wages in Germany decreases the disability exit rate by twelve percentage points. In contrast, a ten per cent increase in benefits increases the exit rate by four percentage points.

Finnish studies on retirement and disability that would also account for the financial incentives were almost non-existent prior to this thesis. Yet I also reviewed studies that do not control for economic incentives. Some of these provided ideas on how to set up the research questions of the present thesis.

Lilja's study (1996) pooled four panel data sets from the Finnish Labour Force Surveys (1984, 1985, 1986 and 1987 - the final year of the panels was 1989). The data set lacks information on individuals' pensions and income. Yet she identifies a number of other variables that have an effect on the propensity for early exit.[24] The variable that she claims to proxy the economic incentives, work experience[25], has only a slight or no effect on the exit propensity. If work experience is a good proxy for the economic incentives, this implies that Lilja's findings reject the importance of the economic incentives on the exit propensity. Some of the results actually have a reverse sign. This suggests that a higher work experience actually induces earlier exit. In incentive terms this would mean that the higher the incentive is, the lower is the propensity to exit. This would be difficult to explain, and it is most likely that the effect of the incentives is not sufficiently captured by the work experience.

Gould (1996) uses survey data combined with some information from registers of the private sector employment pension scheme (tel).[26] The core results of her paper are found using logistic regression models - both for the probability of an early exit as a whole, as well as separate equations for each of the three exit routes (namely; disability, unemployment and other pensions). Gould finds that different exit pathways are best explained by somewhat different explana-

[23] The effect is high as regards falling into temporary disability. The effect on moving from temporary disability to permanent disability is not as strong.

[24] Various covariates do not have an equal effect on each channel. The channels of exit that are considered are a) actuarily reduced early retirement, b) retirement due to the long-term unemployment, c) retirement due to the disability, and d) exit without a pension.

[25] Because pensions are a function of the past work experience, this claim is theoretically plausible. Yet the work experience is likely to have an effect on the retirement propensity that is independent from the effect of the financial incentive.

[26] Surveys were done in 1990 and 1994.

tory variables. A pure economic incentive effect has a statistically significant role only in the pathway that consists of other pensions than the disability and unemployment pensions. Gould's study provides stronger causation effects for the labour demand variables.

Luoma's study (1995) focuses on the disability pensions. He uses the Social Insurance Institution's (KELA) Mini-Finland Health Survey data. These data were gathered between 1976 and 1980. Its special feature is its uniquely accurate health statistics.[27] The income variable is a response to a survey question of the appropriate income category. Luoma estimates probit equations while correcting for the sample selectivity in the income estimates.[28] None of the estimated equations produces a statistically significant coefficient for the economic incentive variable. Some of the equations actually produce contradictory results (as in Lilja), even if these coefficients mostly remain statistically insignificant.

Hakola (1999) studies retirement decisions in the late 1980s and early 1990s. Her data sample is a random sample from the population in Employment Statistics. The sample covers the years from 1987 to 1994. Hakola constructs an option value estimate and uses this as a control variable in a probability regression (random effects probit). She also uses the estimated coefficients and the data sample to make simulations of certain pension policy changes. Her results show that the option value of retirement has a statistically significant impact on the probability of retirement. The simulations reveal that even a big reform in the incentives is likely to have a small effect on the probability of retirement.

Pyy-Martikainen (2000) studies the exit patterns of the aged unemployed. She also uses a sample from Employment Statistics with the years 1987 to 1994. Pyy-Martikainen's sample is from the same source as that of Hakola (1999), but Pyy-Martikainen's sample consists only of those individuals who had terminated at least one unemployment spell in those years. Pyy-Martikainen applies a nested logit model to the probability of exit from unemployment. The exit channels that are analysed are employment, active labour market programmes, unemployment pension and other pensions. The main economic incentive variable is the starting wages (estimated by Kyyrä (1998)). Starting wages are defined as wages that would be received by the unemployed were they to be

[27] Health is evaluated both through self-response in surveys and "objectively" by a special medical core.

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

hired for a job that would match their characteristics. Pyy-Martikainen (2000) finds that the starting wages have a relatively strong impact on the probability of exit from unemployment. Because the incentive variable is different from what is generally used, it is difficult to assess Pyy-Martikainen's results in view of the impact of the economic incentives on retirement. Starting wages control more for the demand side. Moreover, there are no controls for the incentives that can be obtained from retirement. Of the non-work incentives, Pyy-Martikainen finds a strong role for the types of the unemployment benefits (unemployment insurance benefits versus unemployment assistance).

Pyy-Martikainen's (2000) model also assesses the substitutability of the exit channels. She concludes that active labour market programmes and the unemployment pension are the closest alternatives for the aged unemployed. This leads her to claim that some of the unemployed have extended their earnings-related unemployment benefit by participating in the active labour market programmes. The rest of the substitutability estimates are unstable (and imply a negative correlation between the channels). The instability might be due to the fact that Pyy-Martikainen has no channel specific covariates in her data set.[29]

At the macro level, early exits in Finland are extensively reviewed by Hytti (1998). She uses several different sources of aggregate data.[30] Her study claims that early exits are 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 have the highest ratios of early exits (and vice versa).

The most comprehensive study on partial retirements in Finland was conducted by Takala (1999). She surveys all those who were partially retired in 1995. On the basis of the survey, she identifies a number of the individual-specific or job-related features of the partially retired. Yet there is no control group in her study. Therefore, it is difficult to assess how the partially retired compare with the rest of the population. Moreover, there is no question in the survey on the substitutability of partial retirement for either with full-time work or full-time retirement.

Summary of the Finnish studies is in Table 3.

[29] The only channel specific variable is the starting wages which are formed by the individual- and job-specific attributes.

[30] 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.

Author, year [Data, years]	**Technique**	**Economic Incentive**	**Results**
Luoma, 1995 [Mini-Finland health survey, 1976-1980]	Probit (selectivity correction on wages and pensions)	Response to question on the income category	0/-
Lilja, 1996 [LFS, 1984-1989]	Competing risks duration model	Pension proxied by experience	0/-
Gould, 1996 [tel registers + survey, 1990, 1994]	Logit	Response to question on the income category	0/+
Hakola, 1999 [ES, 1987-1994]	Random effects probit (wage imputations based on estimates from linear random effects)	Option value	+
Pyy-Martikainen, 2000 [ES, 1987-1994]	Nested logit (selectivity correction on starting wages)	Starting wages	+

Table 3: Summary of the Results on the Effect of Economic Incentives on Retirement in Finland

Notes: The signs in the Results column are the following: - indicates contradictory effect, 0 statistically insignificant effect, and + expected sign that is statistically significant. LFS=Labour Force survey, ES=Employment Statistics.

1.3.4 The Essays of the Thesis

The main goal of this thesis is to understand retirement of Finnish aged employees better. The studies produce new evidence on the determinants of the labour market transitions in those of an older age. The main focus is on the potential impact of the economic incentives on the timing of the labour force withdrawal. The thesis also considers the extent of the substitutability of several alternative labour market states. This is important, because a change in the incentives in one retirement alternative might also affect behaviour with respect to the other retirement alternatives. Even if the emphasis of the thesis is mainly on the labour supply, the last essay also takes into account determinants of the firm behaviour.

This thesis continues the work that was started in Hakola (1999). The essays in the thesis mainly use the same data source as earlier, but the data samples have been updated and some new register mergers have been made. For example, with the information on the pension accruals, it was possible to calculate the pension benefits more accurately than previously. Moreover, the data on the firm behaviour was obtained.

The first essay starts with a rather elaborate description of the Finnish pension system. The empirical section of the essay tests the impact of the economic incentives on the conditional probability of retirement (a duration model). The effect of the incentives is tested on the risk of retirement in all the retirement schemes jointly, as well as on the major retirement schemes separately. The main retirement schemes are retirement due to old age, disability and unemployment. In the first essay, I also claim that the unemployment pension and individual early retirement (one of the disability pension schemes) are likely to be the closest options for some individuals. Hence, I also test the effect on the unemployment probability of the eligibility restrictions of the disability pension schemes.

The second essay takes a deeper look at the two early retirement schemes, the disability retirement scheme and unemployment (with the unemployment pension). The disability pensions are governed by an application-award (-appeal) procedure. Therefore, there might be a considerable difference between the probability of the disability application and the probability of retirement due to disability. And so this essay separates the disability pension application stage from the actual disability transition. For this, it uses the information on the rejected disability pension applicants. The second essay also studies the unemployment decision more carefully. In the first essay, the withdrawal from the labour markets because of unemployment is measured by the award of the unemployment pension. This second essay allows for multiple transitions. This implies that the same individual can become unemployed several times at the end of his career. The reverse transitions, that is re-employments, are also modelled.

The third essay focuses on part-time pensions. A common policy recommendation is to enhance the attractiveness of part-time pensions in order to raise the average retirement age. Yet there is no evidence on whether the part-time pension actually raises the average retirement age. The part-time pension can also lower the average retirement age. This would be the case if the part-time pension scheme attracted pensioners who would otherwise have continued in full-time work. Hence, the aim of the third essay is to compare the economic incentives of part-time retirement with the incentives of other labour market states, and assess whether the part-time pension can be expected to extend or to shorten the working life.

The final essay tries to move away from the strong labour supply focus. It develops and tests a model where retirement is best explained by an interaction of the employer and employee incentives. This essay was motivated by massive unemployment rates for the aged after the recession of the 1990s in Finland. Because withdrawal from the labour market took place a number of years prior to the actual retirement age, it became increasingly hard to attribute the increased unemployment rates merely to the employee incentives. Employees actually lost financially because of the loss of employment, and big changes in leisure preferences seemed unlikely to account for the change in behaviour in this period. Therefore the essay also brings in the employer incentives. The essay shows how the ability to link the employer and the employee data can make a big impact on labour market studies of the aged.

1.4 Data Used in the Thesis

Data for virtually all the studies in this thesis came from the Employment Statistics of Statistics Finland. Employment Statistics is a register database on the whole Finnish population. It combines information from more than thirty different individual registers. Information on each individual in the different registers is linked by using his/her personal identity number. The most important registers for the current thesis are the tax files from the Finnish Tax Administration[31], employment information from the Ministry of Labour[32], and pension information from the Central Pension Security Institute (ETK) and the Social Insurance Institute (KELA). Additionally, the data had socio-demographic variables from various other sources - the most important being the Population Register.[33] Individual level data is generally available from 1987 onwards, and the data on spouses (age, earnings, education etc.) has been available since 1991. Most samples for this thesis were available until 1996.

In order to enhance the value of the data set for studies on the labour market behaviour of the aged, an additional data match was performed. Some registers of the Social Insurance Institution (KELA) and Central Pension Security Institute (ETK) in Finland were merged into a sample of Employment Statistics, using the personal identity number. The Social Insurance Institution provided information on health (from the register on the Reimbursed Medication on Chronic Diseases). The Central Pension Security Institute provided information on rejections of the disability pension applications, on the accrued pension rights (vapaakirjat), total work experience, length of the on going job, sector of the on going employment, and an indicator on whether the individual had a right to the so-called future time provision. Most of the variables from the Central Pension Security Institute are needed in calculations of the pension accrual. This is the pension benefit that the individual is entitled to, were he to retire immediately. This variable is rarely available in the data sets, but most of the studies have to rely on the benefits calculations, using the rules and the regulations of the pension systems.

The extra register merge was performed on a random sample of 32,619 individuals. The sample is restricted to individuals above the age of fifty-one in 1996. Information for the register merge is readily available for the private

[31]Therefore the data contain wages and salaries, other earnings, taxable income under the municipal taxation, taxable income under the state taxation, taxable wealth, deductible debt etc.

[32]Employment information contains, for example, dates of the current employment each year, the reason for termination of the employment contract etc.

[33]Other sources are the Population Information System of the Population Register Centre, employment registers by the Central Pension Security Institute, the State Treasury and the Municipal Pension Insurance Programmes, the Business Register and Register on the Non-Corporate Public Sector of Statistics Finland, the Pensioner Register by the National Social Insurance Institute, Student Registers, Register on Degrees and Examinations of Statistics Finland and the Conscript Register.

sector employees (tel and lel systems) whereas the data on the public sector is available only for the public sector jobs that were on going in 1996. The whole sample is longitudinal, covering the period 1987-1996. This sample with 32,619 individuals is used in the first and the second essays of the thesis.

The third essay uses a larger sample of Employment Statistics. This sample is a random sample of 300,000 individuals in 1996. The source population is limited to thirteen to seventy-four -year olds in 1996, and the sample is about eight per cent of the relevant population. Because the estimations in the third essay are limited to the age group that is eligible for part-time pensions, the actual sample is considerably smaller (but still more than 20,000 each year). The available years for this sample were 1987 to 1997, but the information for the part-time retirees is available only in 1996 and 1997. (1995 data on part-time pensioners were erroneous.)

Employment Statistics also contains firm identity codes for the individual's employer. When these identity codes were linked to Financial Statements Statistics and the Register of Enterprises and Establishments, a new employer-employee panel, the Integrated Panel of Finnish Companies and Workers, was created (see Korkeamäki and Kyyrä, 2000). The employer register is an annual rotating survey of about 5,000 companies. Because the data set contains the years from 1989 to 1995, there are about 11,700 firms in total. This data set is used in the last essay of this thesis.

Data samples, years on which the information was available, the number of observations, and the essay where each sample is used are listed in Table 4.

Data sample	**Years**	**Number of Obs**	**Essay**
Employment Statistics	1987-1997	300,000	3
Employment Statistics with additional matched information	1987-1996	32,619	1,2
Retirement shares by age groups	1991-1999		3
Employment and unemployment shares by age groups	1991-1999		3
Matched Employer-Employee data			
- employer panel	1987-1995	>1,000,000	4
- employee panel	1989-1995	12,000	4

Table 4: Data Samples Used in the Thesis

As all the data sets of this thesis are at least partly based on Employment Statistics, the quality of the employee data can be assessed jointly for all of the different samples. The quality of the data is dependent on the quality of the source register (the register where the information is originally found before it is linked to Employment Statistics). Moreover, the quality of the data seems to be improving over time. (The reason for this is unknown.)

The data set records the labour force status (employed, unemployed, retired, and the type of pension if retired) at the end of the year. The wages and pension benefits are also reported yearly.[34] There is a variable that records how many months per year the individual worked. This information, however, is erroneous. Consequently, it was hard to attribute the earnings data to the corresponding length of time in employment.

The measurement error in the work months is serious because the construction of the economic incentive variable relied on the wage and benefit information prior to retirement. If the wage is higher or lower than is actually attributable to the spell of employment, pension benefit calculations that rely on this wage are correspondingly miscalculated. Because the incentive values that are used are, at times, complex functions of both the wages and the benefits, the effect of the measurement error on the estimated coefficients was not clear.

The measurement error in the work months is demonstrated in Figure 2. It shows that in the data the employees who work only for one month earn considerably more in that one month than employees who work more time. This does not make sense if it were not for irregularities in the data.[35] There is no inherent reason why short employment spells should be more lucrative than longer spells. If anything, it should actually be the reverse. As we see, the data quality seems to improve quite considerably after four months in employment.[36] Therefore many of the estimations are tested by also restricting the estimations for those who report more than four months at work.

Because there is the measurement error in earnings, this is also reflected in the pension benefit and pension accrual calculations. Pension benefits and accruals are functions of current wages. Yet as accruals and benefits are weighted averages of several years of wages, the measurement error is smaller in them than

[34] The income data is from taxes that have been filed. The only inaccuracy could be related to tax evasion. Tax evasion in Finland is likely to be of rather minor importance. Yet tax evasion could be more severe with the retired as the salary earnings limits for receiving pension benefits are relatively low. No studies on the magnitude of tax evasion could be found.

[35] Some of these irregularities were known. For example, short-time lel-insured employment contracts were categorically marked to last for one month, irrespective of their actual duration.

[36] Consequently, the measurement error is not classical. Data construction and estimations have to take this into account.

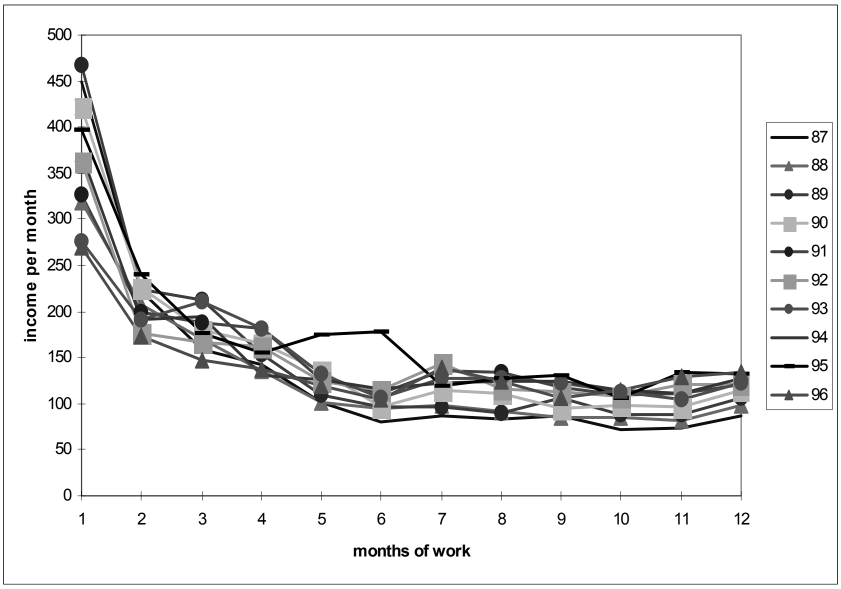

Figure 2: Months of Work vs. Income per Month

it is in wages. This is reflected in the estimations of the first essay.

The data indicate that some individuals have more than ninety years of work experience. Hence, there is also clearly a problem with the work experience variable. High values are obtained by individuals who hold several pension-accruing jobs at the same time.[37] The jobs, however, cannot be separated. Estimations which use the work experience variable in this thesis restrict the years of work experience to the maximum of forty years. Forty years of work experience provides the maximum pension benefit (if the accrual percentage is normal), and it is considered a reasonable upper limit. The measurement error of this rounding is likely to be small. Moreover, experience is used only as a control variable in the estimations, so this measurement error is unlikely to be serious.

Dates of the disability pension rejections and dates of the termination of employment prior to retirement are also inaccurate. According to the data, several disability rejections are received after the individual has already received a disability pension. Because in Finland it is not possible to receive benefits

[37] The work experience variable comes from the Central Pension Security Insitute.

from more than one pension scheme at the same time, it is not clear what the source of this inaccuracy is. This data error seems more frequent than would be expected from the applications by the retirees that did not know that they could not receive the second pension. Therefore, I do not use the dates for the rejections, but consider the rejections only yearly.

Because nearly all income is taxable in Finland and the main financial data come from the tax files, the data set has information on almost all types of income.[38] The major exceptions are social assistance and housing allowance (and child allowance, but this is hardly relevant for the study of the aged). Social assistance is the last resort of financial compensation. It is given only on condition that the net income of the whole family (of spouse's income and that of the children under 18) is assessed to be insufficient. Each social assistance application is therefore reviewed case by case. It is also claimed that not all individuals who are entitled to social assistance apply for it.[39] Therefore, in this thesis, very small wages (less than 3,000 FIM per month) are simply dropped from the sample rather than replaced by the calculated social assistance entitlement.

If an individual loses his job and his income falls below a certain level, the individual is entitled to the housing allowance.[40] The housing allowance is a function of the rent which is not reported in the data set. Moreover, the living conditions can be altered, if the labour market status changes. Therefore, it is not clear how the potential housing allowance should be calculated. Hence, the housing allowance is not taken into account in this study.

In theory, wealth can have an impact on retirement. Yet taxable wealth is a bad measure of the total wealth. In Finland, the value of wealth (including housing wealth) that needs to be reported for taxes is considerably lower than the value of the true wealth. In the data, there is a rather significant fraction of individuals (almost twenty per cent in some years) who own their homes, but do not have any wealth according to their tax records. Hence, in addition to the inaccuracy in wealth that is reported, it is likely that quite a significant

[38] Yet as there are too many distinct categories of income, not all categories are given in the data samples separately (as they are in the original registry). The income category that is currently missing, but would have been useful for the current study, is the nature of the unemployment benefit. (Finland has three distinct types of unemployment benefits: unemployment insurance, unemployment assistance and labour market support.) All different income categories are, nevertheless, included in the taxable income measure.

[39] See Hellsten, Katri and Hannu Uusitalo (eds): Näkökulmia sosiaaliturvan väärinkäyttöön, Stakes raportteja 245.

[40] The housing allowance is calculated somewhat differently for pensioners than for the rest of the population.

proportion of wealth is not reported at all.

Despite some difficulties, Employment Statistics is considered to be highly appropriate for studying the labour market transitions of the aged (and indeed the best data set that is currently available in Finland). Employment Statistics is the best source of the yearly income data in Finland, and it is fully representative of the whole Finnish population. In addition to the base data, inclusion of the accrual data and company information is an added bonus that is rarely available to retirement researchers.

1.5 Key to Finnish Pension and Labour Market Terminology

Accrual (eläkkeen karttuminen)=an increase in the pension benefit for an individual who has not yet retired

Accrual percentage (eläkekertymä)=the multiple that is used to calculate an increase in the pension benefit that is due to an additional year of work, currently 1.5% for most of the labour force in Finland

Accrued pension rights (vapaakirjat)=pension benefits that have been "earned" in previous jobs (Pension benefits are calculated separately for each job.)

Active labour market programmes, manpower programmes (aktiivinen työvoimapolitiikka)=labour market training, subsidized work and/or public employment services

Actuarial reduction of the pension benefits (aktuaarinen eläkkeen alennus)=the pension benefit that is drawn early is reduced by an amount that equalizes the expected total pension benefit with the total pension benefits if they were not drawn early

Central Pension Security Institute (Eläketurvakeskus, ETK)=the institution in Finland that acts as a clearing house of all the pensions in the private sector; it also records all private sector employment contracts

Defined Benefit (etuuksiin perustuva)=the amount of the pension benefit is pre-determined, for example, by the years of employment; the worker bears no risk from the financial markets (see Defined Contribution)

Defined Contribution (maksuihin perustuva)=the amount of the pension benefit depends on how much the worker has contributed to the system and possibly on the yields of the assets (see Defined Benefit)

Dependency ratio (huoltosuhde)=the ratio of non-workers to workers

Early exit, early retirement (varhaiseläke)=retirement from the labour force before the official old-age retirement age (age of 65 in Finland)

Employment condition (työssäoloehto) 1) =an employee who becomes unemployed is required to have the minimum of ten months of employment prior to the period of unemployment, in order to qualify for the unemployment insurance benefit; 2) =in order to be eligible for the part-time pension, an individual must have been employed for a minimum of five out of the past fifteen years, and the job(s) must have yielded him or her the right to a pension; moreover, in the past one and a half years, at least twelve months must have been full-time work

Employment pension (työeläke)=the main pension system in Finland, where the amount of pension benefit depends on the career of the individual

Experience rating ("historiaan" perustuva)=required contributions are a function previous incindence. For example, the pension liabilities of a firm are a function of a number of retirements from the firm.

Extended unemployment benefit for the aged (työttömyyspäivärahan lisäpäivät)=the maximum duration of the unemployment insurance benefits is extended if the worker is 57 years or older before this maximum duration of the unemployment insurance benefits runs out

Firm pension liability (yrityksen eläkevastuu)=share of the pension benefits that is paid by the retiree's former employer

Fully Funded (täysin rahastoitu)=future liabilities are collected in a full amount beforehand and invested (often in the capital markets) (see Pay-As-You-Go)

Future time (tuleva aika)=time between the age of old-age retirement (65) and early retirement; included in some pension calculations as if the retired individual had worked even if he has retired early

Grace period (ensisijaisuusaika)=time period that a pension applicant has to receive another type of social security in order to "qualify" for a specific pension benefit (e.g. 500 days of unemployment benefit are required for the unemployment pension)

Individual Early Retirement (yksilöllinen varhaiseläke)=a disability pension with minimum age criteria and less stringent health conditions than those of the actual disability pension

Labour Market Support (työmarkkinatuki)=unemployment benefit that is means-tested after 180 days; lower or equal to the unemployment assistance; paid only if the individual has no access to the other types of unemployment benefits (e.g. he has been unemployed "for too long")

National Pension (kansaneläke)="first pillar" pension, universal lump sum for all retirees until 1996; since then also means-tested

National Social Insurance Institute (KELA)=institute that administers national pensions plus a number of other social security allowances

Old Age Dependency ratio (vanhuushuoltosuhde)=ratio of the population over 65 years of age to the population of working age

Pay-As-You-Go (jakojärjestelmä)=the financing system where current social contributions are used to pay the current beneficiaries (see Fully Funded)

Pension accrual (eläkekarttuma)=the pension benefit an individual would be entitled to were he to retire immediately

Pension Appeals Board (Eläkelautakunta)=an independent appeals authority for private pensions

Pre-funding (etukäteisrahastointi)=future liabilities are collected beforehand and invested

Reference wage (eläkepalkka)=the wage that is used in the final pension calculations; currently the past ten years' average, previously an average of the medians of the final four years of employment

Replacement rate (korvaussuhde)=share of the replaced income when the labour market status changes (e.g. benefit over wage or accrual over wage)

Social security (sosiaaliturva (Suomi)/julkinen eläketurva (USA))=all public transfer payments in Finland (in all age groups); public pension system in the US

Social security contribution rate (eläkevakuutusmaksu)=the pension entitlement "fee"; currently collected both from the employer and employee in Finland

Unemployment Assistance (peruspäiväraha)=unemployment benefit that is independent of wage, not means-tested, since 1994 of a limited duration (500 days), requires membership in an unemployment benefit fund and fullfilment of an employment condition (see above employment condition 1)

Unemployment Condition (työttömyysehto)=to receive the unemployment pension the unemployed applicant must have received the maximum number of days of the unemployment benefit (since 1994, 500 consequent days plus the possible extension)

Unemployment Insurance Benefit (ansiosidonnainen työttömyyspäiväraha) =unemployment benefit that is a function of the previous income, not means tested, of limited duration (500 days), requires membership in an unemployment benefit fund and fullfilment of an employment condition (see above employment condition 1)

Unemployment Pension (työttömyyseläke)=early retirement due to long-term unemployment

Unemployment Tunnel (työttömyyseläkeputki)=an approximately ten-year period prior to old-age retirement when the individual can withdraw from the labour markets with unemployment and early retirement (unemployment pension) benefits

Window plan (eläkeikkuna)=targeted pension arrangements that have been offered by firms in the US in order to renew their work force; the arrangement is temporary

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2 The Pension System in Finland - Incentives and Substitutability of the Different Pension Schemes

2.1 Introduction

Pension expenditure in Finland in 1998 was 11.5 per cent of the GDP. It is the biggest expenditure category of the social security expenditure (40% of all social security expenditure in 1998).[41] Because the population is ageing, pension expenditure is expected to rise further. Baby-boom generations of the late 1940s and early 1950s are about to reach retirement age. The Finnish working age population will start to fall in 2010.

Parallel to the ageing of the population, employment rates among the aged have fallen in industrialized countries. In Finland, the employment share of the age group of 60 to 64 -year-olds fell from 46 per cent in 1970 to 23 per cent in 2000. This big fall in employment rates can largely be attributed to the early retirement schemes. Retirement due to disability or unemployment has been possible as early as the age of fifty-five.

Because the Finnish pension system is mainly based on the Pay-As-You-Go principle, changes in the worker-retiree ratio affect the financing of the pension system. Lassila and Valkonen (1999) estimate that in order to be able to meet existing obligations, social security contributions will have to double by 2030. This would be a huge increase in the price of labour. Therefore, it would be preferable to change other parameters of the pension system. Because it is very difficult to cut the existing pension benefits or benefit commitments, the primary aim of the pension policy is to increase the average retirement age.[42] Late retirement would improve public finances. If people work longer, pension payments will start later and last for fewer years.

Policy measures that are targeted to increase the average retirement age can be divided into three categories: i) increases in the economic incentives to continue at work (or decreases in the incentives to retire), ii) changes in the eligibility restrictions to the early retirement schemes, and iii) eradications of entire early retirement schemes. Recent reforms in the Finnish pension system

[41] Statistics Finland, 2000.

[42] In essence, later retirement implies a cut in the pension benefits. Fewer years of receiving benefits is somewhat similar to receiving fewer benefits each year. Yet the cut that is made through delaying retirement is less explicit.

have used or are about to use all of these measures.[43]

This paper examines the effect of the first two types of policy measures: changes in the economic incentives and changes in the eligibility rules. The analysis is done both with the system description, and with a number of empirical estimations.

In the descriptive part, I concentrate on the features that are likely to affect the labour supply of the aged. I will try to evaluate these labour supply effects in the empirical part. I construct several economic incentive measures, and test whether these measures have any explanatory power on the timing of retirement. The impact of the economic incentives is tested both on retirement in general, and on all of the major retirement channels separately. The effect of the eligibility restrictions on the labour supply is analysed with a "natural experiment". I use a change in the eligibility age of the disability pension to derive results on the substitutability of this pension with unemployment. Moreover, I use rejections on the disability pension applications to provide information on the "second labour market choice" of the rejected disability pension applicants.

The essay is structured in the following way: I start with a descriptive section on the Finnish pension system. Here, I describe both the availability and the attractiveness of the various pension schemes. After the system analysis, I present a short review of the related literature. Because the intention is to focus only on the studies that analyse several early retirement schemes, papers that consider only one retirement option are not reviewed here. A larger literature review was presented in the introductory chapter of the thesis. In the fourth section, I describe the theoretical and methodological background, and introduce the data that are used in the empirical section. The fifth and the sixth section review the empirical results. These results are first given for the estimates on the impact of the economic incentives, and then on the impact of the eligibility restrictions. Some conclusions are drawn in the final (the seventh) section.

[43] Incentives to continue at work have been repeatedly improved through several reforms. For example, tax deductions on wages have been increased, the pension and income indexing has been changed to reduce the pension benefits, and the accrual rules for the pension benefits have been changed in order to favour work at an advanced age. Eligibility reforms have also been implemented, even if they have been less frequent than the incentive reforms. Eligibility ages have been changed for the disability and the part-time pensions and for the unemployment-related benefits. Moreover, most recently, there has been contemplation of reforms in the third category. Removal of the unemployment pension and one of the disability pensions has been discussed, and an agreed by a pension reform group.

2.2 Finnish Early Exit Channels - Availability and Attractiveness

This section addresses the availability (with the actual use) and attractiveness of the major retirement channels in Finland.

2.2.1 Availability and Use of the Exit Channels

There are at least eight different retirement schemes in the Finnish public pension system. These schemes mainly differ according to the reason for retirement. The schemes with their date of introduction and the target group are listed in Table 5.

Retirement Scheme	**Date of Introduction**	**Target Group**
Old-Age Pension	July 1962	Aged
Disability Pension	July 1962	Disabled
Unemployment Pension	July 1971	Long-term unemployed
Farmer's Pension	January 1974	Farmers
War Veterans' Pension	1982 (male) 1983(female)	Veterans of the war
Individual Early Retirement	January 1986	Reduced work ability and/or long work history
Early Old-Age Pension	January 1986	
Part-Time Pension	January 1987	

Table 5: Employment Pension Schemes

The most common retirement routes are the old-age pension, the disability pension, the unemployment pension and individual early retirement. Sometimes both the disability pension and individual early retirement are categorised as disability pensions. Flexible early retirement schemes (individual early retirement, early old-age pension and part-time pension) were introduced in the late 1980s.

All retirement schemes have specific eligibility criteria, as the intention is to restrict the access of a specific retirement channel only to the target group. For the disability pensions, the main criterion is illness or reduced work ability. For the unemployment pension, the criterion is long-term unemployment. In addition to these main criteria, all retirement schemes have age restrictions. These age restrictions and their changes in recent years are listed in Table 6.

The old-age pension constitutes official retirement at the age of sixty-five. Benefits can be drawn earlier with the early old-age pension. Early old-age

Pension Scheme	**Eligibility Age**	**Previous Eligibility Ages (Years when in effect)**
Old-Age Pension	65	public sector gradually from 63 to 65 in 1989-1999
Disability Pension	16-64	
Unemployment Pension	60-64	55-64 (1980-1986), 58-64 (1978-1979), 60-64 (1971-1977)
Individual Early Retirement	60-64	58-64 (1995-1999) 55-64 (1987-1994)
Early Old-Age Pension	60-64	
Part-Time Pension	58-64	56-64 (2000-2002) 58-64 (1995-1999) 60-64 (1987-1994)
Farmer's Pension	55-64	

Table 6: Eligibility Ages for the Employment Pensions

pension, however, reduces pension benefits permanently. As it is the only pension scheme with this feature, it is less popular than the other early retirement schemes.

The disability pension is the only pension scheme that is available in practically all age groups. Individual early retirement is also a disability pension, but it has a minimum age restriction. Medical conditions for individual early retirement are less stringent than the medical conditions for the normal disability pension. According to the law, reduced working capacity and a long career are pre-conditions for individual early retirement.

Figures 3 and 4 show shares of some age cohorts in different labour market states in 1990 and 1996 respectively. As both graphs demonstrate, the bulk of the early retirees[44] receive a disability pension. Because individual early retirement is available only in the older age categories, shares of the disabled pensioners are considerably higher in the older age categories. Unemployment pensioners generally make up about a fifth of the relevant age group (even a fourth of the 62-year-olds in 1996).

All of the early retirement pension benefits are converted to the old age pension at the age of sixty-five. This explains the huge jump in the old-age retirees at this age.

Transition paths to the unemployment pension change between the two fig-

[44] Early retirees are those who retire before the official retirement age for the old-age pension, age 65.

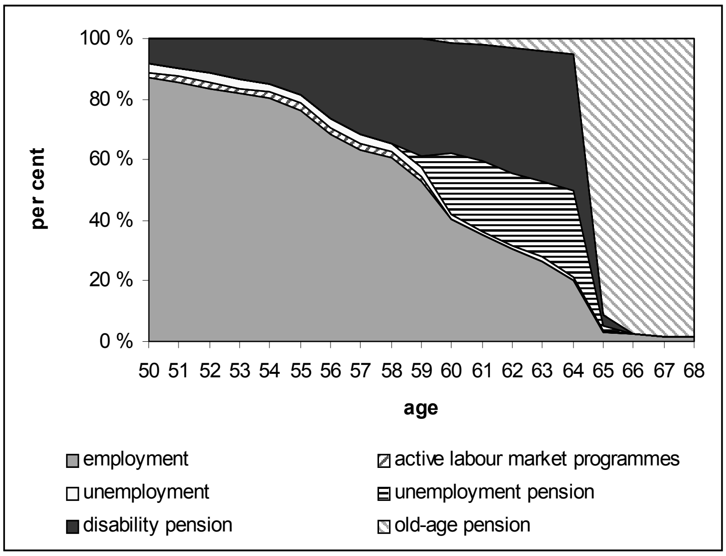

Figure 3: Labour Market Shares in 1990

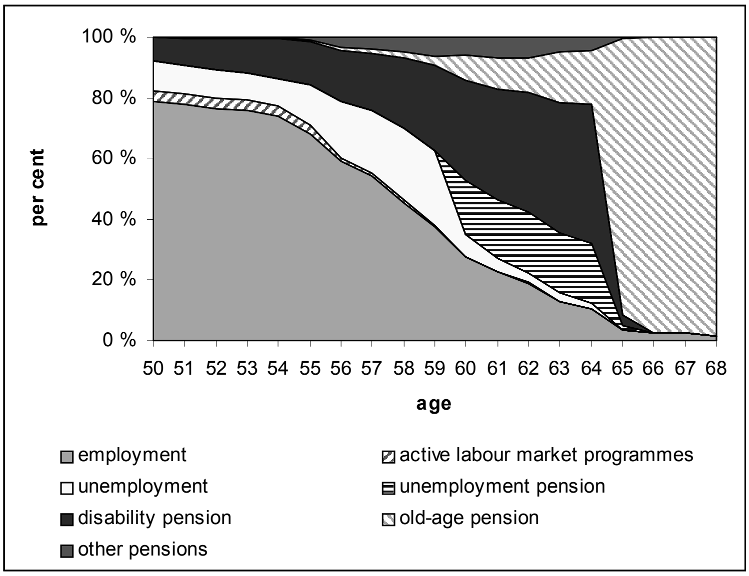

Figure 4: Labour Market Shares in 1996

ures. The stream from unemployment to the unemployment pension (and from the active labour market programmes to unemployment) was continuous in 1996.[45] This was not so for 1990. The share of the unemployed is considerably smaller than the share of the unemployment pensioners after the eligibility age for the pension is reached. Therefore it looks as if the unemployment pensioners in 1990 do not come as directly from unemployment as they do in 1996. This is partly explained by a regulation change in 1994. Since 1994 the unemployment condition to obtain the unemployment pension has been 500 consequent days of unemployment benefit. Prior to 1994, this condition was 200 days in the previous sixty weeks. Therefore, prior to 1994, other labour market states in addition to unemployment could precede the unemployment pension.

The unemployment and the disability pensions entail a grace period prior to eligibility for the actual pension scheme. For the disability pension, the grace period is 300 days of sickness allowance.[46] This corresponds to one calendar year, as the sickness allowance is received on six days a week.[47] As explained, the grace period for the unemployment pension changed in 1994. Currently it stands at 500 days of unemployment assistance or unemployment insurance, with the possibility of extension for older workers.

Grace periods can also be viewed as extensions of the early retirement window. Accordingly, in Finland it became customary to talk of the "unemployment tunnel". The tunnel consists of the earnings-related unemployment benefit (unemployment insurance (UI) or unemployment assistance (UA)), an extended unemployment benefit, and an unemployment pension that is received until the old age pension.[48] The tunnel currently starts at the age of fifty-five years and one month. Hence, it is possible to stop work at this age and live on social security until old-age retirement without a huge drop in the income level.

Changes in the age criteria governing the access to the disability and unemployment pensions are reflected in the time series of unemployed versus unemployed pensioners, and those on sickness allowance versus disability pensioners.

[45] The "belt" of unemployment related labour market states is as thick when the unemployment pension is not available as when it is available.

[46] This grace period is not required for individual early retirement

[47] This assumes that sickness allowance is received in consequent days. This is not required.

[48] Earnings-related unemployment benefit is paid for a maximum of 500 days. If the 500 day limit does not run out before the age of 57 (55 before 1997), the individual gets a right to the extended benefits until the age of sixty. At the age of sixty, the individual receives the unemployment pension.

The old-age pension also accrues while receiving unemployment benefits (työttömyyslisä, työeläkelisä) or the unemployment pension (tuleva aika).

Figure 5 plots the unemployment pensioner and the unemployment rate of the

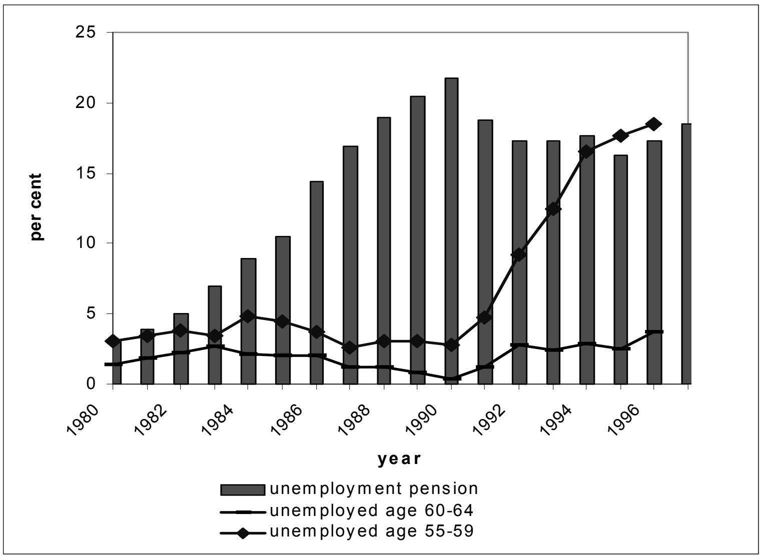

Figure 5: Share of the Unemployed and Unemployment Pensioniers of the Relevant Age Groups

aged. A change in the age limit for the unemployment pension changes the composition of the labour market withdrawal path for the unemployed. Accordingly, the number of years of unemployment before the unemployment pension is a function of the institutional features. The figure also shows how Finland was hit by a big recession in the early 1990s. This sent unemployment rates soaring for virtually all age groups - except for the oldest, who could obtain the unemployment pension.[49]

Use of the disability route (shown in Figure 6) presents a pattern that is almost a mirror-image of the unemployment picture. In 1982, the disability pension was subjected to the maximum number of days of sickness allowance (300). Hence, the number of those receiving sickness allowance was high, in contrast to the low amount of the disability pension recipients. In 1986[50], the second disability pension, individual early retirement, was introduced. As mentioned before, this scheme did not require a preceding period of sickness

[49] The unemployment pension could be received by those who were at least sixty years of age and had received a specified number of days of unemployment benefit.

[50] 1986 in the private sector, 1989 in the public sector

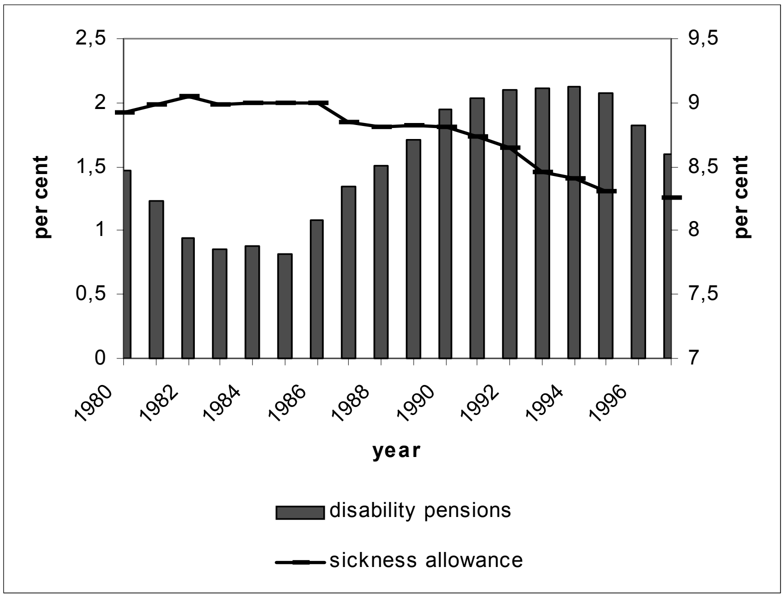

Figure 6: Share of the Disability Retirees (right-hand scale) and Those Who Received Sickness Allowance (left-hand scale) - whole population

allowance. Consequently, the number of those receiving the disability pension grew, and the number of those receiving the sickness allowance fell. Individual early retirement eligibility age was raised from fifty-five to fifty-eight years in 1994. Therefore, there was a fall in the number of disability retirees.

2.2.2 Attractiveness

In order to analyse the attractiveness of the exit channels, both consumption and leisure implications need to be assessed. The time of the earliest possible withdrawal from employment gives the years out of work.[51] Consumption implications are analyzed through income. Both the income during the grace period and the actual pension income are considered in this essay.

The age of the earliest possible labour market exit is given in Table 7. The table gives the earliest age when an aged employee can quit work at the beginning of the grace period as well as the earliest age when he can actually start to draw the pension. The table shows that the earliest exit from work as well

[51] The possibility that the earlier withdrawal causes longer life expectancy is ignored in this essay.

Pension Scheme	**Min. Age at the Beg. of the Grace Period**	**Min. Age for the Pension**
Unemployment Pension	55 years, 1 month*	60 years
Disability Pension	15	16
Individual Early Retirement	no grace period	60
Old Age Pension	no grace period	65
Early Old Age Pension	no grace period	60

Table 7: Minimum Ages for Labour Market and Labour Force Exits

Notes: * Prior to 1994 start of the grace period for the unemployment pension was at 53 years, 1 month. Other age limit changes in Table 6.

as from the labour force can take place with the disability pension. Entrance to this scheme, however, is most tightly controlled. It is therefore conjectured that there is closer substitution between the unemployment pension and individual early retirement.[52] Withdrawal from employment can take place earlier with the unemployment route. Because of very low re-employment probabilities for the older workers, labour market exit of the aged is often equated with the labour force exit. Therefore, the unemployment pension would yield the earlier withdrawal path than individual early retirement.

Grace period compensations consist of a sickness allowance for the disability pension and unemployment benefits for the unemployment pension. The unemployment benefit can be either unemployment assistance (peruspäiväraha) or unemployment insurance (ansiosidonnainen päiväraha). Out of the grace period benefits, unemployment insurance and sickness allowance are, to some extent, functions of the previous wages. Table 8 compares the sickness allowance with the unemployment insurance for certain income categories. For the sense of magnitude, the corresponding pension levels are also included in the table, even if their direct comparability is more questionable. Correct calculation of the pension benefits requires information about the whole career of each individual.

As the table shows, the unemployment insurance yields more income than the sickness allowance for the lower income category, but quite soon the sickness allowance starts to dominate. The sickness allowance is substantially higher than the unemployment insurance in the higher income categories. The pension

[52] Even if the age limits in the early old age pension are similar to the unemployment pension and individual early retirement, the early old age pension is less popular because of the permanent actuarial reduction in the pension benefits.

Earnings/Month	Sickness allowance	Unemployment Insurance	Pension Benefit
4,000	2,660	3,180	3,692
5,000	3,325	3,579	3,977
6,000	3,990	3,978	4,262
7,000	4,655	4,377	4,547
8,000	5,320	4,776	4,832
10,000	6,650	5,574	5,700
12,000	7,980	6,253	6,840
15,000	9,358	6,823	8,550

Table 8: Sickness Allowance and Unemployment Insurance by Income Categories

Notes: Sickness allowance is calculated according to the rules in www.kela.fi (2001). Unemployment insurance regulations are taken from Toimeentuloturva 2001, Varma-Sampo. Pension benefits are a sum of the employment pensions (www.etk.fi (2001)) and national pensions (Toimeentuloturva 2001). All figures are gross and do not take into consideration additional transfer payments that can differ between the labour market states.

benefit dominates both the sickness allowance and the unemployment insurance in the lower income categories. The pension benefit, however, falls below the sickness allowance in the higher income categories, mainly because the national pension is phased out in the higher income categories. (Income levels of 10,000 FIM/month and above in the table yield no right to the national pension.) The pension benefit is higher than the unemployment insurance in all income categories.

From the point of view of the financial incentives, the best retirement route for the higher income categories is via either of the two disability pensions. In the lower income categories, the choice between the disability and the unemployment pension depends on the income level.

The formula for calculating the pension benefit for each of the channels is the same: reference wage, multiplied by the accrual percentage and by the years of work.[53] The reference wage, years of work, accrual percentage and indices used for inflation correction are not functions of the exit channel. Differences in the channel-specific compensations are therefore due to the differences in the

[53] This formula is applied to each job separately and all of the accrued pension rights are indexed and added up to the final pension benefit.

The final pension benefit is often enhanced by the so-called future time correction. This correction corresponds to the amount of pension benefit that the individual would have earned, had he remained in the current job with the current wage all the way until the age of the old age pension (65).

compensations for the grace period.

This basic incentive framework is further complicated by severance pay, adjusted unemployment benefits for temporary work during unemployment, and differences in the amounts that can be earned while receiving the pension benefits.[54] For the purposes of this essay, however, these are ignored. They could not be reliably traced from the data. Moreover, their effect was considered to be more marginal.

Furthermore, for the purposes of this essay the impact of taxation is also ignored (taxes and deductions). Taxation would considerably complicate the analysis. Because the data on income contained considerable measurement error (see the introduction to the thesis), adding taxes to the incentive variable was considered a further complication that was likely to hide the effects of the "raw" data. Moreover, the incentive measures that are forward-looking in time already try to forecast the wages and the pension benefits. The inclusion of taxes would force additional forecasting - forecasting the future of the tax system. So far, such work has not been done - probably because of the huge identification problem.

2.3 Related Literature

Models separating the early exit channels were not very common in the microeconometric retirement literature prior to the 1990s.[55] This is because most of the microeconometric retirement papers dealt with the US, and, in the US, the approach with several retirement options is less obvious than in Europe. The only acceptable form of early retirement in the US is disability. The unemployment rates of the aged are less of a serious problem. The disability benefits and the old-age benefits are primarily targeted to the different age groups.

Yet the multichannel analysis of early retirements has recently become very popular. For example, the OECD (1998) published a study which included a micro-econometric analysis of five OECD countries (the United States, Germany, Italy, the United Kingdom and the Netherlands). The studies separated retirement due to disability, unemployment and old age. In each of the country studies, separating the channels clearly led to a better analysis of early retire-

[54] Generally speaking, the alternative earnings limits are higher for the unemployment pension recipients than for the individual early retirees. For the disability pension there are no explicit earnings limits.

[55] Haveman et al (1988) is interesting exception.

ment.

In Finland, there are three earlier multichannel studies dealing with retirement. Lilja's (1996) study covers the late 1980s, Pyy-Martikainen (2000) focuses on the late 1980s and early 1990s, and Gould (1996) concentrates on the 1990s. Out of these, only Pyy-Martikainen attempts to analyze the channel substitutability.

Lilja (1996) divides the exit channels into four categories: retired early, retired because of long-term unemployment, retired because of ill health, and left the labour market without an immediate pension. In her estimations, she uses a data set that consists of pooled Finnish Labour Force Surveys from 1984 to 1987. She focuses on private-sector employees and the self-employed. Her explanatory variables have to do with working conditions and socioeconomic status. Lilja's findings indicate that retirement has a clear positive duration dependence, but this duration dependence does not differ statistically significantly between the various exit channels. Some of her covariates have a different impact on the different exit channels, and this justifies her use of a competing risks duration model. Perhaps the most unfortunate drawback of the data set is a lack of any direct measure of pension or income levels. Hence, the paper cannot really test the significance of the economic incentives. Moreover, her data set dates further back than the launch of the new early exit channels and the mass use of the unemployment pension.

Pyy-Martikainen (2000) restricts her study to the labour market transitions of the aged unemployed. Her alternative exit channels (exits from unemployment) are 1) employment, 2) manpower programmes, 3) unemployment pension, 4) other pensions[56], and 5) withdrawal from the labour market without a pension. She analyses the problem of multiple channels in a nested logit model. Pyy-Martikainen uses starting wages as an economic incentive. Starting wages are defined as wages that the unemployed would get, were they to be re-employed in a job that would match their characteristics.[57] Starting wages are a highly significant explanatory variable in Pyy-Martikainen's regressions.

The nested model structure also allows Pyy-Martikainen to assess the substitutability between the different channels out of unemployment. She claims that manpower programmes and unemployment pensions are the closest alter-

[56] Pyy-Martkainen does not explicitly state what these other pensions are. Most of these pensions are likely to be disability pensions.

[57] See Kyyrä 1998.

natives. The correlation of the unobservable variables between the other exit channels is negative, and this implies problems with the model. Her data set does not include channel specific variables, which is likely to be the reason why the model works poorly in some specifications.

The third paper, Gould (1996), uses survey data which is appended with information from the registers of the private sector employment pension scheme (tel). The core of her paper is implemented with logistic regression models - both for the probability of an early exit, as well as separately for each of the three exit routes (in her paper: disability, unemployment and other pensions). Gould finds that different exit pathways tend to be best explained by somewhat different explanatory factors. Economic incentives[58] are statistically significant only in the pathway that consists of other pensions (not of the disability or the unemployment pensions). Gould's study provides a stronger role for the labour demand variables.

2.4 Life-Cycle Theory, Duration Model and Data

Quinn et al. (1990) claim that Burkhauser was the first to emphasize the multi-period nature of retirement benefits (in 1979). This insight is best explained by the Life-Cycle theory. Retirement in Finland tends to be self-absorbing, and, therefore, the duration model is considered a good way to test this Life-Cycle theory. In this section, I will first review the basic Life-Cycle theory, then explain the duration model, and finally describe the data that I use in testing the implications of the Life-Cycle theory in the duration model.

2.4.1 Life-Cycle Theory

In the Life-Cycle (LC) view of utility maximization, each individual maximises his expected lifetime utility. In other words, individuals make decisions based on the utility values over the whole life-cycle. During the life cycle, an individual can re-optimize his behaviour, once new information becomes available. Therefore, the expected utility value can be re-calculated in each period.

The utility in the Life-Cycle model consists of consumption and leisure. Because it is hard to find reliable consumption data, empirical studies on retirement proxy consumption by income.[59] The reduced form models cannot

[58] The survey consists of a question of what the approximate income bracket of the individual is.

[59] This naturally implies that savings behaviour cannot be taken into account. Ignoring the

estimate leisure preferences explicitly. Yet the preference for leisure is implicitly reflected in the retirement decision. Earlier retirement with the same level of income implies a higher preference for leisure.

The lifetime utility function for an individual who is approaching the age of retirement can be divided into two parts. These are the utility derived *before* his retirement, and the utility derived *thereafter*. When an individual is still working, his utility can be evaluated by his wages. The relevant time span is then the time span from the present day until the year prior to his retirement. After his retirement, the utility of an individual is evaluated by his pension benefits. These need to be considered from the year of retirement until the end of his life expectancy.

In the Life-Cycle models, the utility function is assumed to be additively separable. Period-specific utilities are then discounted to the current period and added up to produce the lifetime utility. The lifetime utility function can be expressed as follows:

$$U_t(r) = \sum_{s=t}^{r-1} \beta^{s-t} u(Y_s) + \sum_{s=r}^{T} \beta^{s-t} u[kB_s(r, Y_{r-1})]. \tag{12}$$

U_t is the lifetime utility evaluated at the time t, $u(.)$ is the period-specific utility, t is the current period, r is the period of retirement, β is the discount factor, Y is the wage, B is the pension benefit, and k is the relative utility of the pension benefits to the wages.[60] The amount of the pension benefits is a function of the period of retirement and the wage level prior to retirement.

The value of the total utility in equation 12 can be estimated with a set of assumptions. In order to make reduced form estimations, the functional form of the period-specific utility function, the discount factor (β), the relative marginal utility of income (k), and the expected end of the life time (T) need to be specified.[61] The simplest functional form for the period-specific utility

savings can be specially problematic in a period of high turbulence when wide-ranging changes in economic behaviour are presumed to take place. The attempts to construct a variable for consumption have not been successful. See Rust, 1990.

[60] k is an explicit indicator of the preference for leisure that is used in the structural models of retirement. k measures the relative utility of the wage income to the pension income. If k is greater than one, the utility derived from a unit of income from work (hence, out of wages) is less than that from retirement (hence, out of the pension benefits). This difference in the utilities is due to the preference for leisure.

[61] Structural models can produce an estimate for the discount factor and the preference indicator k. These estimates are, however, extremely difficult to identify, and require distributional assumptions that cannot be tested.

function is to equate the utility of income to the income itself ($u(Y_s) = Y_s$ and $u[kB_s] = kB_s$). Furthermore, in the simplest case, the relative preference parameter is equated to one ($k = 1$).[62] To further simplify the calculation of the values, it would be possible to fix the discount factor. (in this essay $\beta = 1.03$, which implies an interest rate of three per cent.) Finally, it is necessary to make assumptions about the end of the life expectancy (T). These assumptions can either use the life-tables or make a fixed assumption for everyone. (In this essay I assume that $T = 90$.)

The assumption of a utility-maximising individual implies that retirement is more likely when the utility of retirement is higher. Therefore, the utility measure could be inserted as an explanatory variable into a probability model of retirement. The testable hypothesis is then that a higher utility value induces a higher probability of retirement. This is given in equation 13, where we would expect to get a positive sign on the utility coefficient γ.

$$\Pr(retirement_t) = \alpha + \gamma \times U_t + \varepsilon \tag{13}$$

Because the "correct" functional form of the utility function is unknown, there is considerable measurement error in the utility term. As this can bias all estimates in a non-linear model, it is customary to include other control variables in the right hand side of the equation 13. These variables try to control, for example, for differences in the preferences for leisure.

There are several probability frameworks that can be used to test the model in equation 13. For panel data, we can use either one of the discrete choice panel estimators (random effects probit, random effects logit or fixed effects logit) or a duration model.[63] This paper uses a duration model. The model is explained in the following section.

2.4.2 Duration Model

Because retirement in Finland tends to be fully absorbing, a duration model was considered an appropriate framework for modelling retirement. This section presents the basics of the duration model. The presentation mainly follows Lancaster (1990), and all equations that are presented are standard.

[62] Hakola (1999) tried to find the best value of k by comparing the likelihood values of regressions that were otherwise identical, except for the value of k. She found that the k value of one was more likely than greater values. Lower values of k were not tested.

[63] See Hakola, 1999, for a random effects probit model.

The Basic Model Duration in this essay was defined as years of work after the year 1987.[64] 1987 was neither a boom nor a bust year. The choice of a neutral year is good for an empirical analysis because the choice of the starting year has distributional implications.

The hazard function gives the instantaneous rate of leaving the state per unit of time period t, given that the individual has not left before. This is demonstrated in equation 14.

$$\theta(t) = \lim_{dt \longrightarrow 0} \frac{P(t \leq T < t + dt | T \geq t)}{dt}, \tag{14}$$

where duration T is a random realisation.

Applied to retirement, the hazard function gives the probability of retirement, given that the individual has not yet retired.

As there were no prior beliefs about the shape of the baseline hazard, the baseline hazard was kept as flexible as possible.[65] Yearly data favoured the use of a piecewise constant hazard function. The piecewise constant model assumes an exponential hazard within the time periods, indicating that the probability of retirement does not change within the years. Yearly observations would not enable detection of probability changes within the years anyway.[66] Between the years, the piecewise constant model does not impose any restrictions on the hazard function.

The piecewise constant model is given in the equation group 15.

$$\theta(t) = \left. \begin{array}{c} a_1, \text{ if } 0 \leq t \leq c_1 \\ a_2, \text{ if } c_1 \leq t \leq c_2 \\ . \\ . \\ a_M, \text{ if } c_{M-1} \leq t \leq \infty \end{array} \right\} \tag{15}$$

Applying this to the model that is estimated, 0 refers to the year 1987, c_1 to 1988, c_2 to 1989, and so forth. The probability of retiring in a certain year is independent of the time within the year, whereas the probability of retiring between the years is not restricted.

[64] Another possiblity is to arrange the data in such a way that duration is defined as duration at work after a certain age. See Hakola 2000a.

[65] Because most of the retirements in Finland cluster in two age groups (around the age of 60 and the age of 65), the hazard function for the agewise duration is multimodal (see Hakola 2000a).

[66] In practice, the non-parametric Cox model and the piecewise constant/exponential model produce results that are very close.

The likelihood function for the duration model is given in the equation group 16.

$$\begin{aligned}
L &= \Pi_{i=1}^{n} f(t,a)^{(1-c)} \times S(t,a)^{c} \qquad (16)\\
\ln L &= \Sigma_{i=1}^{n}[(1-c)\times \ln f(t,a) + c\times \ln S(t,a)]\\
&= \Sigma_{i=1}^{n}[(1-c)\times \ln(S(t,a)\times\theta(t,a)) + c\times \ln S(t,a)]\\
&= \Sigma_{i=1}^{n}[((1-c)\times \ln\theta(t,a)) + \ln S(t,a)]\\
&= \Sigma_{i=1}^{n}[((1-c)\times \ln\theta(t,a)) - (H(t,a))],\\
&\quad \text{where } H(t,a) = \int_0^t \theta_i(t,a),
\end{aligned}$$

where f is the density function, S is the survival function, c is the censoring indicator, t is the duration, θ is the hazard function, H is the integrated hazard, and a is the parameter vector for $\{a_1, a_2, ...a_M\}$ of the piecewise exponential hazard function.

The density function for those who retire is multiplied by the survival function for those who get censored (do not retire during the sample). The equation group also shows how the log likelihood function can be converted into a combination of the hazard and the integrated hazard functions. (See Lancaster 1990.) The last line defines the integrated hazard.[67]

Competing Risks and Right Censoring Competing risks duration models apply to situations where there are several alternative end states to the transitions. In this paper, there are three types of pensions (disability pension, unemployment pension and old age pension) which are mutually exclusive. Moreover, one of the "states" can be right censoring - that is, the exit time of the individual is unknown because, for example, the sample finishes before the individual retires. (Or the individual ends up in another retirement scheme.)

The multi-state framework is usually thought of consisting of several latent durations - out of which only the shortest is observed. For each duration spell that has ended, the observation gives both the length of the duration and the state to which the individual exited. Competing risks models generally assume the independence of channels. In other words, the existence of one channel does not affect the use of another. The destination-specific transition intensity (in equation 17) is written as the probability of duration ending and the end state

[67] True to its name, the integrated hazard is merely an integral of the hazard function.

as being state k, given that the duration lasted until time t:

$$\theta_k(t) = \lim_{dt \to 0} \frac{P(t \leq T < t + dt,\ D_k = 1 | T \geq t)}{dt}, \tag{17}$$

where D_k is the channel specific dummy, equal to one if a specific channel was chosen.

Because the independence of the channels assumption is not considered plausible, the substitutability of the channels is also assessed in this essay. Because of the difficulties in implementing models that relax the assumption of the independence of channels, the substitutability of the channels is assessed separately.

The probability that an individual leaves for destination k at time t is written in equation 18.

$$S(t) \times \theta_k(t) \times dt = \exp\{-\int_0^t \sum_{k=1}^{K} \theta_k(u) du\} \times \theta_k(t) dt \tag{18}$$

The probability of survival until time t multiplied by the destination specific hazard is equal to the right hand side of the equation.

Assuming independence of the channels, the joint probability density function is simply a product of the marginal densities (specific to each channel). Henceforth, the joint probability for the multi-state framework is written in equation 19.

$$\begin{aligned} p(d_1, d_2, ...d_K, t) &= \exp\{-\int_0^t \sum_{k=1}^{K} \theta_k(u) du\} \times \prod_{k=1}^{K} \theta_k(t)^{d_k} \\ &= \exp\{\sum_{k=1}^{K} [d_k \times \log \theta_k(t) - \int_0^t \theta_k(u) du]\} \end{aligned} \tag{19}$$

Left Truncation When the data are sampled from a stock, sampling of all individuals is not symmetric. Assume that we are interested in a scheme which has the minimum eligibility age of fifty-five years. We can therefore consider how 54-, 55- and 56-year-old individuals in 1987 would end up in our sample. The 54-year-old individual is not eligible for our scheme. Hence, he would not be in our sample in 1987, but he could enter in year 1988. The 55-year-old is eligible immediately in 1987. He would therefore enter the sample immediately. The 56-year-old was already eligible in 1986. If he had already retired then, he would not be in our sample. By contrast, if he did not retire in 1986, he would appear in our sample. The problem of the 54-year-old entering the sample "too late" is easily handled, because we are still observing the whole spell from the left. The problem of the 56-year-old is called left truncation, and it is harder to deal with.

Truncation from the left (sometimes also called left censoring) has distributional implications for the specification of the likelihood function. It actually leads to length-biased sampling.[68] Accordingly, longer spells are more likely to be sampled. (the 56-year-old was in our sample only if he remained in the risk group for a longer time period.) Therefore, the likelihood contribution of a left-truncated spell has to be modified. This modified probability density function is given in equation 20.

$$f_c(t) = \frac{t \times f(t)}{E(t)} = \frac{t \times f(t)}{\int u f(u) du} \tag{20}$$

An unmodified probability density function is weighted by the spell length. If the spell is long, it is more likely to be sampled. Therefore, the distribution of the spells (f) is multiplied by the spell length (t). This is re-scaled by the expected spell length ($E(t)$). Hence, truncated spells that are longer than the average get more weight, and the spells that are shorter than the average get less weight in the modified likelihood function.

Proportional Hazard Model with Time-Varying Covariates In a proportional hazard model, the effect of the covariates comes through multiplication of the hazard function. For identification, a "typical individual" is defined to have a baseline hazard function. Hazard functions of the other individuals are then compared with this baseline hazard function. In other words, each hazard function is proportional to the baseline hazard (multiplied by function k). This is given in equation 21. ($\theta(t, a|x)$ gives the baseline hazard function.)

$$\theta(t, a, x) = k(x) \times \theta(t, a|x) \tag{21}$$

The most typical choice for the function k(x) is exp(-xβ). This function fulfills the non-negativity constraint, and is log-linear in the parameters. Correspondingly, the exponential of the estimated coefficients produces a hazard ratio with proportional interpretation. It is a proportional increase/decrease in the exit probability of an individual with the specific characteristic, to the exit probability of the individual with the baseline hazard.

[68] Accordingly, the probability that a spell is sampled is proportional to its length.

Time-varying covariates (explanatory variables that change over time) enter the proportional hazard model in the same way as time-constant covariates. The conditioning, however, is done on the entire path of the covariate up to the specific date. As time-varying covariates are also observed yearly in my data, their time-invariance within each year makes their inclusion in the piecewise constant model straightforward. Both the hazard function and the time-varying covariates (as well as the time invariant covariates) are constant within a year.

Unobserved Heterogeneity Unobserved heterogeneity refers to the unobserved determinants that vary among the individuals (groups of individuals). The most common reason for unobserved heterogeneity is the omitted variable.[69] In duration models, omitted variables bias all estimates (both the estimated duration dependence and the coefficients of the other explanatory variables).

Unobserved heterogeneity can be taken into account in the estimations. It is included proportionally to the hazard function - as was the observable heterogeneity. (See the previous section.) Equation 22 gives the conditional hazard function - conditioned by the unobserved characteristics (v).

$$\theta(t,a|v) = v \times \theta(t,a) \tag{22}$$

As we can see, the unobservable characteristics simply multiply the hazard function. Using the relationship between the survival function and the integrated hazard, I can write (23).

$$\begin{aligned} S(t,a|v) &= \exp\{-\int_0^t \theta(t,a|v)dt\} \\ &= \exp\{-v\int_0^t \frac{f(t,a)}{S(t,a)}dt\} \end{aligned} \tag{23}$$

The proportional hazard (proportional to the unobservables) is inserted into the integrated hazard. The following line is derived from the relation between the hazard, the probability density function and the survival function. To obtain equation 24

$$\begin{aligned} S(t,a|v) &= \exp\{-v\int_0^t \frac{f(t,a)}{S(t,a)}dt\} \\ &= \{S(t,a)\}^v \end{aligned} \tag{24}$$

[69] Other reasons being errors in recorded duration or errors in the recorded regression variables. See Lancaster (1990).

I used the equality $f(u) = -S'(u)$ and the rules of integration. The conditional survival function (on v) is therefore equal to the unconditional survival function to the power of the unobservable variable. To get the conditional probability density function (in equation 25), I can use again the relationship between the probability density function and the negative derivative of the survival function ($f(u) = -S'(u)$).

$$\begin{aligned} f(t, a|v) &= -S'(t, a|v) \\ &= vf(t, a)\{S(t, a)\}^{v-1} \end{aligned} \tag{25}$$

Since v is unobservable, it has to be integrated out of the formula. Denoting by g(v) the probability density function for v, the probability density function for t with the unobserved heterogeneity is

$$\begin{aligned} f_{uh}(t) &= \int_0^\infty f(t, a|v)g(v)dv \\ &= \int_0^\infty vf(t, a)\{S(t, a)\}^{v-1}g(v)dv \end{aligned} \tag{26}$$

Because of its mathematical convenience, the gamma distribution is often used for the distribution of the unobserved heterogeneity (also in this essay). The probability density function for the gamma distribution is

$$g(v) = \frac{v^{a-1}e^{-v/b}}{\Gamma(a)b^a}. \tag{27}$$

Its mean is equal to 1 and the standard error is ϕ.

Inserting the gamma distribution into equation 26 and integrating, I can derive the survival function for the model with the unobserved heterogeneity[70],

$$S_{uh}(t, a) = [1 - \phi \ln\{S(t, a|v)\}]^{-1/\phi}. \tag{28}$$

Hence, the survival function with unobserved heterogeneity is the conditional survival function modified by the mean and the variance of the unobserved heterogeneity distribution.

2.4.3 Data

General Description of the Data The data that was used in the empirical analysis is a sample from the Employment Statistics of Statistics Finland. The

[70] $S_{uh}(t) = 1 - \int_0^t f_{uh}(u)du$

Employment Statistics was created by Statistics Finland in 1987. It combines information from a number of existing registers, from a variety of sources.[71] The most important registers for this essay were the tax files from the Finnish Tax Administration, employment information from the Ministry of Labour, pension information from the Central Pension Security Institute and socio-demographic variables from the Population Register.

The value of the current sample for pension research was further enhanced by an extra data merge. Information on accrued pension rights, entitlement to the future time, the accrual percentage of the current job, years in that job, rejected pension applications, and use of refunded medication for chronic illnesses, were linked to the existing database through a Personal identity number. Accrual pension rights and entitlement to the future time are used in the expected pension benefit (accrual) calculations.

Availability of the accrued pension benefits in a data set is rather rare because the accrued pension rights can usually be observed only when they are materialized, that is, when the pension benefits are actually received. In Finland, these data are registered by the Central Pension Security Institute. The Central Pension Security Institute acts as a clearing-house of all pension funds. It registers all the pension information on the job spells that are complete. It also registers the length of the on-going job for each individual, because the length of employment is used when the pension benefit for that job is calculated. The Central Pension Security Institute has full information on all employed individuals in the private sector. Information on the public sector has been registered since 1996.

The data sample that was used in the estimations of this essay consisted of 32,619 individuals in the age group of fifty-one years and above in 1996. There were more than 150 variables for each individual from 1987 to 1996. The analysis sample was restricted to those who were working in 1987 in order to facilitate the calculation of the long-term economic incentives. Because the exit avenues are governed by different eligibility ages, the number of individuals in the estimations varies according to the estimated channel.

[71] Data is gathered from the Population Census of the Finnish Bureau of Census, Tax Registries of the Finnish Finnish Tax Administration, Employment Registries of the Central Pension Security Institute (ETK), the Municipal (Kunnallinen Eläkevakuutus) and Government Pension Institutes (Valtiokonttori), Registry of 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 Statistics Finland.

Expected Pension Benefits and Wages Because the merged data had all the elements that are used in the calculations of the expected pension benefit, I was able to construct this variable. In what follows, I will explain the construction of the variable for the expected pension benefits, and the measure that was used to control for the labour force participation.

The calculation of the expected pension benefits uses the data on the accrued pension rights, the right to the future time, the wages and the months in employment. The total pension benefit is a sum of the accrued pension rights from all the previous jobs as well as the current job. The accrued pension right from the current job is calculated by multiplying the accrual percentage, years in the job and the reference wage. The reference wage is approximated in this essay to the yearly wage. The yearly wage is corrected for work that lasted for only part of the year. The sample also consists of an indicator on whether the individual has a right to the future time. The future time is defined as the time until the individual qualifies for the old age pension. In essence, the future time equals the years remaining until his sixty-fifth birthday.

The expected pension benefit calculation is summarized in equation 29.

$$\begin{aligned} E(pb) &= accrued\ pension\ rights\ from\ previous\ jobs + \\ &\quad [(accrual\ percentage \times w^c \\ &\quad \times (years\ of\ employment + future\ time))] \\ w^c &= w \times (\frac{12}{months\ in\ employment\ this\ year}) \\ future\ time &= 65 - age,\ if\ age < 65 \end{aligned} \tag{29}$$

As was explained in the introduction to this thesis, employment, unemployment and sickness spells within a year are poorly measured. Because the yearly amounts of income are accurate, all types of income are summed up yearly to measure the financial compensation from the labour force participation. The labour force participation consists of employment, unemployment and sickness spells. In financial terms, the income that was summed up therefore consists of wages, unemployment benefits and sickness allowance. Income from the labour force participation is given in equation 30,

$$Y_{lfp} = w + ub + sa, \tag{30}$$

where Y_{lfp} is the compensation from the labour force participation, w is the wage, ub is the unemployment benefit and sa is the sickness allowance.

Economic Incentives Because a reliable measure of the Life-Cycle utility is hard to construct, many studies on retirement have also used simpler measures to approximate the economic incentives. One such measure is the replacement rate. The replacement rate gives the share of the wages that is replaced after the individual quits work. In essence, it then gives the immediate financial impact of retirement.

For the analysis of retirement, the replacement rate is formed by dividing the pension benefits by the wages. Yet it is clear that the two values cannot be observed simultaneously for the same individual. Because I use a duration model where individuals are no longer in the risk group once they have retired, I need to construct replacement rates only for those individuals who are still at work. Therefore, for the replacement rate, I only need values of the expected pension benefits, not of the expected wages when retired.

Using the expected pension benefits and the observed income from the labour force participation (explained in the previous section), I could construct the replacement rate. Because of the problems with the spells data, the replacement rate was constructed yearly. The formula for the replacement rate is given in equation 31.

$$E(replacementratio) = \frac{E(pb)}{Y_{lfp}}, \tag{31}$$

where $E(pb)$ is the expected pension benefit and Y_{lfp} is the labour force compensation.

Table 9 gives the mean, maximum and minimum values of the expected pension benefits, labour force compensation and the expected replacement rate as they were constructed from the data sample.

	mean	*maximum*	*minimum*
	FIM/year	FIM/year	FIM/year
Expected Pension Benefit	42,786	1,101,440	4,664
Labour Force Compensation	95,767	2,953,899	0
Expected Replacement Rate	0.67	40.99	0.01

Table 9: Descriptive statistics of the expected pension benefit, labour force compensation and expected replacement rate

As we see in Table 9, the maximum of the replacement rates is very high and the minimum is very low. As these extreme values are caused by very special circumstances (for example, no financial compensation for the labour force participation), it is suspected that the very high or the very low values have a very different impact on the probability of retirement when compared with the "normal" range. This is why the replacement rate is included in the duration model in several different ways. The most straightforward way to deal with these extreme values is to discretizise the variable. The replacement rate can be included in the duration model as a categorical dummy. As there are no economic or statistical bases for the choice of categories, I test "a plausible replacement rate range" (30-80%) with ten percentage point categories (plus separate categories for the extremes). Hence, the first replacement rate category is under thirty per cent, the next is thirty to forty per cent, the next forty to fifty per cent, and so forth. Even if the interest in the replacement rate is in the continuous variable, we will see in the results section that categorising this replacement ratio variable proves extremely useful.

The Life-Cycle measure of utility is calculated for the three possible retirement channels. This is done by adding up the wages when at work, the compensation during the grace period (period between employment and retirement) and the pension benefit when retired. As explained previously in section 2.2., the grace period compensation differs between the exit channels (unemployment benefit or sickness allowance). For the individuals in the sample, the grace period compensation lasted for a maximum of seven years.

Calculation of the Life-Cycle incentives is summarized in equation 32.

$$\begin{aligned} E(Incentive_{ijt}) &= \sum_{t=1}^{gp-1} w_{it}^c + \sum_{gps}^{r-1} gpb_{ijt} + \sum_{r}^{T} E(pb)_{it} \\ w_{it}^c &= w_{it} \times (\frac{12}{months\ in\ employment_{it}}), \end{aligned} \tag{32}$$

where gp is the grace period, w^c is the corrected wage, w is the wage, gpb is the grace period benefit and $E(pb)$ is the expected pension benefit. Indexes i and j refer to the individual and the exit channel respectively, and the index t refers to the time period. gps is the period when the grace period pay starts, r is retirement, and T is the end of the life-cycle.

Pension benefit is received until the end of the life expectancy. It is necessary to make assumptions about this life expectancy in order to get a non-explosive sum of the arithmetic series of the yearly pension benefits. The life expectancy in this essay was assumed to be ninety years of age. The sensitivity of the estimates was tested by adding thirty years to the present age for each individual.[72]

The means, maximums and minimums for the life-cycle incentive for the different channels for 1990 are reported in Table 10. As observed, individual early retirement, which has no grace period, produces the highest mean and the maximum. This is followed by the normal disability pension. The mean and the maximum are the lowest for the unemployment route. It was demonstrated earlier in this essay that unemployment protection is better than the sickness allowance at the lower end of the income scale (Table 8). This appears as a higher minimum income flow for unemployment than in the other channels.

	mean	*maximum*	*minimum*
Unemployment			
- life cycle incentive for all	2,309,069	51,820,850	144,031.3
Individual Early Retirement			
- life cycle incentive for all	2,435,960	55,229,950	103,971.4
Normal Disability			
- life cycle incentive for all	2,406,076	53,124,310	113,016

Table 10: Life Cycle Incentives for Different Retirement Channels (FIM until 90 years of age)

2.5 Empirical Estimates of the Economic Incentives on the Probability of Retirement

In the previous sections, I explained the duration model, the data, and the construction of the measures for the economic incentives. In this section, I will put all of these together. In other words, this section reports the empirical estimates of the impact of the economic incentives on the risk of retirement. The risk of retirement is defined as the probability of retirement, conditional on not having retired previously.

As there are a number of retirement schemes available at the same time (described in section 2.2), I provide results for both a single-event model (where the event is retirement with any of the individual schemes) and a competing risks model (where three of the alternative retirement options are considered separately). The retirement options of the competing risks model are the three

[72] Hakola (1999) uses the life tables by gender and age to make individual-specific expectations of the end of the life expectancy. As the method is cumbersome and the advantages are not obvious, the life tables are not used here. Instead, the retirement equation has controls for age and gender.

most common retirement channels: unemployment pension, disability pension (which includes both the normal disability and individual early retirement) and the old age pension.[73] As was explained earlier, all pensions are technically converted to the old age pension at the age of sixty-five, so I consider only the transitions where the old age pension was the first pension benefit that was received.[74] In the competing risks model, exits through other channels are censored. Both the baseline and the coefficients are allowed to vary according to the exit channel.

The basic duration model that is estimated is given in equation 33.

$$Hazard = \{\exp[(LC \times \beta_0) + (X\beta_1)]\} \times Base\ hazard \tag{33}$$

Here the LC refers to the incentive (Life-Cycle or the replacement rate) and X to the other control variables (13 variables in the models that were estimated). The basic hypothesis with regards the incentive variable is that higher incentives increase the risk of retirement. I would therefore expect that $\beta_0 > 0$.

Table 11 reports the results. The coefficient on the Life-Cycle incentive is negative (that is, counter-intuitive) for all other retirement channels except for the old age pension (where the coefficient is statistically insignificant). We also see from the table that the coefficients of the Life-Cycle incentive vary across the retirement channels. This shows that modelling the retirement decision without taking into account the variety of the pension schemes can be inappropriate.

The advantages of the multi-event model over the single-event model are even clearer if we consider the coefficients of the health variable.[75] In a single event model, I would conclude that the bad health raises the retirement risk by thirty per cent. Yet in the multi-event model I conclude that those who suffer from bad health have a more than forty per cent (0.57×base) lower unemployment pension risk, whereas the disability pension risk is threefold (2.9×base). The old-age retirement risk as a first channel of exit is about fifteen per cent lower for those with a health problem. Hence, there is huge variance between the

[73] Part-time pension is not included separately, because it is not as common as the three major channels. Moreover, it is not obvious whether the part-time pension should be treated in the same manner as the other pensions, because it could also be defined as part-time work.

[74] In Finland, there is no mandatory retirement age, so there is also variance at the age when people obtained the old age pension.

[75] The data set consisted of information on the diseases and medication for which the individual had received medical re-imbursement by the National Social Security Institute (see the data section). The health variable used in the regressions is a dummy variable on the diseases that have a detrimental effect on the work ability of the individual (classified by a medical professional).

	Single Event	**Competing risks**		
	All pensions	Unemployment pension	Disability pension	Old-Age pension
Regressor	Coef (SE)	Coef (SE)	Coef (SE)	Coef (SE)
	1	2	3	4
Economic Incentives				
Life cycle incentive	-0.18 (.02)	-0.96 (.05)	-0.23 (.03)	0.01 (.01)
Individual-specific				
Bad Health (1/0)	0.25 (.04)	-0.55 (.13)	1.07 (.05)	-0.15 (.06)
Female (1/0)	-0.34 (.03)	-0.21 (.07)	-0.18 (.05)	-0.20 (.05)
Years of Education	-0.34 (.01)	-0.04 (.03)	-0.10 (.01)	-0.38 (.01)
Work Experience	-0.02 (.00)	0.03 (.00)	0.01 (.00)	-0.03 (.00)
Job-related.				
Public sector (1/0)	-0.03 (.03)	-0.45 (.11)	-0.05 (.05)	-0.18 (.07)
Self-empl. (1/0)	-0.46 (.04)	-4.39 (.59)	-0.43 (.07)	0.20 (.05)
Industrial Field				
- manufacturing (ref)	ref	ref	ref	ref
- agriculture (1/0)	-0.49 (.04)	-1.33 (.15)	-0.50 (.08)	-0.56 (.06)
- construction (1/0)	-0.35 (.04)	0.02 (.10)	-0.02 (.07)	-0.49 (.10)
- commerce (1/0)	-0.30 (.04)	-0.27 (.08)	-0.20 (.06)	-0.35 (.07)
- transport (1/0)	-0.54 (.06)	-0.86 (.20)	-0.18 (.09)	-0.74 (.09)
- finance (1/0)	-0.00 (.09)	-1.00 (.31)	0.00 (.14)	-0.34 (.19)
- services (1/0)	-0.28 (.04)	-0.81 (.12)	-0.14 (.06)	-0.43 (.08)
Log likelihood	-7,227.9	-791.9	-5,311.1	-175.3
Subjects	11,307	5,010	10,298	2,023
events	6,057	778	2,396	1,157
Time at risk	76,042	14,081	43,266	10,652
Age groups considered	55-	60-64	55-64	65-

Table 11: Duration Model 1988-1996

Notes: Regressions also include the relevant age dummies (and the yearly dummies - which are needed for the piecewise duration model). Standard errors are in brackets. They are corrected for heterogeneity (White).

distinct retirement channels on how health actually affects the retirement risk. This information is lost in a single-event model. Analysis of the other control variables is in the appendix.

The effect of the economic incentive variable on the conditional probability of retirement is highly dependent on the way in which the economic incentive variable was included in the regressions. I tested a number of different incentive specifications.

The replacement rate, as was explained in the previous section, is the ratio of the expected pension benefit divided by the labour force compensation. If the individuals maximise utility, the higher ratio should increase the risk of retirement (assuming that retirement always yields the same amount of "leisure").[76] The first estimated equation is given in equation 34. The hypothesis is that $\beta_1^1 > 0$.

$$Hazard = \exp[\beta_0^1 + \beta_1^1(E(\frac{pb}{Y_{lfp}})) + \beta_2^1 X_t] \times Base\ Hazard \tag{34}$$

The regressions results on the replacement rates are in Table 12, specification 1.

The results of the table are contrary to expectations. A higher replacement rate lowers the retirement risk for unemployment and the coefficients of the other channels are also "of the wrong sign", even if they are not statistically significant.

Because I showed in the data section that there are a number of replacement rate values that are outside the "normal" 0.3-0.8 range, I also report the model with a discretizised replacement rate variable (explained in the data section). The replacement rate is discretisized into stepwise dummies in equation 35.

$$\begin{aligned} Hazard &= \exp[\beta_0^2 + \beta_1^2 D_{0.3<E(\frac{pb}{Y_{lfp}})} + ... + \beta_7^2 D_{E(\frac{pb}{Y_{lfp}})>0.8} + \beta_8^2 X_t] \\ &\quad \times Base\ Hazard \end{aligned} \tag{35}$$

The testable hypothesis is that lower replacement rates induce lower increases in the risk of retirement, and higher ratios induce higher increases ($\beta_0^2 < \beta_1^2 < .. < \beta_7^2$). These results are in Table 12, specification 2.

[76] The underlying utility maximization model implies that because leisure is derived from retirement, financial compensation from retirement should have more utility value to the individual than the utility value from the labour force compensation. Hence, it is possible that retirement takes place even when the replacement ratio is less than one.

		Single Event	**Competing risks**		
	Incentive specification	All pensions	Unemployment pension	Disability pension	Old-Age pension
	[cell size]	Coef (SE)	Coef (SE)	Coef (SE)	Coef (SE)
1	replacement rate	-0.04 (.01)	-0.52 (.28)	-0.04 (.02)	-0.01 (.01)
2	replacement rate dummies				
	- <0.3 [0.20]	0.49 (.04)	0.37 (.12)	0.76 (.07)	-0.13 (.07)
	- 0.3 to 0.4 [0.18]	0.24 (.05)	0.17 (.13)	0.18 (.08)	-0.05 (.08)
	- 0.4 to 0.5 [0.20]	ref	ref	ref	ref
	- 0.5 to 0.6 [0.17]	-0.14 (.06)	0.01 (.16)	-0.10 (.10)	-0.02 (.08)
	- 0.6 to 0.7 [0.12]	-0.10 (.07)	0.14 (.19)	-0.11 (.12)	-0.03 (.10)
	- 0.7 to 0.8 [0.03]	0.42 (.08)	0.84 (.22)	0.79 (.13)	0.13 (.09)
	- >0.8 [0.09]	0.83 (.05)	1.30 (.14)	1.28 (.08)	0.07 (.06)

Table 12: Economic Incentives Based on the Replacement Ratio

Notes: All values indexed by the CPI to 1990. Controls as in Table 11. Standard errors are in brackets (corrected by White). Cell sizes are in square brackets.

The dummy specification is unable to reject the hypothesis that the incentives matter in some of the replacement rate categories. (That is, for example, $\beta_6^2 < \beta_5^2 < \beta_4^2$ is true for unemployment.) Most importantly, however, the dummy specification reveals considerable non-monotonicity. Even if the highest replacement rate categories increase the retirement risk most, the effects are clearly non-monotonic. In all retirement routes, there are replacement rate categories where increasing the replacement rate reduces the risk of retirement. This non-monotonic relation is the cause of the unexpected negative sign in the continuous replacement rate specification. The non-monotonic effect itself is probably at least partly due to the data errors.

With the exception of the first two replacement rate categories (<0.3 and 0.3-0.4), coefficients of the incentive dummies for the unemployment pension specification increase for the higher replacement rate categories. Therefore, the risk of retirement because of unemployment increases with the replacement rate, assuming that this ratio is within a "reasonable range". For the disability and old age pensions, there is an increase for the two highest replacement categories. These high compensatory categories are beyond the range of the "normal" replacement rates. (The target levels are 38-66%.)

The replacement rate divides the expected pension benefit by the compensation for the labour force participation. It therefore restricts the coefficients of these two variables. If the variables are measured in logarithms, the coefficients of the two variables are equal, but of the opposite sign. Equation 36 breaks the replacement rate into two; the labour force participation compensation and the expected pension benefit are logarithmic.

$$\begin{aligned} Hazard &= \exp[\beta_0^3 + \beta_1^3 \ln(Y_{lfp})_t + \beta_2^3 \ln(E(pb))_t + \beta_3^3 X_t] \\ &\quad \times Base\ Hazard \end{aligned} \tag{36}$$

If the replacement rate were a correct specification, I would expect to get $\beta_1^3 = -\beta_2^3$.

		Single Event	**Competing risks**		
	Incentive specification	All pensions	Unemployment pension	Disability pension	Old-Age pension
	[cell size]	Coef (SE)	Coef (SE)	Coef (SE)	Coef (SE)
1	replacement rate	-0.04 (.01)	-0.52 (.28)	-0.04 (.02)	-0.01 (.01)
3	lf compensation	-0.07 (.01)	-0.01 (.05)	0.18 (.04)	-0.11 (.02)
	(/1,000) and expected	-0.69 (.02)	-1.03 (.05)	-0.71 (.04)	-0.25 (.04)
	pension benefit (/1,000)				

Table 13: Economic Incentives Based on the Replacement Ratio

Notes: All values indexed by the CPI to 1990. Controls as in Table 11. Standard errors are in brackets. Cell sizes are in square brackets (corrected by White).

The coefficients in specification 3 in Table 13 show that the replacement rate specification for the Finnish data does not seem correct. The coefficients are not equal, and most of them are of the same sign.

Coefficients of specification 3 are interesting in themselves. Expected pension benefits have a larger impact on the retirement risk for unemployment and disability than the compensation for the labour force participation. Moreover, the impact of the expected pension benefits is negative, implying that the higher the expected pension benefits are, the lower is the retirement risk (even when experience is controlled). This is contrary to the traditional incentive effects. It is conceivable that the expected pension benefits are a better measure of permanent income than the income itself, because the expected pension benefits suffer less from measurement error. Hence, it is possible that the expected pension benefits actually pick up the income effect and this would explain the "reverse sign" of the coefficient.

Life-Cycle incentives are also included in the regression both as a continuous as well as a stepwise dummy specification (equations 37 and 38).

$$\begin{aligned} Hazard &= \exp[\beta_0^4 + \beta_1^4(E(LC)) + \beta_2^4 X_t] \\ &\quad \times Base\ Hazard \end{aligned} \tag{37}$$

$$\begin{aligned} Hazard &= \exp[\beta_0^5 + \beta_1^5 D_{(E(LC))<200{,}000} + ... + \beta_8^5 D_{(E(LC))>4{,}000{,}000} \\ &\quad + \beta_9^5 X_t] \times Base\ Hazard \end{aligned} \tag{38}$$

Table 14 reports the Life-Cycle incentive results. They also do not follow expectations.

		Single Event	**Competing risks**		
	Incentive specification	All pensions	Unemployment pension	Disability pension	Old-Age pension
	[cell size]	Coef (SE)	Coef (SE)	Coef (SE)	Coef (SE)
4	continuous life-cycle	-0.18 (.02)	-0.96 (.05)	-0.23 (.03)	0.01 (.01)
5	life-cycle dummies				
	- < 200,000 [0.003]	-0.16 (.15)	-9.64 (0.68)	-6.19 (.52)	-0.33 (.16)
	- to 400,000 [0.02]	-0.19 (.07)	-0.02 (.49)	0.55 (.18)	-0.30 (.08)
	- to 1,000,000 [0.07]	-0.12 (.04)	0.14 (.12)	0.31 (.08)	-0.23 (.04)
	- to 1,500,000 [0.09]	ref	ref	ref	ref
	- to 2,000,000 [0.12]	-0.27 (.03)	-0.10 (.09)	-0.07 (.07)	-0.03 (.05)
	- to 3,000,000 [0.25]	-0.50 (.04)	-0.96 (.10)	-0.40 (.07)	0.05 (.08)
	- to 4,000,000 [0.18]	-0.77 (.06)	-2.83 (.34)	-0.85 (.10)	0.27 (.13)
	- > 4,000,000 [0.27]	-0.69 (.07)	-16.99 (.12)	-1.01 (.10)	0.35 (.15)

Table 14: Economic Incentives Based on the Life-Cycle Incentive

Notes: All values indexed by the CPI to 1990. Controls as in Table 11. Standard errors are in brackets. Cell sizes of each category are in square brackets (corrected by White).

For a robustness check, I ran a number of models altering the data sample. I showed in the introduction to this thesis that data quality improves considerably with the job spells that are longer than four months. Hence, my first robustness check was to run the models with the data that included only the individuals who had longer job spells per year than the four months. This did not, however, change the nature of the results. Secondly, because of the very low and very high values, I trimmed the incentive distributions. I excluded the highest and the lowest one per cent from each incentive specification. Even this exclusion of the outliers did not change the results qualitatively. Finally, I changed the end of the life expectancy. Instead of the expected end of life at ninety years, I assumed that the individuals lived thirty years more. Even this did not change the sign of the coefficients, but the negative coefficients seemed to be highly persistent.

One plausible explanation for the "reverse" sign of the Life-Cycle coefficient is the cross-section versus time-series variation in the variable. Those with higher wages also have high pension benefits, and, accordingly, high lifetime incentives. Individuals with higher wages are less likely to retire early. Therefore, individuals with a correspondingly higher Life-Cycle incentive are also less likely to retire early. The idea of the Life-Cycle model, however, rests on the time-series rather than the cross-section variation. In order to "clean" the results from the cross-sectional variation and concentrate on the time-series variation, the incentive variables can be differenced in time. This is done, for example, in the option value variable. (See the next essay or Hakola, 1999.)

Model with the Unobserved Heterogeneity Table 15 gives the results of the same model as was reported in Table 11, but also includes the unobserved heterogeneity. Unobserved heterogeneity is modelled using the gamma distribution. For the single event model and the unemployment and disability channels, the table replaces the age dummies with a continuous age variable because, in these models, age dummies were sufficient to make the unobserved heterogeneity specification redundant.

Likelihood ratio tests[77] show that the models that include the unobserved heterogeneity are statistically significantly better than the basic model only in the case of a single event model and for the old age pension channel. The unobserved heterogeneity model for the disability channel does not seem to work at all.

With the exception of some of the coefficients in the single event model, there is little change in the coefficients for the other explanatory variables. Most importantly, the coefficients of the economic incentive variable are virtually identical to the coefficients without the unobserved heterogeneity. Therefore it seems that the model with the unobserved heterogeneity is not a huge improvement

[77] Chi^2 on the probability that the unobserved variance between individuals is zero, ϕ=0

	Single Event	**Competing risks**		
Regressor	Coef (SE)	Coef (SE)	Coef (SE)	Coef (SE)
	All pensions	Unemployment pension	Disability pension	Old-Age pension
Economic Incentives				
Life cycle incentive	-0.21 (.01)	-0.99 (.11)	-0.23 (.03)	0.03 (.08)
Individual-specific				
Age	0.20 (.01)	-0.47 (.04)	-0.03 (.01)	dummies
Bad Health (1/0)	0.45 (.04)	-0.56 (.13)	1.07 (.05)	-0.30 (.12)
Female (1/0)	0.04 (.03)	-0.22 (.08)	-0.18 (.05)	-0.39 (.10)
Years of Education	-0.02 (.01)	-0.04 (.03)	-0.10 (.01)	-0.38 (.02)
Work Experience	0.01 (.001)	0.03 (.01)	0.01 (.00)	-0.05 (.01)
Job-related.				
Public sector (1/0)	0.05 (.04)	-0.46 (.12)	-0.05 (.05)	-0.30 (.15)
Self-empl. (1/0)	-0.42 (.05)	-4.41 (.60)	-0.44 (.07)	0.36 (.12)
Industrial Field				
- manufacturing (ref)	ref	ref	ref	ref
- agriculture (1/0)	-0.16 (.05)	-1.37 (.19)	-0.50 (.08)	-0.97 (.13)
- construction (1/0)	-0.04 (.06)	0.03 (.11)	-0.01 (.07)	-1.05 (.19)
- commerce (1/0)	-0.24 (.04)	-0.28 (.09)	-0.20 (.06)	-0.64 (.15)
- transport (1/0)	-0.20 (.07)	-0.86 (.21)	-0.18 (.09)	-1.23 (.21)
- finance (1/0)	-0.09 (.10)	-1.03 (.31)	-0.01 (.14)	-0.50 (.48)
- services (1/0)	-0.27 (.04)	-0.88 (.14)	-0.14 (.06)	-0.74 (.16)
Chi^2 (prob (ϕ=0))	6.95 (0.004)	0.21 (0.32)	0 (1.00)	107.2 (0.00)
Log likelihood	-6,662.8	-803.9	-6,824.4	-121.7
Subjects	10,460	5,010	12,664	2,023
events	6,057	778	10,747	1,157
Time at risk	45,266	14,081	80,995	10,652
Age groups	55-	60-64	55-64	65-

Table 15: Duration Model 1988-1996 with Unobserved Heterogeneity

Notes: Regressions also include the yearly dummies - which are needed for the piecewise duration model. Standard errors are in the brackets. They are corrected for heterogeneity (White).

of the basic model. This could be because the gamma distribution for the unobserved heterogeneity is incorrect, or the flexibility of the baseline hazard is a sufficient control for the unobserved differences between the individuals, or because the observed heterogeneity (the control variables) is a sufficient control for the model.

2.6 Substitutability between Unemployment and the Disability Pension

The second empirical question set for this paper was to assess the effects of the eligibility restrictions on the probability of retiring through an alternative channel. In section 2.2., I claimed that individual early retirement and unemployment were likely to be the closest alternatives. In this section, I will test whether there is substitutability between these exit rates.

The first indication of the channel substitutability between the unemployment pension and the disability pension was the health coefficient in the duration model. The health coefficient for the unemployment pension channel was strongly negative (-0.55 (0.13)). If an individual had a health problem, he was less likely to end up with the unemployment pension. In the absence of the channel substitutability, the health status should not affect the unemployment pension risk - or, at least, it should not affect the unemployment pension risk negatively.[78] Therefore it had to be that individuals who had a health problem were less likely to enter unemployment because they already had a disability pension. Had they not been able to receive this disability pension, some of them would have had a higher risk of unemployment.

Substitutability between unemployment and disability retirement is also tested by an eligibility indicator of the individual early retirement scheme. Because eligibility for the individual early retirement scheme is reached at a certain age, normally I would not be able to distinguish the age effect and the effect of the eligibility on individual early retirement. In section 2.2., however, I reported that there was a change in the age limit for individual early retirement in 1994. This change in the eligibility age enabled me to identify the eligibility coefficient from the standard age coefficient.[79]

[78] As a complement, a variable indicating unemployment benefit recipiency (and a constructed variable indicating unemployment insurance benefit recipiency) had a strongly negative impact on the probability of transition to the disability pension channel.

[79] Corresponding regression was done for the disability propensity with unemployment pen-

This eligibility indicator was included in the unemployment regression (as in equation 39).

$$\Pr(unemployment) = \beta X + \gamma IER_{elig} \tag{39}$$

In order to check the robustness of the results, I ran the regression in 39 both with a continuous age control as well as with the age dummies. If the coefficient on the eligibility indicator (γ) is negative, availability of the disability alternative reduces the unemployment propensity. This would be evidence for the channel substitutability. The results are in Table 16.

	Unemployment	*Unemployment with unobs het*
	Coef (SE)	*Coef (SE)*
Individual Early Retirement available (1/0)		
- age control continuous	0.41 (.04)	0.41 (.03)
- age dummies	-0.22 (.05)	-0.29 (.06)

Table 16: Substitutability between Unemployment and Individual Early Retirement

Notes: Other controls as in Table 11. (White corrected) Standard errors are in brackets.

The coefficient on the channel eligibility indicator is negative when the age dummies are used as a control, but positive when the age control is continuous. As the Kaplan-Meier survival function by age rejects a linear relationship between unemployment and age, results on the age dummy specification are more reliable.[80] Hence, I conclude that there is substitutability between individual early retirement and unemployment. The magnitude of the coefficient indicates considerable substitutability, because those who are eligible for individual early

sion eligibility. Yet as there was no exogenous variation in the unemployment pension eligibility age in this period, the coefficient could not be identified from the normal age coefficients. Regression results on "time-left-until-the-alternative-channel-eligibility" were unstable.

[80] The Kaplan-Meier estimator is an empirical approach to the survival and hazard function estimation. The Kaplan-Meier estimator shows the share of the non-completed spells of the risk group at a point in time. (See Kaplan, El. L. and P Meier (1958): Nonparametric estimation from incomplete observations, Journal of the American Statistical Association 53, 457-481. For quick reference, for example, Greene, 1997.)

The Kaplan-Meier estimator of the unemployment risk by age shows that the risk of unemployment does not rise monotonically with age. Therefore, the proportionality assumption that is generally made to include the explanatory variables to the hazard function does not hold (see the explanation of the duration model). Discretizing the age into the age dummies allows for this non-monotonic relationship.

retirement are twenty to thirty percentage points less likely to become unemployed.

Another "test" of the channel substitutability is done by comparing the labour market states of those who had received a disability pension rejection to the labour market states of the others. I allocated those individuals who had received a disability pension application rejection in any of the years of the sample to the target group (rejection on either individual early retirement or the disability scheme). The control group, in contrast, consisted of those who did not receive a rejection and were employed.[81][82] Even if there are no time restrictions on how quickly another pension application can be submitted or how many applications can be submitted to the same channel, submitting a pension application to an alternative exit channel can potentially enhance the probability of the pension approval of the applicant.[83] If rejected disability pension applicants transit from employment to unemployment or to the unemployment pension more often than the others, I would hold this as evidence of the channel substitutability.

Out of the rejected pension applicants in the sample, forty-eight per cent change their labour market status within a year, whereas, out of the others, only twenty-five per cent change their labour market status within the same time span. So there is clearly more labour market mobility by those who are rejected.

Table 17 shows that a significant proportion of the rejected disability applicants move from employment to unemployment (17.2 per cent of those who receive a disability rejection and were employed in the previous year). This is considerably higher than the corresponding share of the control group (7.6% of the non-rejected employed).[84] Hence, this would support the channel substitution.

The rest of the table provides further interesting results. A considerable

[81] The control group could not be restricted to those who applied, because there was no information on the applications.

[82] Almost fifty-six per cent of the rejected pension applicants are working when they are rejected and less than twenty-three per cent are unemployed. Therefore, I focus the analysis on the transitions from employment.

[83] If the re-application is submitted within a month of the decision for the previous application, the re-application is considered as an appeal. Yet the first stage of the appeals is exactly the same as that of the re-application. Neither the re-application nor the appeal incurs any explicit extra cost to the applicant in Finland.

[84] The evidence on those ending up with the unemployment pension is similar even if the absolute numbers are so small that it is not held as good evidence.

	to	employment	unempl.	unempl.	disability	old-age	unknown
from				pension	pension	pension	
rejected							
employment		453	194	14	386	32	47
		40.2%	17.2%	1.2%	34.3%	2.8%	4.2%
unempl.		13	128	23	38	0	16
		6.0%	58.7%	10.6%	17.4%	0%	7.3%
non-rejected							
employment		50,124	4,892	415	3,686	2,717	2,531
		77.9%	7.6%	0.6%	5.7%	4.2%	3.9%
unempl.		979	4,052	1,318	297	258	399
		13.4%	55.5%	18.1%	4.1%	3.5%	5.5%

Table 17: Labour Market Transitions of the Rejected and Non-Rejected Pension Applicants

share of the "pension rejects" continues working the following year (40.2% of the rejected applicants from employment). Yet the share of the corresponding control group, which continues working, is almost double this (78% of the non-rejected from employment). A considerably larger percentage of the rejected applicants than that of the control group ends up in either of the early retirement schemes. (34.3% of the target group employed receive a disability pension and 1.2% receive the unemployment pension within the sample years, whereas from the control group 5.7% receive the disability pension, and 0.6% receive the unemployment pension.) In particular, it is interesting to note a very high share of the rejected working applicants who receive a disability pension (34.3% versus 5.7% of the target group). Even if there is evidence of the channel substitutability, it seems as if re-submittance to the disability channel is still more common.

Because it is possible that these results are sensitive to the health status, cross-tabulations are also given when health is controlled. Table 18 shows that the share of the target group without a health problem who ended up in unemployment or with the unemployment pension is three times higher than the share of the control group (17.5%+1.3%=18.3 of the rejected employed without a health problem, in contrast to 7.6%+0.6%=8.2% of the non-rejected without a health problem). This difference is smaller for those who have a health problem. Hence, the channel substitutability holds even when the health status is controlled.

	to					
	empl.	unempl.	unempl.	disability	old-age	unknown
from			pension	pension	pension	
rejected, with health problem						
- employment	11	3	0	21	1	1
	29.7%	8.1%	0%	56.8%	2.7%	2.7%
- unemployment	0	2	0	2	0	1
	0%	40%	0%	40%	0%	20%
- total	11	5	0	23	1	2
	26.2%	11.9%	0%	54.8%	2.4%	4.8%
non-rejected, with health problem						
- employment	464	49	6	200	43	46
	57.4%	6.1%	0.7%	24.8%	5.3%	5.7%
- unemployment	10	33	16	25	5	5
	10.6%	35.1%	17.0%	26.6%	5.3%	5.3%
- total	474	82	22	225	48	51
	52.5%	9.1%	2.4%	24.9%	5.3%	5.7%
rejected, without health problem						
- employment	442	191	14	365	31	46
	40.6%	17.5%	1.3%	33.5%	2.9%	4.2%
- unemployment	13	126	23	36	0	15
	6.1%	59.2%	10.8%	16.9%	0%	7.0%
- total	455	317	37	401	31	61
	34.9%	24.3%	2.8%	30.8%	2.4%	4.7%
non-rejected, without health problem						
- employment	49,660	4,843	409	3,486	2,674	2,485
	78.1%	7.6%	0.6%	5.5%	4.2%	3.9%
- unemployment	969	4,019	1,302	272	253	394
	13.4%	55.8%	18.1%	3.8%	3.5%	5.5%
- total	50,629	8,862	1,711	3,758	2,927	2,879
	71.5%	12.5%	2.4%	5.3%	4.1%	4.1%

Table 18: Labour Market Transitions of the Rejected and Non-Rejected Pension Applicants by Health Status

The persistence result of the disability channel also holds when the health status is controlled. Those who got a rejection are much more likely to obtain the disability pension than the others. The difference between the target group and the control group is higher for those who do not have a health problem. In other words, those without an obvious health problem are even more set on applying to the disability channel again than those with a health problem.

2.7 Conclusion

In the empirical part of this paper I sought answers to three questions:

1) Do the economic incentives have any impact on the timing of retirement?

2) Do these incentives have a different impact on the different retirement options? and

3) Do we find any evidence of channel substitutability? In other words, if entry to one of the retirement channels is restricted, what is the impact of this on the use of an alternative exit channel?

The answers to these questions, according to the results of this paper, are 1) maybe (some of the incentives had an impact on the withdrawal, but many of the incentive effects were implausible); 2) yes (the impact differs between the channels) and 3) yes, there is evidence of channel substitutability.

In the paper, I used mainly two basic definitions of the economic incentives: replacement rate and life-cycle incentives. The replacement rate indicated that the economic incentives seem to have an impact on the timing of retirement. This impact, however, is non-monotonic and, at some incentive ranges, the probability of retirement falls when the incentives improve. Because of this non-monotonic relationship, the continuous replacement rate variable gave contradictory results. Breaking the replacement rate into its two components, the expected pension benefit and the labour force participation compensation showed that the coefficient restriction that is made for the replacement rate variable does not hold. Expected pension benefits were claimed to be a better control for the permanent income than the income itself (measured by the labour force compensation).

The Life-Cycle incentive variable consistently produced counter-intuitive results. Higher Life-Cycle compensation reduced the risk of retirement. This result held even when the variable was discretizised, the expected end of the life time was changed or the sample outliers were removed. The counter-intuitive result was explained by the dominance of the cross-sectional variation over the time-series variation. In a cross-section, higher income individuals are less likely to retire early. Those individuals with a higher income also have higher pension benefits and, consequently, higher Life-Cycle incentives. Even if each individual timed his retirement at the maximum of his Life-Cycle incentives, this time-series effect is overpowered by the cross-sectional effect. If the variable is differenced in time, the cross-sectional component is removed. This is done in the next essay.

Even if the impact of the economic incentives varied quite clearly among the different exit channels, the advantages of the competing risks model over the single event model were even more obvious if other control variables were considered. The effect of some of the explanatory variables was misinterpreted if all the channels were lumped together. For example, the health indicator had a slightly positive effect on the retirement risk if retirement was considered as a yes or no option (more likely to retire). Yet this was actually true only for the disability pension. The effect of health on the unemployment pension and old age retirement was actually the reverse. (That is, bad health reduced the retirement risk through these channels.) The single event model therefore lost information, and even gave misleading results.

Evidence of the channel substitutability was sought both within the basic model and with the disability pension application rejection data. Both results showed some channel substitutability. The eligibility coefficient showed that the availability of the individual early retirement alternative reduced the unemployment risk by twenty to thirty percentage points. Hence, the substitutability between individual early retirement and unemployment was quite considerable. Yet when the disability pension application rejection data were considered, there was stronger evidence for the disability channel application persistency than for the channel substitution. This disability pension application persistency continues even past the time when the unemployment pension becomes available at the age of sixty.

The goal of future research should be to model the impact of the economic incentives and the eligibility restrictions within the same framework. This could be done, for example, in a competing risks model where the unobserved heterogeneity was shared between the various retirement alternatives (for an example of this type of a model, see Jensen et al, 1999). So far, however, those models with a shared unobserved heterogeneity term have been very difficult to implement and rather unstable.

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Appendix

The Impact of the Control Variables on the Probability of Retirement

Individual-Specific Characteristics The bad health variable is based on the medical reimbursement received by an individual with a specific disease. The indicator variable on whether the individual has a disease that is detrimental to his ability to work almost triples the risk of retirement through the disability channel.[85] Interestingly also, retirement through the unemployment pension is significantly less likely for someone with a health problem.

Of the other variables, we note that the risk of retirement through any of the channels is lower for women.[86] More educated individuals have a lower risk of retirement through any of the alternative channels. (The coefficient for the unemployment pension route is not statistically significant.) Hence, higher education prolongs working time prior to retirement. This can be explained by higher work motivation, better job opportunities or physically less straining working conditions for the more educated. Work experience is rather neutral in its effect on retirement, slightly increasing the risk of early retirement and decreasing the risk of old-age retirement as a channel of first instance. This is when there is a separate control for the economic incentives. Lilja (1996) obtained similar results without any controls for the economic incentives.

Job-Related Characteristics Public sector employment provides security against unemployment. The coefficient of the public sector employment dummy is considerably negative for the unemployment pension. Until recent years, public sector employees had a lower old age retirement age. Therefore, if the age limit for the old age pension channel was changed from sixty-five to sixty-three, which is the normal old age retirement age for the public sector, the coefficients for the public sector indicator change considerably. With the sixty-three year age limit, public sector employment actually increases the risk of old age retirement as a channel of the first instance.

Self-employment clearly reduces the risk of retirement through any of the early retirement channels, increasing the retirement likelihood with the old age

[85] exp(1.07)=2.92

[86] This is conditional on them working in 1987. These women are compared with men working in 1987.

pension. The lower risk of early retirement by the self-employed is almost invariably confirmed by all retirement studies. Those choosing self-employment seem to have a distinct "work drive". (See Uusitalo, 1999.) Some retirement studies actually exclude the self-employed altogether.

Industry was controlled using six dummies with work in the manufacturing industry as a reference group. Those in manufacturing have a rather high risk of retirement in any of the schemes. The low risk of retirement from agriculture through any of the specific schemes is explained by the existence of a number of early retirement schemes that are targeted only to agricultural workers. Exit through the unemployment pension is most alien to employees in the financial sector, and is also, to a somewhat lesser extent, used by employees in transport and services. The "least disabled" are found in commerce, transport and services.

3 Timing of Early Withdrawal from the Labour Force: Multiple Transitions and the Application Uncertainty[87]

3.1 Introduction

Labour force participation rates of the aged work force have fallen in Finland in the past decades. For example, in 1970, forty-six per cent of the sixty to sixty-four-year-olds were working, while in 2000 only twenty-three per cent of the same age group were still at work. This fall in labour force participation rates is due to the early retirement schemes. Early retirement because of disability or unemployment has been possible as early as the age of fifty-five.

Most of the early retirees receive a disability pension. In Finland in 1998, the share of disability pensioners was as high as thirty per cent of some age cohorts. Disability pensions are governed by an application-approval procedure, with possible rejections and appeals. Yet because of the lack of suitable data, almost all prior analysis of the disability pensions disregard this application uncertainty.

The second most common form of early retirement is unemployment. After the major recession of the 1990s, more than a fifth of some age groups in Finland can be considered to be permanently out of the labour force because of long-term unemployment. Long-term unemployment benefits that start at the age of fifty-five are an institutional gateway to early retirement. The unemployed can receive the unemployment pension at the age of sixty, and maintain this until the old age pension at the age of sixty-five. Many individuals experience several unemployment spells at the end of their careers.

This paper sets out to modify previous incentive estimates for early withdrawal from the labour market by the aged by taking into account the special features of the two early retirement schemes. First, rather than considering just the disability pension transition, we distinguish between the disability pension application and actual disability retirement. In our model, we separate the time of the disability pension application from the time of disability retirement. Second, we modify our model to allow for several transitions in and out of unemployment. We model the possibility that an individual has several spells of unemployment. We also allow for the reverse transitions, that is, the model also estimates the chances of re-employment. In the essay, we test the effect

[87] Joint work with Maarten Lindeboom.

of the economic incentives on the probability of transitions. We have defined the incentives in a number of alternative ways. All the incentive definitions are based on the concept of the whole Life-Cycle.

The paper is structured in the following manner: After this introduction, we describe some of the Finnish social security provisions. Thereafter, we review the related literature. In the fourth section, we explain the measurement of the Life-Cycle incentives, our model that we use to account for the labour market transitions, and the data that we use to test the model. In this section, we also construct the incentive variables that will be used in the transition model. In the fifth section, we present the estimation results of the transition model. The essay is concluded in the sixth section.

3.2 Social Security Provisions

In the Finnish public pension system, there are at least eight different retirement schemes. These schemes with their age restrictions and a number of retirees in each scheme at the end of 1998 are listed in Table 19.

Pension Scheme	**Eligibility Age**	**# of Recipients 31.12.1998**
Old-Age Pension	65	710 000
Disability Pension	16-64	179 900
Unemployment Pension	60-64	48 700
Individual Early Retirement	60-64	40 100
Early Old-Age Pension	60-64	38 200
Part-Time Pension	56-64	10 900
Farmers' Pension	55-64	42 700
War Veterans' Pension	War Veterans	

Table 19: Employment Pension Schemes, Eligibility Ages and the Number of Recipients

The most common retirement routes are the old age pension, the disability pension, and the unemployment pension. Individual early retirement is also a disability pension scheme. Therefore, it is often included in the definition of disability pensions. The old age pension is the terminal point of all retirement. In this paper, we focus on the main early retirement schemes, so we will not consider the old age pensions.[88] Farmers' pensions and war veterans' pensions

[88] The data did not allow us to separate the old age pension scheme from the early old age pension scheme.

are highly targeted pension schemes, and the part-time pensions attract relatively few individuals. We will, therefore, concentrate in this essay on the two disability schemes (disability pension and individual early retirement) and the unemployment pension.

In Finland there are two types of pensions that are classified as disability pensions. The more commonly used disability pension is the "normal" disability pension. It can be obtained virtually at any age. The law states that in order to receive the disability pension "the ability to work must have decreased because of an illness, handicap or injury, at least by two-fifths of the normal work ability, and this disability is to last at least for one year. In assessing the disability, the employee's ability to earn his living is considered by taking into account his education, previous work history, age and living conditions, as well as other related issues".[89] The extent of the reduction in the ability to work can be assessed, for example, by the expected change in the earnings level if the employee returns to work after the onset of the disability.[90] The disability pension benefit can be obtained only after a grace period of three hundred days of a sickness allowance.[91]

The second type of the disability pension, individual early retirement (IER), has the more limited age eligibility criterion (currently, 60-64). An employee is entitled to individual early retirement (IER) if, in addition to meeting the age criterion, "his ability to work has been reduced to such an extent that, taking into account his illness, handicap or injury, the effects of ageing, long career, physical and mental strain of the job or the working conditions, the employee cannot be expected to continue his work".[92] Individual early retirement (IER) is therefore granted with less stringent health criteria than the "normal" disability pension. Moreover, work ability is assessed with respect to the specific job that the individual holds, rather than with respect to any job that he would be able to perform. The pension benefits for both disability pensions are calculated by means of virtually the same formulae, but individual early retirement does not

[89] Pentikäinen et al. (1996), p. 39.

[90] Disability pension can be either full (if the ability to work has been reduced by a minimum of three-fifths) or partial (ability to work reduced by two-fifths). In 1996, partial disability pension was changed into "re-capacitation allowance".

[91] This period of 300 days corresponds to one calendar year, as sickness allowance is received six days a week. The grace period of one year for the disability pension requires that sickness allowance is received in consequent days. This is not required by law. The sickness allowance can be received over a longer period, and still yield a right to the disability pension.

[92] Pentikäinen et al., 1996.

require a grace period.

The application process for the two disability schemes differs a little because of the grace period. For both schemes an individual must submit an application that contains a medical certificate. The application is submitted to the pension fund or the pension insurance company where the individual was last insured. If the pension is granted, the pension payment starts immediately in the following month. If there are substantial delays in handling the application, but the pension is nevertheless granted, the individual will receive the missed pension benefits retrospectively.[93] A pre-application can be submitted prior to eligibility. For example, an individual early retirement application can be submitted half a year before the minimum eligibility age is reached. A disability pension award is valid for nine months, within which the individual must stop work and start receiving the pension.

The individual can, without any cost, submit as many applications as he wants. If the re-application is submitted within a month of the rejection, it is considered to be an appeal. Both the re-application and the appeal are initially directed to the same pension fund (or the pension insurance company) which handled the initial application. The appeal must be written, and it can contain new evidence, for example, another medical certificate. The pension fund (or the insurance company) examines the appeal (or the re-application), and if it accepts it in full, it can change its previous decision. If it does not accept the appeal, or if it accepts the appeal only partially, the case is transferred to the Pension Appeals Board. In 2000, the Pension Appeals Board reviewed about 4,000 cases. The average waiting time for a case was four months. The Appeals Board changed the previous decisions in favour of the applicant in about eleven per cent of the cases. In the cases that were not decided in favour of the applicant, about every second applicant appealed to the Insurance Court. The Insurance Court changed about a fifth of these final stage appeals.[94]

The second (third) early retirement scheme that is analysed in this essay is the unemployment pension. It can be drawn at the age of sixty. Unemployment pensioners in Finland, unlike most other countries, have also *de jure* retired from the labour force. In many other countries, long-term unemployment at an advanced age is considered *de facto* retirement, but the unemployed are still

[93] A substantial delay is defined to be three months from the month of the application.
[94] Information was obtained from www.elakelautakunta.fi in 2001.

part of the labour force. In Finland, such a *de facto* criterion must also include those in the grace period for the unemployment pension.

The grace period for the unemployment pension currently stands at 500 days of unemployment assistance or unemployment insurance benefit.[95] Older workers can get an extension of the unemployment benefit. So withdrawal from the labour market can effectively take place at the age of fifty-five. Accordingly, for unemployment, it has become customary to talk of the "unemployment tunnel" in Finland. The tunnel consists of the earnings-related unemployment benefit, extended unemployment benefit, and the unemployment pension until old age retirement. The start of the tunnel is currently at the age of fifty-five years and one month.[96] Hence, it is possible to stop work at this age without a huge drop in the income level even if the individual is on social security for the rest of his life.

Table 20 gives the earliest age when an aged employee can quit work, and receive continuing benefits without a major fall in income. The table also marks

Pension Scheme	**Min. Age at the Beg. of the Grace Period**	**Min. Age for the Pension**
Unemployment Pension	55 years, 1 month*	60 years
Disability Pension	15	16
Individual Early Retirement	no grace period	60

Table 20: Minimum Ages for Labour Market and Labour Force Exits

Notes: * Prior to 1997 the start of the grace period was at 53 years, 1 month.

the earliest age when the individual can actually start to draw the pension, and, therefore, withdraw from the labour force.

The table shows that the earliest exit from work and the labour force is possible with the disability pension. As mentioned before, however, entrance to this scheme is most tightly controlled. Withdrawal from employment can take

[95] Unemployment grace period is exactly hundred weeks, amounting to one year and eleven months.

Prior to 1994, the grace period was 200 days and the recipiency of the benefits did not have to be consequent days.

[96] Earnings-related unemployment benefit is paid for 500 days at the maximum (five days a week). If the 500 day limit does not run out before the age of 57 (55 before 1997), the individual gets a right to the extended unemployment benefits until the age of sixty. At the age of sixty the individual receives the unemployment pension.

Old age pension also accrues while the individual is receiving the unemployment benefits (työttömyyslisä, työeläkelisä) or the unemployment pension (tuleva aika).

place earlier with unemployment than with individual early retirement, but the time of the actual labour force exit is the same for the two. Because of a very low re-employment probability for older workers, labour *market* exit has often come to be equated with labour *force* exit. Therefore, from the viewpoint of quitting work, the unemployment channel is more advantageous than individual early retirement.

If we compare the financial compensation among the different retirement alternatives, we shall first and foremost need to compare the grace period compensations. The unemployment insurance benefits (grace period benefit for the unemployment pension) and the sickness allowance (grace period benefit for the disability pension) are functions of the previous wages. Table 21 compares the benefit levels of these two social security payments for certain income categories. Corresponding pension levels were also included in the table, even if their direct

Income per Month	Sickness Allowance	Unemployment Insurance	Pension Benefit
4,000	2,660	3,180	3,692
5,000	3,325	3,579	3,977
6,000	3,990	3,978	4,262
7,000	4,655	4,377	4,547
8,000	5,320	4,776	4,832
10,000	6,650	5,574	5,700
12,000	7,980	6,253	6,840
15,000	9,358	6,823	8,550

Table 21: Sickness Allowance, Unemployment Insurance and Pension Benefit by Income Categories

Notes: Sickness allowance is calculated according to the rules in www.kela.fi (2001). Unemployment Insurance regulations are taken from Toimeentuloturva 2001, Varma-Sampo. Pension benefits are a sum of the employment pensions (www.etk.fi (2001)) and national pensions (Toimeentuloturva 2001). All figures are gross and do not take into consideration additional transfer payments that can differ between the labour market states.

comparability is more questionable.[97] As the table shows, the unemployment insurance benefit is more advantageous than the sickness allowance in the lower income category, but quite soon the sickness allowance is higher. The sickness allowance is all the more advantageous, the higher the base income is. The pen-

[97] Calculation of the pension benefit requires information on the whole career. Breaks in the career or changes of jobs can reduce the total pension benefit. Unemployment benefits and sickness allowances can be calculated without the information on the whole career.

sion benefit is higher than the unemployment insurance benefit, but loses to the sickness allowance in the higher income categories. Prior to 1996, pension benefits were always higher than the sickness allowance, but since then, when the National Pension was phased out in the higher pension categories, the relative order of the sickness allowance and the pension benefit is not clear.

Calculation of the pension benefit for each of the channels follows the same formula: the reference wage, multiplied by the accrual percentage and by the years of work.[98,99] The reference wage, years of work and indices used for inflation correction do not differ between the exit channels.

The descriptive analysis shows that, from the point of view of the financial incentives for the grace period, the best retirement route in the higher income categories is one of the disability pensions. In the lower income categories, the preference order would be individual early retirement first, and then the unemployment and the disability pension. Because the order differs with the labour market withdrawal considerations, the final order with the total incentive is not apparent.

3.3 Related Literature

Pension application data have so far mainly been available in the US. Therefore, the literature that considers the application stage of disability is highly US dominated. Even in the US, however, there are not many data sets that have information on both the applications (or rejections) and actual transitions at the same time.

The best known contribution concerning rejected pension applicants is that by Bound (1989). With a post-rejection labour market state analysis, and a regression of non-applicants' labour market participation, Bound claims that the large financial incentive effects attributed to the US disability insurance system are misinterpreted or flawed. This claim is attacked by Parsons (1991). He points out that denied applicants may be out of the labour force while waiting for an appeal or planning to re-apply. They may also face increased obstacles on returning to work. According to Parsons, it is, therefore, not clear

[98] The final pension benefit is often enhanced by the so-called future time correction. This correction corresponds to the amount of the pension benefit that the individual would have earned, had he remained in his current job with his current wage, all the way until the age of the old-age pension (65).

[99] This formula is applied to each job separately, and all the accrued pension rights are indexed and added up to the final pension benefit.

how the evidence on the labour market states of the rejected applicants should be interpreted.

In a more recent article, Benitez-Silva et al. (1999) take into account the disability application, appeal and award process. They build a multi-state decision-making model where an individual and the government (or the social security authorities) take turns in making decisions. First, the individual decides whether to apply for the disability. If he applies, then the government decides whether to accept the application. If the government rejects, the individual then decides whether to appeal, and so forth. Benitez-Silva et al. (1999) estimate four separate equations for each of the decision stages: application decision, application award decision, appeal decision, and the appeal award decision. In the estimations, Benitez-Silva et al. do not consider the effect of the economic incentives per se, but merely control for the income variables as they are observed in the data.

Other disability researchers in the US have estimated the effect of the level of the benefits or the screening stringency either on the applications or on the labour force participation. Applications were considered, for example, by Halpern (1979), Halpern and Hausman (1986) and Kreider (1999). The effects of the disability scheme on the labour force participation, in contrast, were studied in, for example, Haveman and Wolfe (1984a and b), Gruber (1996), Gruber and Kubik (1997) and Riphahn and Kreider (1998). These and a number of other papers have recently been surveyed by Bound and Burkhauser (1999). Virtually none of the papers on disability considers unemployment. (Haveman and al., 1988 and Autor and Duggan, 2001 provide exceptions.) This is because unemployment of the aged in the US is not as common as it is in Europe, where unemployment is an alternative form of early retirement.

In Finland, previous comparable studies either deal with transitions to different retirement schemes (Hakola, 1999, Hakola, 2000a and b and Lilja, 1996), or consider labour market transitions in all age groups (Kyyrä 1998, Rantala, 1998 and Tuomala 1998). The former group of studies ignores labour market transitions prior to retirement, whereas the latter does not consider the disability. The only major exception is a study by Pyy-Martikainen (2000). She considers the labour market states of the aged unemployed. In a nested logit model, she analyses terminated unemployment spells. These spells can end in i) employment, ii) unemployment pension, iii) active labour market programmes, or iv) other pensions. Yet Pyy-Martikainen does not consider transitions from employment to other labour market states, even if these transitions are dominant for the aged. Moreover, she clamps the disability pensions with other forms of retirement, providing little information on the disability transitions.

Gould and Nyman (1998) provide an interesting descriptive study of the disability pension rejections in Finland. They claim that disability pensions and unemployment pensions have been substitutes. This is shown by the evidence regarding time series. Fewer disability pensions start during recessions, because unemployment is then the main exit route. In contrast, when there has been a change in the eligibility rules for the disability, the number of those in the unemployment route has increased. Those who are entitled to the unemployment tunnel apply less often for the disability pension than others.

3.4 Life-Cycle Incentives, Data, Income Estimations, Descriptive Statistics and the Model for the Transitions

This section first gives the theoretical framework for the economic incentive calculations. We consider the economic incentives within the whole life cycle. As we calculate, these incentives are for each individual, and we test them against the probability of a retirement transition; we also need to introduce the data and calculate the income values that we need for the construction of the economic incentives. Lastly, in this section, we will explain the model that we use to study the transitions.

3.4.1 Life-Cycle Incentives

In the Life-Cycle (LC) view of the utility maximization, each individual maximises his expected lifetime utility. In other words, individuals make decisions based on the utility values over the whole life cycle. During the life cycle, an individual can re-optimize his behaviour, once new information becomes available. Therefore, the expected utility value can be re-calculated in each period.

The utility in the Life-Cycle model consists of consumption and leisure. Because it is hard to find reliable consumption data, empirical studies on retirement proxy consumption by income. The reduced form models cannot estimate preference parameters explicitly. Yet the preference for leisure is implicitly reflected in the retirement decision. Earlier retirement at the same level of income implies a higher preference for leisure.

The lifetime utility function for an individual who approaches the age of retirement can be divided into two parts. These are the utility derived *before* retirement, and the utility derived *thereafter*. When an individual is still working, his utility can be evaluated by his wages. The relevant time span is then the time from the present time until the year prior to retirement. After retirement, the utility of an individual is evaluated by his pension benefits. These need to be considered from the year of retirement until the end of his life expectancy.

In the Life-Cycle models, the utility function is assumed to be additively separable. period-specific utilities are discounted to the current period and added up to produce the lifetime utility. The lifetime utility function can be expressed as follows:

$$U_t(r) = \sum_{s=t}^{r-1} \beta^{s-t} u(Y_s) + \sum_{s=r}^{T} \beta^{s-t} u[kB_s(r, Y_{r-1})]. \tag{40}$$

U_t is the lifetime utility evaluated at the time t, $u(.)$ is the period-specific utility, t is the current period, r is the period of retirement, β is the discount factor, Y is the wage, B is the pension benefit, and k is the relative utility of the pension benefits to the wages.[100] The amount of the pension benefits is a function of the period of retirement and the wage level prior to retirement.

The value of the total utility in equation 40 can be estimated with a set of assumptions. In order to make reduced form estimations, the functional form of the period-specific utility function, the discount factor (β), the relative marginal utility of income (k), and the expected end of the lifetime (T) need to be specified.[101] The simplest functional form for the period-specific utility function is to equate the utility of income to the income itself ($u(Y_s) = Y_s$ and $u[kB_s] = kB_s$). Furthermore, in the simplest case, the relative preference parameter is equated to one ($k = 1$).[102] To further simplify the calculation of the values, it would be possible to fix the discount factor. (In this essay, $\beta = 1.03$

[100] k is an explicit indicator on the preference for leisure that is used in the structural models of retirement. k measures the relative utility of the wage income to the pension income. If k is greater than one, the utility derived from a unit of income from work (hence, out of wage) is less than while retired (hence, out of the pension benefits). This difference in the utilities is due to the preference for leisure. Quite often the estimates of k have been unstable. See Redher-Harris, 2001.

[101] Structural models can produce an estimate for the discount factor and the preference indicator k. These estimates are, however, extremely difficult to identify, and require distributional assumptions.

[102] Hakola (1999) tried to find the best value of k by comparing the likelihood values of regressions that were otherwise identical, except for the value of k. She found that the k value of one was more likely than greater values. Lower values of k were not tested.

which implies an interest rate of three per cent.) Finally, it is necessary to make assumptions about the end of the life expectancy (T). These assumptions can either use the life-tables or make a fixed assumption for everyone.

The simplifying assumptions above yield an estimate of the social security wealth. Other life-cycle-based measures of economic incentives that are used in this essay are the option value (Lazear and Moore, 1986, and Stock and Wise, 1990) and the implicit tax (subsidy) (Coile and Gruber 2000b). Both of these measures account for the changes in the social security wealth if the individual continues to work. Rather than considering a change of one additional year of work, they consider the potential changes in the further future.

An option value for an individual is the 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. The option value therefore optimizes the difference between the financial cost of retiring immediately and the leisure cost of retiring later.[103] If the individual retires immediately, he loses some years of income and the potentially higher pension benefits, while if he retires later, he will lose the leisure time in the years when he works.

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

$$G_t = E_t[U(R^*)] - U_t(t), \tag{41}$$

where E is the expectations operator, U is the total utility, and R^* is the optimal age of retirement if the worker postpones his exit decision.

In option value terms, an individual behaves as a rational utility maximizer, if and only if he retires when

$$G_t \leq 0. \tag{42}$$

If the option value is used as an explanatory variable in a discrete choice model, the testable hypothesis is whether the higher option value reduces the probability of retiring (or, in other words, delays the retirement decision). Hence, we would expect to get a negative coefficient on the retirement probability.

Coile and Gruber (2000b) emphasize that it is natural to look at the incentive measures in relation to the wage. Then one could consider the difference in the

[103] Both of these are measured in utility terms.

benefit streams as either an implicit tax (if the stream difference is negative) or as an implicit subsidy (if it is positive). The relevant wage stream for the option value is that between the current period and the period when the total utility is expected to be at the maximum. The formula for this is given in equation 43.

$$P_t = \frac{G_t}{\sum_{s=t}^{R^*} w_s} \tag{43}$$

3.4.2 Data

The data set for this study came from Employment Statistics of Statistics Finland. Employment Statistics is a compilation of a number of registers.[104] The registers contain a wealth of information on demographic variables. Moreover, the data set contains the full tax file information on each individual. The specific sample used for this essay also contains detailed information on the accrued pension rights, rejected pension applications and the use of the refunded medication. Accrued pension rights and the tax file information can be used to construct the economic incentives.

The data on the rejected disability pension applications and actual disability transitions enable us to identify the disability applications. Rejections were reported only yearly, and we have no information on whether there were several rejections per year.[105] Even if the data included the dates of the rejections, they could not be used in the analysis. Simple cross-tabulations revealed that many of the rejections were given after the individual had retired. As we do not know the reason for this, we do not attempt to consider the dates of the rejections, but consider the rejections only yearly. Another shortcoming of the rejection data is the lack of information on the various stages of the appeals.

The period of the data set (1987-1996) presents very high volatility. For example, total unemployment in this period varied between three (1989) and seventeen per cent (1994). The unemployment rates of the aged were as high as

[104]Data is gathered from the Population Census of the Finnish Bureau of Census, Tax Registries of the Finnish Tax Administration, Employment Registries of the Central Pension Security Institute (ETK), and 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 Statistics Finland.

[105]If the individual's pension contributions during his career were paid to several pension funds or pension insurance companies (each employer can choose the fund or the company), one pension application can render several pension rejections. This "multiplicative rejection" would need to be separated from several "true" pension rejections. Yet we could not do this with the data set that was available for us.

about a third of some age categories in certain years. This ensured us a large number of transitions to and from unemployment during the sample.

The total sample has 32,619 individuals above the age of forty-one. For the estimations, however, we need to restrict the sample. For the wage regressions, we consider only those who were employed for a minimum of two years. Therefore, we are left with 17,818 individuals. As some of these individuals are observed for several years, wage estimations are done on data that have 101,014 individual-year observations. In the transition equations, we consider only those who are employed at the beginning of the sample.[106] Moreover, we exclude the self-employed (4,807 yearly observations) and a few observations where the labour market state is not clearly defined (817 yearly observations). Finally, we exclude the labour market transitions that are relatively infrequent (5,376 observations, see below). This leaves us with 14,444 individuals for the transitions estimations.

3.4.3 Income Estimation

Measures of the Life-Cycle income require estimates of wages even when they are not observed.[107] Therefore we need to impute them. We chose to do this with forecasts that are based on a fixed effects regression on the logarithmic wage levels. We used the estimation results and the observations of the data set to derive the expected income for each individual. With these income estimates and the pension accrual and pension benefit information we could further construct the economic incentive measures that were described above (section on the life-cycle incentives).

The fixed effects estimator in a panel regresses the dependent variable on a set of independent variables and individual-specific dummies. In other words, there are as many dummies in the regression as there are individuals. In order to get an estimate for the individual-specific constant, at least two observations per individual are needed. Therefore, only individuals who have at least two observations are included in the sample. We drop the observations where the individual has zero wages, and when he is not employed even if he has a wage observation. As we want to include all observations when the person is employed,

[106] Without restricting the sample to the employed at some point in time, we could not have formed the financial incentive.

[107] As we had information on the pension accruals, the pension benefits did not need to be imputed for those who were not retired.

even when his career is non-continuous, we form dummy variables for those individuals who in the previous year are not employed or report zero wages.

The data set reports the total wages that are earned each year. Yet we want to estimate wages that the individual would receive, were he to work for the whole year. Therefore, we add "months worked" as an additional control to our regression.[108]

The estimated regression is in equation 44.

$$\begin{aligned} Y_{it} &= \beta_{0i} + \beta_1 \log(age)_{it} + \beta_2[\log(age)_{it}]^2 + \beta_3(D_{health})_{it} \\ &\quad +\beta_4 \log(school_{it}) + \beta_5 \log(community\ unempl.)_{it} \\ &\quad +\beta_6 \log(months\ of\ work)_{it} \\ &\quad +\beta_7(D_{unempl.})_{it-1} + \beta_8(D_{zero\ wages})_{it-1} \end{aligned} \tag{44}$$

and the results are in Table 22.

Variable	*Coefficient (SE)*
log(Age)	12.23 (1.20)
log(Age) squared	-1.53 (0.15)
Bad health	-0.02 (0.01)
log(Schooling) (years)	0.82 (0.11)
log(Unempl. in home comm.) (%)	-0.06 (0.00)
log(Months worked)	0.51 (0.01)
Non-employed previous year	-0.41 (0.01)
Zero wages previous year	-0.34 (0.01)
Constant	-22.98 (2.35)
rho (variation due to fixed effects)	0.88
Numberr of Observations (groups)	101,014 (17,818)
F (8,83188)	3,354.66
R^2 overall	0.2271

Table 22: Fixed Effects Model on Wages (log('000 FIM per year))

Notes: Standard errors are in brackets (White corrected).

The results in the table seem reasonable. Wages are a quadratic function of age.[109] Bad health, bad local employment conditions and irregularities in the

[108] We could have divided the yearly wages by work months, and do the fixed effects regression on monthly wages. Yet, as the work months variable has considerable measurement error, a monthly specification is more likely to be erroneous. As we have controls for breaks in the career, there is a high chance to have correlation between the contaminated error term and some of these regressors. Therefore, the yearly wage regression is better.

[109] The age coefficient seems large. Yet one additional year of age increases the wage for young

work history lower wages. Schooling, in contrast, increases them. More working months increase the yearly wages, as they should. Yet doubling the months at work does not double the yearly income. This reflects the measurement error in the months at work.

Using both the regression coefficients and the predicted fixed effects[110], we predicted wages for all individuals. In the predictions, we assumed that the individuals were at work for the full twelve months. The equation that was used for the income predictions is equation 45.

$$\begin{aligned} E(\widehat{w}) &= \widehat{\beta_{0i}} + \widehat{\beta_1}\log(age_{it}) + \widehat{\beta_2}[\log(age)_{it}]^2 + \widehat{\beta_3}(D_{health})_{it} \\ &\quad + \widehat{\beta_4}\log(school)_{it} + \widehat{\beta_5}\log(community\ unempl.)_{it} + \widehat{\beta_6} \times \log(12) \\ &\quad + \widehat{\beta_7}(D_{unempl.})_{it-1} + \widehat{\beta_8}(D_{zero\ wages})_{it-1} \end{aligned} \tag{45}$$

Means of the wage and pension predictions are in Table 23. In order to assess the goodness of the predictions, the table also reports the mean differences between the predicted and the observed wages for those individuals who are at work at the end of the period (fourth column). As the table shows, the predictions are fairly good. The two final years are somewhat less accurate, but even that difference is relatively small.

Then we insert these predicted wages into the pension benefit formula, adding up both the previously accrued pension rights and the potential pension rights if the individual worked during the year.[111] These means of the predicted pension benefits are also reported in Table 23 (5th column). Because the pension benefit in Finland is at maximum sixty per cent of the previous wages (and mostly below), predicted pension benefits of the table seem reasonable when compared with the predicted wages.

Next, the wages and pension benefits are added up to produce the life cycle measure, as defined above. In other words, we add up the wages until each potential date of retirement, and the pension benefits until the end of life-expectancy. Life-expectancy here is fixed alternatively at ninety and at sixty-five. We also form the variables for the option value, and the value of the implicit

individuals by about 100 FIM, and reduces the wage for older individuals by an insignificant amount.

[110] The fixed effects estimator does not produce an estimate for the time-invariant explanatory variables, but their effect is included jointly in the fixed effects estimates.

[111] We insert the predicted wage into the pension accrual formula, if either the individual has no wage for the year in question, or the wage observation is less than 85 per cent of the previous wage. The latter replacement is intended to deal with employment that lasts only for part of the year.

	Predicted wage (SE) for all	Observed wage (SE) if employed	Pred.-Obs. wage if employed	Pred. pension ben. (SE) for all
	('000 FIM pa)	('000 FIM pa)	('000 FIM pa)	('000 FIM pa)
1988	102.842 (67.978)	104.484 (69.348)	0.37	47.425 (26.181)
1989	103.073 (69.348)	103.693 (73.680)	2.31	47.052 (25.688)
1990	104.949 (71.522)	105.084 (76.732)	3.13	47.011 (26.914)
1991	103.770 (71.272)	108.107 (78.427)	1.34	46.439 (26.024)
1992	97.337 (68.611)	104.568 (75.315)	-0.17	45.158 (24.690)
1993	95.635 (68.459)	102.055 (74.708)	1.37	42.241 (21.376)
1994	94.671 (69.366)	101.809 (77.922)	0.11	41.055 (20.679)
1995	96.643 (71.298)	107.475 (83.961)	-3.26	40.713 (20.217)
1996	96.615 (72.332)	109.310 (86.191)	-3.75	41.300 (20.879)

Table 23: Predicted and True wages, Difference in the Two, and Predicted Pension Benefits

Notes: Standard errors are in brackets.

tax (subsidy). Comparing the values of the Life-Cycle measure, we also make variables that mark the maximum Life-Cycle value, and the years left until this maximum. We also compare the Life-Cycle values between the unemployment and the disability channels, and create an indicator variable that shows whether the Life-Cycle incentive for the unemployment channel is greater than that for the disability channel.

3.4.4 Descriptive Statistics on Transitions

As we are interested in the effect of the economic incentives on the labour market transitions, we identified all the transitions and their frequencies in our data set. As some of the transitions are relatively infrequent, they were removed from the data set. All the transitions and their relative frequency (that is, the share of the frequency of those transitions from all the transitions made during the sample period) are graphed in figure 7. The size of each of the arrows reflects the relative frequency of the specific transition out of all the transitions.[112] For example, transitions from employment to unemployment are almost a third (28%) of all the transitions that are shown in the figure. Transitions involving employment, unemployment, disability pension, unemployment pension and old age pension

[112] We have left out technical conversions of disability and unemployment pensions to the old age pension.

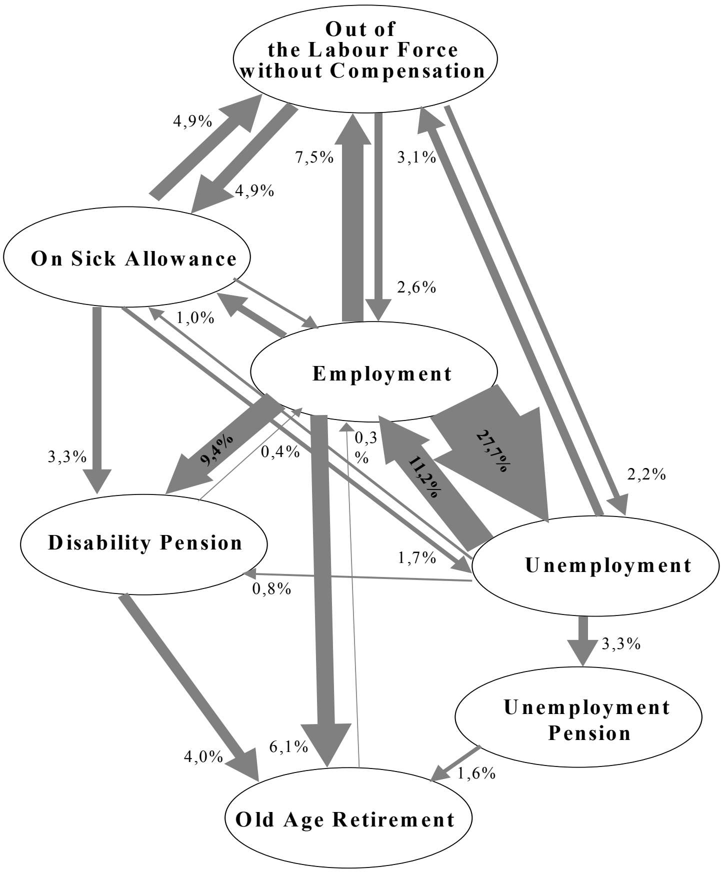

Figure 7: Labour Market Transitions of the Aged (41-64 years) in 1988-1996

are well identified.[113] Out-of-the-Labour-Force and On-Sickness-Allowance, in contrast, are harder to identify from the data. Therefore, transitions into and from these labour market states should be interpreted with caution.[114]

As the figure indicates, most of the transitions in these age groups (41 to 64 years) are transitions from employment to unemployment. Effectively, many of those falling into unemployment get re-employed (many possibly through the active labour market programmes), some of them obtain the unemployment pension, and some fall out of the labour force without any, or with minimum, compensation. Relatively few transitions take place between unemployment and the labour market states that are tied to the health status. In contrast, there is a lot of movement from employment to disability (either directly or through the sickness allowance).

We considered transitions out of employment and unemployment more carefully. These transitions are listed in Table 24. The table shows that we list almost eighty-two per cent of all transitions (78.06+3.71=81.77%). The table shows which transitions are so minor in importance that they are simply deleted from the final sample (fewer than four per cent). In the end, we use about seventy-eight per cent of the sample. The table divides the transitions according to whether the individual applies or does not apply for the disability pension. We will use this division to separate the application probability from the transition probability.

3.4.5 The Model for the Transitions

There are a number of probability models that we could use to test the impact of the economic incentives on the probability of making a specific labour market transition. Here, we develop our own model, where we account for all the major transitions that we could identify from the data. For these major transitions, we also separate the disability application from the disability transition.

The model that we use is a compilation of logit models. We identify four transitions that have the most significance. We model these four transitions by six transition paths that take into account the disability application and

[113] All labour market states are measured at the end of the year.

[114] There is no direct information in the data set on either the sickness allowance or income when out of the labour force. For the purposes of the graph, these channels were identified with the help of some additional information (whether the individual received any sickness allowance that year) and on the condition that the observation did not belong to any of the other categories.

From	Apply	To	# of obs	%age
Modelled				
Employment	no	Employment	89,936	62.08%
Employment	yes	Employment	859	0.006%
Employment	no	Unemployment	7,280	5.02%
Employment	yes	Disability	2,640	1.82%
Unemployment	no	Unemployment	9,567	6.60%
Unemployment	no	Employment	2,742	1.89%
		TOTAL	113,060	78.06%
Deleted				
Employment	yes	Unemployment	115	0.0008%
Employment	yes	Old Age Pension*	62	0.0004%
Employment	no	Old Age Pension*	1,210	0.008%
Employment	no	Unempl. Pension	46	0.0003%
Employment	yes	Other Pensions	21	0.0001%
Employment	no	Other Pensions	903	0.006%
Employment	yes	OLF w'out pens	11	0.0001%
Employment	no	OLF w'out pens	726	0.005%
Unemployment	yes	Unemployment	173	0.001%
Unemployment	yes	Disability	201	0.001%
Unemployment	yes	Employment	26	0.0002%
Unemployment	yes	Unempl Pension*	38	0.0003%
Unemployment	yes	Old Age Pension*	4	0.0000%
Unemployment	yes	Other Pensions	2	0.0000%
Unemployment	yes	OLF w'out pens	9	0.0000%
Unemployment	no	Unempl. Pension	992	0.007%
Unemployment	no	Old Age Pension*	233	0.002%
Unemployment	no	Other Pensions	40	0.0003%
Unemployment	no	OLF w'out pens	564	0.004%
		TOTAL	5,376	3.71%

Table 24: Transitions from Employment and Unemployment

Notes: Differences in percentages are due to rounding errors. * marks a deterministic transition. OLF w'out pension=out of the labour force without a pension.

the specific transition that an individual makes. These six transition paths are the following: i) an employed person applies for the disability pension, but stays employed[115] (d_{eae}), ii) an employed person applies for the disability pension and moves into the disability pension (d_{ead}), iii) an employed person does not apply for the disability pension and stays employed (d_{ene}), iv) an employed person does not apply for the disability pension, but becomes unemployed (d_{enu}), v) an unemployed person does not apply for the disability pension, but instead gets a job (d_{une}), and vi) an unemployed person does not file a disability pension application and stays unemployed (d_{unu}).

In addition, we identify an indicator of non-contribution (d_z), whereafter the observation is no longer of interest to us. This indicator takes value one, once the individual is retired. We make this simplification because retirement tends to be an absorbing process with very few returns. (This was shown earlier in Figure 7.) While unemployment at an advanced age can imply that the person will not make any more transitions, we keep the unemployed in the sample until they actually obtain the unemployment pension.[116] This is because until the pension, according to the law, the unemployed are still in the labour force, and could, at least technically, become re-employed.

Noting the six transitions paths (or seven, if we include the non-contribution dummy), we write the likelihood contribution for each individual. We assume that each probability term can be modelled as a separate logit equation. Henceforth, each of the transition paths can be written as a multiplicative of probabilities. For example, the probability of applying for the disability pension from employment and staying employed is a multiplicative of the probability of applying and not going from employment to any of the alternative channels (unemployment or disability). This is given in the first row of the log likelihood

[115] In essence, an employed person who applies for the disability pension, but stays employed, gets a rejection of the disability pension application.

[116] The unemployed will naturally make the deterministic or nearly deterministic transitions from unemployment to the unemployment pension and from the unemployment pension to the old age pension. After the transitions from unemployment to the unemployment pension, the individual moves out of the labour force, and falls out of our sample.

function in equation 46,

$$
\begin{aligned}
\ln L \quad = & \qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad (46) \\
& (d_{eae}) \times \ln\{[\frac{\exp(-x_a b_a)}{1+\exp(-x_a b_a)}] \times [1 - \frac{\exp(-x_{ed} b_{ed})}{1+\exp(-x_{ed} b_{ed})}] \times [1 - \frac{\exp(-x_{eu} b_{eu})}{1+\exp(-x_{eu} b_{eu})}]\} \\
& +(d_{ead}) \times \ln\{[\frac{\exp(-x_a b_a)}{1+\exp(-x_a b_a)}] \times [\frac{\exp(-x_{ed} b_{ed})}{1+\exp(-x_{ed} b_{ed})}]\} \\
& +(d_{ene}) \times \ln\{[1 - \frac{\exp(-x_a b_a)}{1+\exp(-x_a b_a)}] \times [1 - \frac{\exp(-x_{eu} b_{eu})}{1+\exp(-x_{eu} b_{eu})}]\} \\
& +(d_{enu}) \times \ln\{[1 - \frac{\exp(-x_a b_a)}{1+\exp(-x_a b_a)}] \times [\frac{\exp(-x_{eu} b_{eu})}{1+\exp(-x_{eu} b_{eu})}]\} \\
& +(d_{une}) \times \ln\{[1 - \frac{\exp(-x_a b_a)}{1+\exp(-x_a b_a)}] \times [\frac{\exp(-x_{ue} b_{ue})}{1+\exp(-x_{ue} b_{ue})}]\} \\
& +(d_{unu}) \times \ln\{[1 - \frac{\exp(-x_a b_a)}{1+\exp(-x_a b_a)}] \times [1 - \frac{\exp(-x_{ue} b_{ue})}{1+\exp(-x_{ue} b_{ue})}]\} \\
& +(d_z) \times \ln[1],
\end{aligned}
$$

where x_a are the explanatory variables for applications probability, b_a is the corresponding vector of coefficients, ed indicates transitions from employment to the disability pension, eu transitions from employment to unemployment, and ue transitions from unemployment to employment. d's indicate dummies for the transition paths: employed-applies-employed (d_{eae}), employed-applies-disabled (d_{ead}), employed-does not apply-employed (d_{ene}), employed-does not apply-unemployed (d_{enu}), unemployed-does not apply-employed (d_{une}), unemployed-does not apply-unemployed (d_{unu}) and out-of-the-labour-force (d_z).

The second line of the likelihood function defines a probability term that is attributed to the individual who applies for disability from employment and gets accepted. This is the probability of applying multiplied by the probability of the transition from employment to the disability pension. The third row gives the probability term for an individual who is employed and stays employed without applying for the disability pension. The next three lines give probabilities of moving into and out of unemployment. Finally, the last line ensures that when the individual is no longer of interest to us ($d_z = 1$), his likelihood contribution is equal to zero ($\ln[1]$).

The six transition paths in the likelihood function contain four different logit functions. Consequently, the model gives us four sets of estimated coefficients. These coefficients give the impact of the selected explanatory variables on the probability of i) becoming unemployed, ii) applying for the disability pension, iii) moving from employment to the disability pension, and iv) getting re-employed. Even if we report the results using identical sets of explanatory variables for each of these probability regressions, there is no need to do so. Each logit specification is written separately, so each of the four specifications can contain any combination of the explanatory variables.

The likelihood function is such that if we did not consider the application probability, both the re-employment transitions and the other two transitions could be modelled by two separate independent logit models (shown by the derivatives with respect to the coefficients). With this specification of the likelihood function, however, we are also able to identify the application probability. Moreover, as we are working on a model with unobserved heterogeneity, this specification allows us to test for the unobserved heterogeneity that is common to individuals making different types of transitions.

3.5 Estimation Results

This section gives the results of the model that was described above. We will first report the results without economic incentives, and then concentrate solely on the results of the different incentive specifications.

Table 25 gives the coefficients of the explanatory variables on the four probabilities: i) transition from employment to unemployment, ii) application from employment to the disability pension, iii) given the disability pension application, the probability of going from employment to the disability pension, and iv) transition from unemployment to employment.

According to the results, those women who are employed in 1987 are less likely than their male counterparts to become unemployed or disabled. Some of the lower probability of a disability transition is explained by a higher number of rejected female disability applicants, as women get more disability rejections than men. This is either because the women who apply are healthier than men who apply, or because the disability criteria are more catered to the illnesses that are more common among men. More women tend to apply for disability pensions if their husbands are already retired. Therefore, the explanation that female applicants are healthier would seem preferable. Yet as we have a health control[117] in the regressions, the mere health explanation seems insufficient.

[117] The data set consists of information on the diseases and medication for which the individual received medical re-imbursement by the National Social Security Institute. The health variable used in the regressions is a dummy variable on the diseases that have a detrimental

	empl. to unempl.	**applies to disability**	**empl. to disability**	**unempl. to empl.**
			(cond on applied)	
Parameter	Estimate (SE)	Estimate (SE)	Estimate (SE)	Estimate (SE)
constant	-3.55 (0.16)	-11.09 (0.22)	-2.24 (0.45)	4.86 (0.35)
female	-0.13 (0.03)	-0.06 (0.03)	-0.26 (0.07)	0.07 (0.06)
sickness indicator	-0.91 (0.07)	1.60 (0.04)	0.02 (0.07)	0.08 (0.17)
age (years)	0.04 (0.00)	0.17 (0.00)	0.08 (0.01)	-0.12 (0.01)
schooling (years)	-0.23 (0.01)	-0.14 (0.01)	-0.01 (0.02)	0.05 (0.02)
home community unemploym (%)	0.07 (0.00)	-0.02 (0.00)	0.01 (0.01)	-0.06 (0.00)
occup. sector				
- manufacturing	(reference)	(reference)	(reference)	(reference)
- agriculture	0.42 (0.06)	0.32 (0.08)	-0.43 (0.15)	0.43 (0.11)
- construction	1.10 (0.03)	-0.26 (0.06)	0.25 (0.14)	0.51 (0.06)
- transport	-0.15 (0.05)	0.04 (0.06)	-0.24 (0.12)	0.41 (0.09)
- commerce	0.44 (0.03)	-0.32 (0.05)	-0.10 (0.09)	0.29 (0.07)
- service	-0.02 (0.03)	-0.09 (0.04)	-0.64 (0.07)	0.87 (0.06)
- finance	0.03 (0.07)	-0.27 (0.10)	0.25 (0.23)	-0.19 (0.18)
public sector	0.37 (0.06)	0.16 (0.09)	-0.84 (0.18)	0.12 (0.12)
Mean Log-likelih.	-2.70			
Number of cases	14,444			

Table 25: Transitions Probabilities (probability of moving from employment to unemployment, probability of a disability pension application, probability of moving from employment to a disability pension on condition of having applied and probability of becoming employed when unemployed)

Notes: Standard Errors are in brackets.

People with health problems naturally apply for disability (the highest coefficient in the table). Interestingly, the health indicator does not produce any further information on the disability transitions, once the application is controlled for. Therefore, there is no additional "weeding out" of the bad applicants from the good applicants, once the application is made. The health indicator has a large negative coefficient on the unemployment transitions. This points to the substitutability between the unemployment and the disability channels, as it is hard to find any other explanation as to why those with deteriorated health have more secure employment than those with good health.

Age has a relatively strong positive effect on the disability applications, and it also has a further effect on the probability of being accepted for the disability pension. Ageing is part of the acceptance criteria for individual early retirement, so the positive effect of age is plausible. In contrast, age has a strong negative effect on the re-employment probability. This is because the aged unemployed have fewer incentives to seek work after a certain age, and because employers have lower incentives to hire older workers because they carry an increased disability liability risk.

Schooling improves re-employment chances, and reduces the unemployment and the disability application probabilities. Local employment conditions have some effect. There is an increased unemployment probability, and a decreased re-employment probability when the home community unemployment rates are higher.

Of the occupational sectors, the agricultural sector has its own pension system. Moreover, a number of agricultural employees are self-employed, and are, therefore, excluded from our sample. Agricultural workers who are not self-employed have a higher probability of unemployment, disability and re-employment than the workers in manufacturing. If the self-employed in agriculture are included in the sample, neither the unemployment probability nor the application probability are significant.

Construction and commerce are sensitive to the economic cycles. Unemployment transitions are more frequent and re-employment probability is higher in these two sectors. Moreover, the propensity to apply for the disability pension is lower, and the acceptance probability is relatively higher in construction than in industry. This could be the case because construction workers move

effect on the work ability of the individual (classified by a medical professional).

frequently into unemployment, and do not therefore consider disability. There might be individuals in construction who are entitled to disability pensions, but they never apply.

The service sector workers receive most disability rejections. This is shown by the lowest conditional probability coefficient of obtaining the disability pension. The service sector also provides most employment opportunities. (The re-employment probability in the service sector is the highest.)

Somewhat surprisingly public sector employment induces unemployment. This could be because the public sector indicator also includes municipal employees. Most of the active labour market programme jobs in the data period were in the municipal sector. Many of these active labour market programme jobs did not lead to a permanent job, but eventually ended up in unemployment.

The coefficients in Table 25 were compared to coefficients when multiple transitions were not allowed for unemployment and the disability channel was not split into two (Hakola 2000b). Magnitude of the coefficients when multiple transitions are allowed is generally greater in the absolute value. Otherwise, there are no huge differences with the model that allowed only single transitions and ignored re-employment. If the disability channel is not split into two stages, the coefficients are largely in the middle of the two coefficient values. For example, the effect of the health coefficient in the single phase regression is more moderate than the coefficient in the probability of the disability application, but greater than the coefficient in the probability of the disability transition, conditional on the application.

Results for the economic incentives are reported in Table 26. Because it is not clear how the incentives from unemployment to employment should be defined, we present no results on this. We present only the incentive coefficients in the interest of saving space. Most of the other coefficients are stable and close to the coefficients in those that were reported earlier.[118]

The first specification reports the results when the Life-Cycle incentive is calculated with the expected end of life at the age of ninety (plus other simplifying assumptions). The life-cycle incentive is repeated in equation 47. Because a higher life-cycle incentive implies better economic circumstances, we would

[118] Coefficients of the control variables are rather stable even when the economic incentives are added to the regression. With a few exceptions, qualitative results hold, and even the magnitude of the parameter estimates is almost unaffected. Only the coefficient on the age variable flips the sign for two incentive specifications.

	empl. to unempl.	**applies to disability**	**empl. to disability**
			(cond. on applied)
Parameter	Estimate (SE)	Estimate (SE)	Estimate (SE)
life cycle unempl. (90) life cycle disability (90)	-0.54 (0.01)	 -0.22 (0.02)	 -0.12 (0.03)
life cycle unempl. (65) life cycle disability (65)	-0.22 (0.03)	 -0.67 (0.05)	 -0.07 (0.11)
option value	-0.64 (0.02)	-0.32 (0.02)	-0.35 (0.06)
implicit tax (subsidy)	-4.41 (.)	-2.11 (.)	-3.02 (.)
max life cycle	-0.60 (0.01)	-0.22 (0.01)	-0.11 (0.03)
time until the life cycle value	-0.29 (0.01)	-0.09 (0.01)	-0.09 (0.02)
unempl. incentive is higher	0.43 (0.05)	0.21 (0.05)	0.45 (0.12)

Table 26: Economic Incentive Measures (other controls as before)

Notes: Standard errors are in brackets.

expect that the higher the incentive, the more likely is the transition. In other words, we expect to get a positive coefficient on the incentive term.

$$U_t(r) = \sum_{s=t}^{r-1} \beta^{s-t} u(Y_s) + \sum_{s=r}^{T} \beta^{s-t} u[kB_s(r, Y_{r-1})]. \quad (47)$$

We see from the table that when the life-cycle incentive is included in the transition regressions alone, all of the estimated coefficients for this variable are counter-intuitive.

The second specification reports the same variable, but now the expected end of life is sixty-five years of age. This is when the official old age pension starts. These coefficients are also counter-intuitive. The higher the expected Life-Cycle incentive value was, the lower was the transition propensity to the specific channel. The counter-intuitive signs are explained by the high cross-sectional variation. In the previous essay of the thesis and in Hakola (2000b), Hakola shows that individuals receiving higher income exit the labour force later. Individuals who have a higher income also have a higher Life-Cycle incentive value. Hence, the Life-Cycle incentive estimates are dominated by the variance between individuals.

The next incentive specification is the option value. The option value is the difference in the life-cycle value if retirement is postponed. The life-cycle utility values are compared between retiring in the period when the utility is at the maximum and retiring immediately. The option value definition is repeated in equation 48.

$$G_t = E_t[U(R^*)] - U_t(t), \tag{48}$$

Because the option value measures the opportunity cost of retirement, we would expect to get a negative coefficient on the option value variable.

The option value coefficient in the table is intuitive and statistically significant. The higher expected option value, that is, the higher the opportunity cost if retirement is postponed, produces a lower transition propensity. Because the option value differences two values of the incentives for the same individual, it effectively controls for the income level differences *between* the individuals. Hence, the option value utilizes the variance in time for the same individual, rather than interacts both the time series and the cross-section variation.

Next, we report the results on the implicit tax (subsidy). This variable is repeated in equation 49. For this variable, we would also expect to get negative coefficients - as for the option value variable.

$$P_t = \frac{G_t}{\sum_{s=t}^{R^*} w_s} \tag{49}$$

Because of the different magnitude of the implicit tax (subsidy) variable, the coefficients for this variable in Table 26 are significantly greater in magnitude than the option value coefficients. Unfortunately, the covariance-variance matrix could not be inverted, and the standard errors could not be calculated. Therefore, the significance of these estimates is indeterminate.

The coefficient for the time until the maximum asset value is of the expected sign and statistically significant for all the channels. In other words, the further the individual is from the maximum, the more willing he is to wait until for retirement.

The indicator on whether the unemployment life-cycle incentive is greater than the disability life-cycle incentive is statistically significant and positive for the unemployment channel. Therefore, the unemployed pay greater attention to the economic incentives. Yet the coefficient is of the same sign and also statistically significant for the disability channel. As we find no explanation for this, we believe that the variable does not measure the incentives as was intended.

Life-Cycle incentive measures that are not differenced have a higher coefficient, in absolute terms, for the disability application propensity than for the conditional disability transition. This could suggest that the incentives matter more at the time of the application than at the transition. Yet this result is reversed for the option value and the implicit tax (subsidy) coefficients (but the differences are within one standard error for the option value). Hence, it seems that, for the between variation, the time of the application is more significant, whereas if the focus is on the in-time variation, the transition time is more significant. For the time until the maximum and the indicator on the maximum channel, there is no difference between the application coefficient and the transition coefficient.

3.6 Conclusion

Disability pensions are governed by an application-award/rejection process. Therefore, the applications differ from the transition by the rejection probability. Moreover, there is a lag between the disability application and the disability transition that should be considered when modelling retirement.

In Europe unemployment rates for the aged are higher than for the other age groups. In fact, unemployment has become an early retirement option for the aged. Unemployment at the end of the career can be characterised by frequent in- and outflows to unemployment. At some age (specific age is a function of the institutions), the inflow to unemployment leads to permanent unemployment. This can be the final withdrawal from the labour markets.

In this paper, we constructed a comprehensive model which separated the disability pension application from the actual transition. This was done with the information on the rejections. The model also allowed for multiple and reverse transitions between employment and unemployment.

Dividing the disability pension route into an application and transition stage yielded some differences in the effects of the explanatory variables. For example, as women got more disability pension application rejections than men, and the applications of those in a service sector were more frequently rejected than those in manufacturing, the impact of these control variables clearly differed between the two stages of the disability pension. The application propensity was higher both for women and for those in the service sector, but their transition propensity was lower than for others.

The effect of dividing the disability route into two stages was more mixed when it is a matter of the economic incentive variables. Because the non-differenced Life-Cycle incentive estimate results were counter-intuitive, their differences between the two stages of the disability pensions are hard to interpret. The option value estimates did not differ significantly between the two stages, but the implicit tax (subsidy) effect estimate was stronger for the conditional transition. Yet we failed to invert the variance-covariance matrix, and therefore the significance of the latter estimates was indeterminate.

Taking into account the multiple and reverse transitions into and out of unemployment did not significantly alter the coefficients that were obtained from models with single transitions. The effects of the various controls on the re-employment probability of the aged were largely as expected. For example, education raised the re-employment probability, whereas higher age reduced it. The economic incentive of re-employment was not taken into account in this essay, as it was not clear how this incentive should be defined. Re-employment incentive would have to account for the potential wages of the job, and the unemployment benefit and pension benefit alternatives. Finding suitable identifying conditions for such variable is hard, if not impossible.

Economic incentive results, in this essay, were somewhat mixed. It was difficult to purge the economic incentive variable of the wage effect. This was shown with the counter-intuitive sign on the pure asset flow -type of variables. Yet when the between-individual differences were removed via the option value or the peak value variable, we got statistically significant, plausible signs.

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4 Part-time Retirement - The Effects of Economic Incentives and Eligibility Restrictions

4.1 Introduction

Part-time pension is one of the early retirement schemes. It combines reduced wages with a partial pension benefit, and reduces the required work effort. Therefore, it offers a rather different income and free time-combination from full-time retirement and from full-time work.

Part-time retirement has been advocated as one way to ease the financial pressures on the Pay-As-You-Go pension systems. If individuals retire later, the pension benefits start later and last for a shorter time period. Because of the special nature of the part-time pension, however, it is not clear that those individuals who choose the part-time pension actually retire later. Instead, they might leave full-time work earlier. This is the case if the part-time pension is preferred by individuals who would have chosen full-time work rather than the full-time pension, had the part-time pension not been available. Because the part-time pensions are also financed by the PAYG principle, the part-time pension scheme might therefore increase rather than ease the pressures of the pension benefit financing.

Until recently, part-time retirement in Finland has not been very common. Prior to 1997, less than three per cent of the relevant age cohorts were on a part-time pension.[119] In the past few years, the part-time pension scheme has become more popular. In 1999, four to five per cent of the relevant age cohorts were already receiving part-time pension benefits. Because of this increase in popularity, the analysis of the part-time pension scheme was deemed important, even if the part-time pensioners still form only a small share of all of the pension recipients.

The part-time pension scheme in Finland has previously been analysed by Takala (1999). She surveys almost all the part-time pensioners in 1995. A number of typical characteristics of the part-time pensioners is identified. Yet because of the lack of a comparison group, responses to the survey questions are hard to interpret. Two survey questions in Takala's study deal indirectly with the eligibility restrictions. Questions on whether the part-time pension was

[119] In contrast, the share of the disability pension was as high as thirty per cent of the same age cohorts.

the respondent's first choice and whether the part-time retiree feels more like an employee rather than a retiree give some support on closer likeness of the part-time pensioners to the full-time employees than to the full-time retirees.

This paper analyses the economic incentives of part-time pensions by comparing the financial compensation in three different labour market states: full-time work, part-time retirement and full-time retirement. Because we observe only one of these states for each individual at one time, potential compensations in the two alternative states have to be imputed. If we assume that individuals choose the alternative where their utility is highest, imputations of the potential compensations have to correct for sample selectivity. In this paper, I apply a sample selectivity correction model by Lee (1983).

Secondly, I analyse the importance of the eligiblity restrictions. This is done in two ways. First, I predict the "second choices" of those individuals who choose the part-time pension. Second, I use prior changes in the eligibility restrictions of the part-time pension scheme to derive the effect of the part-time pension eligibility restrictions on the other labour market states. It is conjectured that a change in the eligibility restrictions of the part-time pension scheme most influences the labour market state that is the closest alternative to the part-time pensions.

The paper proceeds in the following order: First there is a short description of the part-time pension system. Then I present the background theory and the methodology that is used in this paper. This section introduces both the multinomial logit model and the selectivity correction (Lee, 1983). The third section introduces the data that are used, and the fourth and the fifth sections present the expected financial compensation and the eligibility restriction results. The final section, the sixth, draws some conclusions.

4.2 Part-time Retirement - History and Rules

The part-time pension system was introduced in Finland as a part of the flexible retirement system at the end of the 1980s. The law for the part-time pension became effective in the private sector in 1987 and in the public sector in 1989. The part-time pension scheme was part of the proposals given by the Pension Reform Committee at the end of the 1970s. The idea of the committee was to produce a "palet of retirement alternatives" whereupon all individuals could choose the form of retirement that most suited their needs. Two other flexible pension schemes, individual early retirement[120] and early old age retirement, were proposed at the same time. These two schemes became effective a year earlier (1986). Originally, the individual early retirement scheme had a lower minimum age limit (55) than either the part-time pension scheme (60) or the early old age retirement scheme (60).

In the first years of the part-time pension scheme, the minimum eligibility age in the private sector was sixty years. The age limit for the part-time pension in the public sector was lower (58 years), corresponding to the lower age limit for the old age pension in the public sector. In 1994, as an attempt to encourage more part-time pensions, the minimum age was lowered to fifty-eight years in the private sector too. In 1998 (July), the age limit was further reduced, to fifty-six years both in the public and in the private sectors. This reduction was initially temporary, and was meant to last for two years. In 2000, however, the reduction was continued for another two years.[121]

Part-time work and a part-time pension is a voluntary arrangement between the employer and the employee.[122] The work arrangement must include sixteen to twenty-eight hours of work per week.[123] The arrangement must be such that there can be no more than a six-week break in employment (excluding sick leave and vacation). The earnings must be between thirty-five and seventy per cent of the previous earnings. There is, however, a minimum salary that must be earned each year. (In 2000, this limit was 1,206 FIM per month.)

Originally, the part-time pension was awarded only to those who transferred from full-time to part-time employment. Currently, however, there can be a break between the cessation of full-time employment and the transition to part-time work. Yet this break cannot exceed six months. Practically, however, most part-time pensioners still transfer directly from full-time to part-time employment. More specifically, the arrangement is generally done with the same employer (Takala, 1999). The unemployed can also obtain a part-time pension if they find part-time work and fulfil the so-called employment condition.[124]

[120] Individual early retirement is a disability scheme with less stringent health criteria than in the normal disability pension scheme.

[121] In 2001, it was decided that the lower age limit of 56 would not be effective beyond 2002.

[122] In 1998, the part-time pension law was ammended to include a statement that if the employee so desired, it was the employer's duty to try to arrange part-time work. Yet the statement is not legally enforceable.

[123] The self-employed must reduce their work hours by one half.

[124] This employment condition in the private sector requires that the employee has been in full-time employment for at least twelve months in the past eighteen months. Within the past

The part-time pension benefit is one half of the difference between the full-time and the part-time earnings. Hence, it is partial compensation for the reduced earnings. This is in contrast to the accrued pension right that determines the pension benefits for full-time pensions. The part-time pension benefit cannot, however, be more than seventy-five per cent of the full-time pension benefit that is due to the individual.

The formula to calculate the part-time pension benefit changed in 1994. Prior to 1994, the compensation was partially dependent on the employee's age. The compensation varied between forty-four and sixty-four per cent of the reduced earnings, being higher for older part-time pensioners. The introduction of a flat rate for all part-time pensioners (50%) increased the financial incentives for younger part-time pensioners, and reduced the incentives for older part-time pensioners. In 1994, the accrual rules for the old age pension benefits during part-time work were also changed. Prior to this, the old age pension benefits accrued only from part-time work, *not* from the reduced earnings. Since then, however, the old age pension benefits also accrue in full, despite the reduced working time. Therefore, there is virtually no reduction in the old age pension benefits, even if retirement occurs earlier.

Summarizing the effects of the 1994 change in the law, the economic incentives of the part-time pension for the younger age groups (58-61 years) improved, but the effect of the change in the law on the incentives of the older age group was ambiguous. (The change in the flat rate reduced the incentives, but the change in the old age pension accruals increased the incentives.)

Figure 8 shows the share of part-time pensioners in the applicable age groups in the 1990s. It is evident that part-time pensions have become increasingly popular over the years. In 1994, the reduction in the age limit from the age of sixty to fifty-eight in the private sector and the increase in the financial incentives increase the number of part-time pensioners in all eligible age groups. Yet the increase is highest in the younger age groups which had a greater incentive improvement. The effects of the 1998 age reduction (from 58 to 56) are even more obvious. Even if part-time retirement increased in all age groups, the youngest cohorts that are eligible have the highest shares of part-time pensioners.

fifteen years, at least five years must have given the employee accrued pension rights.

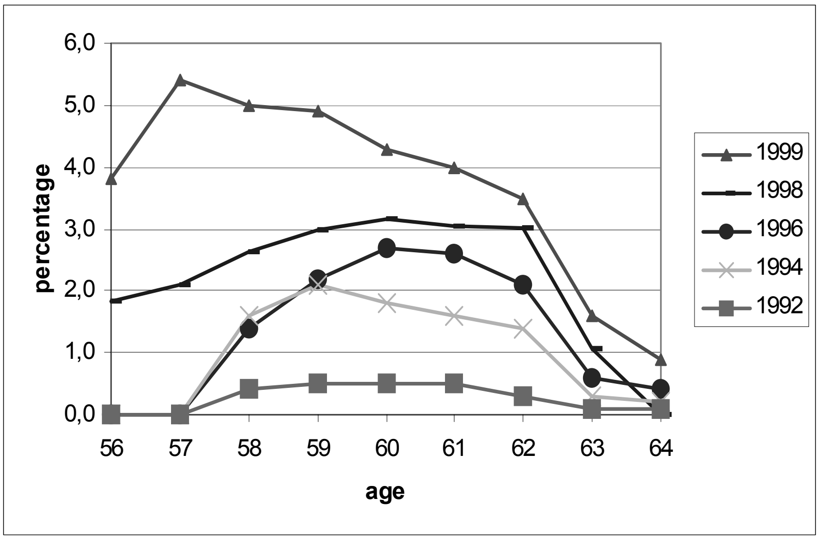

Figure 8: Part-time Pensions Classified by Age (Source: Central Pension Security Institute)

4.3 Utility Maximisation, the Multinomial Logit Model and Selectivity Correction

This section gives the theoretical and methodological framework for the estimations. The first part explains the utility maximisation and the multinomial logit model (MNL), plus the independence of irrelevant alternatives (IIA) assumption that is an intrinsic part of the MNL model. The second part introduces the Lee (1983) approach to the selectivity correction of the sample.

4.3.1 Utility Maximisation and the Multinomial Logit Model

McFadden (1973) showed that a probabilistic theory of choice is the basis of the discrete choice models. If we observe that a certain choice is made, this choice must maximize the utility of the individual. The probability of making a certain choice is therefore a function of the utility levels attributed to the available choices.

Individual behaviour rules map the individual-specific properties and choice-specific attributes into a selection of a discrete choice alternative from the available choice set. In other words, they cause a certain type of individual to choose a certain alternative. There might be different behavioural rules in a population, but all of these rules maximize some utility function. Also, these utility functions need not be the same for different individuals. We might observe that some individuals with the same properties and the same set of choice alternatives make different choices. The choice can also be influenced by properties that we do not observe. (These properties can be either individual-specific or attributes of the choice alternative.) Assuming that the unobservables are distributed randomly within a population, we can rely on the Random Utility Maximization (RUM).

If we assume that the utility of an individual who chooses a specific alternative depends on observable and unobservable individual characteristics and choice attributes, we can present the total utility as follows:

$$U_{ij} = V_{ij} + \varepsilon_{ij}. \tag{50}$$

Here, U is the total utility, V is the observable component (which depends on the observed individual characteristics and choice attributes) and ε is the random utility component (that is, it is not observed). $i = 1, ..., N$ indexes the individual, and $j = 1, ..., J$ the choice alternatives.

If $U_{i,ret}$ is the utility of retirement to an individual i, then $V_{i,ret}$ could be, for example, a function of the health status and the pension benefit of the individual i. ε_{ij} could measure, for example, the work motivation (or any other explanatory variable that is not, or cannot be, measured).

Retirement in this essay consists of three choices: full-time work, part-time retirement and full-time retirement. This gives us three utility equations. These are in equations 51-53.

$$U_{i,fret} = V_{i,fret} + \varepsilon_{i,fret} \tag{51}$$

$$U_{i,pret} = V_{i,pret} + \varepsilon_{i,pret} \tag{52}$$

$$U_{i,work} = V_{i,work} + \varepsilon_{i,work} \tag{53}$$

$U_{i,fret}$ is the total utility of full-time retirement to an individual i. $V_{i,fret}$ is, for example, a function of the full-time pension benefit, $V_{i,pret}$ is then a function of the total financial compensation when the individual is partially retired, and $V_{i,work}$ is a function of the wage when the individual is in full-time work. $\varepsilon_{i,fret}$, $\varepsilon_{i,pret}$ and $\varepsilon_{i,work}$ could measure, for example, the utility value of the flexibility of the work hours.

Because of the unobserved random utility component, the total utility cannot be observed. Yet the observation of the choice that is made by an individual gives information on the ordering of the total utilities of the different alternatives. For example, if we observe that an individual is retired full-time, we conclude that his utility of full-time retirement is greater than his utility of work or his utility of part-time retirement. The probability of full-time retirement is, therefore, equal to the probability that the utility of full-time retirement is greater than the utility of work and the utility of part-time retirement. This is given below. (Individual indicators are dropped to avoid the clutter.)

$$\Pr(j = fret) = \Pr(U_{fret} > U_{work} \;\wedge\; U_{fret} > U_{pret}) \tag{54}$$

If equations 51, 52 and 53 are inserted into equation 54, and the terms are re-arranged, the probability of retirement can be re-formulated as follows:

$$\begin{aligned} \Pr(j &= fret) = \\ \Pr(V_{fret} + \varepsilon_{fret} &> V_{work} + \varepsilon_{work} \;\wedge\; V_{fret} + \varepsilon_{fret} > V_{pret} + \varepsilon_{pret}) \end{aligned} \tag{55}$$

If an assumption of the independence of the irrelevant alternatives (see below) is made, both of these probabilities can be written separately.

If ε_{fret} and ε_{work} are identically and independently distributed, the comparison of full-time retirement and full-time work can be written as equation 56.

$$\Pr(j = fret) = \int_{-\infty}^{+\infty} \{F(\varepsilon_{fret} + V_{fret} - V_{work}) \times f_{fret}\} d\varepsilon_{fret}, \tag{56}$$

where $F(.)$ is the cumulative distribution function, and f_{fret} is the probability density function of the random utility components for full-time retirement.

It is possible to write a similar expression for the choice between full-time retirement ($fret$) and part-time retirement ($pret$). If the choices are assumed to be independent, and all of the error terms are independently and identically distributed, the two probability expressions can be multiplied. Therefore, we get equation 57.

$$\Pr(j = fret) = \int_{-\infty}^{+\infty} \{F(\varepsilon_{fret} + V_{fret} - V_{work}) \times F(\varepsilon_{fret} + V_{fret} - V_{pret}) \times f_{fret}\} d\varepsilon_{fret}, \tag{57}$$

In his seminal work, McFadden (1973) showed that if the random components (ε_j) have a joint generalized extreme value distribution and the random utility maximisation assumptions[125] are met, the model can be resolved by a closed-form multinomial logit model. This is given in equation 27.

$$\Pr(j = fret) = \frac{\exp(\beta' X + \gamma Z)}{1 + \sum \exp(\beta' X + \gamma Z)}, \tag{58}$$

where X is a set of the individual specific properties, Z is a set of the choice specific attributes, β and γ are the coefficient vectors of the individual and choice variables, respectively. Summation is carried out over all the choices.

Independence of Irrelevant Alternatives assumption (IIA) The multinomial logit model rests on the assumption of the independence of the irrelevant alternatives. Accordingly, the choice between two alternatives is assumed to be independent of the other available alternatives. The IIA assumption can be tested by the Hausman (1978) and Small-Hsiao (1985) tests.

The Hausman test statistic compares the coefficient estimates with and without the third (the irrelevant) alternative. The test statistic is

$$q_H = (\widehat{\beta}_u - \widehat{\beta}_r)\prime[V_r - V_u]^{-1}(\widehat{\beta}_u - \widehat{\beta}_r), \tag{59}$$

where $\widehat{\beta}$ is the estimated coefficient vector, V is the variance-covariance matrix (negative of the inverse Hessian, $(-\frac{\partial^2 L_U(\beta^*)}{\partial\beta\partial\beta'})^{-1}$), u is the unrestricted version of the model (there is no third option in the regression), and r is the restricted version of the model. (The regression contains the third option.) For this paper, I tested the IIA assumption with regard to part-time retirement.

If the IIA is to hold, the difference between the two coefficient vectors cannot be too large with the given variable structure. The test statistic has a χ^2 distribution because the coefficients are distributed normally.[126] Therefore, the null hypothesis is:

$$H_0 : q_H < \chi^2_{crit}$$

The null hypothesis can be rejected for two reasons. Either the IIA fails or the explanatory variable vector is misspecified (or both). In other words, even if the test statistic yields a rejection of the null hypothesis, we still cannot be sure that the IIA fails. The test can also reject the null hypothesis because of a model misspecification. Moreover, if the variance-covariance matrices do not

[125] The RUM assumptions are: i) there is a finite set of alternatives; ii) the probability of ties is zero; and iii) the choice is determined by the utility maximisation.

[126] The central limit theorem ensures normality for the $\widehat{\beta}$ estimates.

meet the asymptotic conditions[127], we might not be able to calculate the test statistic.

Small and Hsiao (1985) show that the likelihood ratio test that was proposed by McFadden, Train and Tye in 1977 is asymptotically biased, because their test statistic does not have a chi-squared distribution as assumed. Small and Hsiao derive a test that is asymptotically unbiased. This test is done by dividing the sample first into two random subsamples. Then the unrestricted model is estimated both with the independent and with the same sample as the restricted model. The unrestricted coefficients are weighted appropriately, and compared with the coefficients from the restricted model. The test statistic is based on the difference between the likelihood values of the two estimates. The statistic is given in equation 60.

$$\begin{aligned} q_{SH} &= -2[L(\widehat{\beta}_u^{S1S2}) - L(\widehat{\beta}_r^{S2})], \\ where\ \widehat{\beta}_u^{S1S2} &= (\frac{1}{\sqrt{2}})\widehat{\beta}_u^{S1} + [1 - \frac{1}{\sqrt{2}}]\widehat{\beta}_u^{S2} \end{aligned} \tag{60}$$

Because the sample can be subdivided in a number of different ways, the test statistic can also vary when it is re-performed. It can even provide contrasting results for the same data set. Hence, even this test can be problematic.

4.3.2 Selectivity Correction

The analysis of the financial compensation in the counterfactuals has to deal with an endogeneity problem. In other words, a rational individual is most likely to choose an alternative that rewards him best. If we only observe the choices where the individual has the highest reward, distribution of the observed financial compensation in each of the alternatives is truncated. In order to compare the financial compensation that an individual could receive in each alternative, it is necessary to correct for this truncation. Here, I explain the Lee (1983) method for this selectivity correction.

The Lee method is one of the polychotomous sample selection models. Correction of the sample selectivity in the Lee method uses a transformation of a univariate order statistic (the maximum). In other words, the Lee method uses the knowledge that the chosen alternative, because it was chosen, must

[127] The difference between the restricted variance covariance matrix and the unrestricted variance covariance matrix should always be a positive definite. This, however, might not hold in small samples.

provide the individual with the maximum utility. With this information it is possible to construct a selectivity correction term for the income equations. The Lee method was chosen for this essay because of its convenience in estimations. Alternative methods by Hay (1980) and Dubin and McFadden (1984) make a multinomial generalization of the Heckman method.

Selectivity correction can be presented by the following two-equation simultaneous equation model. (The presentation follows Maddala (1983) and Haveman et al. (1988).)

$$Y_{ij} = \beta_i' X_{ij} + u_{ij},\ (i = 1, 2, ..., n;\ j = 1, 2, ..., m), \tag{61}$$

$$I_{ij}^* = \gamma Z_{ij} + \eta_{ij},\ (i = 1, 2, ..., n;\ j = 1, 2, ..., m), \tag{62}$$

where Y_{ij} is a continuous income variable, observed only if category j is chosen. I_{ij}^* is a continuous underlying latent variable that accounts for the choice of the labour market state. X_{ij} and Z_{ij} are exogenous explanatory variables. Conditional expectation of the error term is zero; $E(u_i|X_i, Z_i) = 0$. The latent variable I_{ij}^* is not observed, but instead we observe an indicator variable I. This variable takes values 1 to m, such that $I = j$, if, and only if, category j is chosen.

More formally this can be stated as

$$I_{ij}^* > I_{ik}^*,\ \forall k\ (k = 1, 2, ..., m;\ k \neq j). \tag{63}$$

Category j is chosen only if it incurs greater value to the individual than any of the other alternatives.

Re-arranging the selectivity equation (62), it is useful to define the following variable (dropping the individual specific i for clarity):

$$\varepsilon_j = \max\ I_k^* - \eta_j,\ (k = 1, 2, ..., m;\ k \neq j) \tag{64}$$

This equation is merely an aid to the presentation. It reads that ε_j is the difference between the value of the second best alternative and the unobservable term of the first best alternative.

It follows directly from the equations above that

$$I = j \quad iff \quad \varepsilon_j < \gamma Z_j. \tag{65}$$

In words, the alternative is chosen, if, and only if, the difference term defined above (difference between the value of the second best alternative and the unobservable term for the first best alternative) is smaller than what can be explained about the first best alternative.

Equation 64 is tractable if ε_j can be specified. If η_j is independently and identically distributed with type I extreme value distribution, it follows that the participation equation can be modelled with a multinomial logit model. (See Maddala p. 59-61.)

In order to insert the necessary corrective term to the wage equation, I can transform ε_j into a normal distribution. This is done in equation 66.

$$\varepsilon_j^* = J_j(\varepsilon_j) = \Phi^{-1}[F_s(\varepsilon)], \tag{66}$$

where Φ^{-1} is the inverse of the standard normal distribution function and F(.) is the conditional density function for the distribution of ε.

Assuming the distribution of ε_j is absolutely continuous and non-decreasing, the choice condition of equation 65 also holds for the transformed distribution:

$$\varepsilon_j < \gamma Z_j \Leftrightarrow \varepsilon_j^* < J_j(\gamma Z_j). \tag{67}$$

With the transformed distribution, I can construct the inverse Mills ratio. The inverse Mills ratio is given in equation 68:

$$\lambda_i = \frac{\phi[J_j(\gamma Z_j)]}{F_j(\gamma Z_j)}. \tag{68}$$

The original income equation can now be estimated with the OLS without any bias in the coefficients. The selectivity term accounts for the truncation in the distribution. The selectivity -corrected equation is the following:

$$Y_j = \beta_j' X_j - \rho_j \frac{\phi[J_j(\widehat{\gamma} Z_j)]}{[F_j(\widehat{\gamma} Z_j)]} + \nu, \tag{69}$$

where $\widehat{\gamma}$ is estimated at the first stage by the multinomial logit model and $\widehat{\beta}$ and $\widehat{\rho}$ are estimated in the second stage by the OLS.

Predictions using the results from equation 69 need to use a different selectivity term for those individuals who do not choose the particular option. As shown before, the selectivity correction term for those who choose the option is $(-\rho_j \frac{\phi[J_j(\gamma Z_j)]}{F_j(\gamma Z_j)})$. In contrast, if the individual does not choose the specific option, the selectivity correction term is $(\rho_j \frac{\phi[J_j(\gamma Z_j)]}{1-F_j(\gamma Z_j)})$. The difference is that the truncation of the distribution occurs at the opposite ends for those who choose the particular option and for those who do not.

4.4 Data

The main data source for this essay is a sample from Employment Statistics. Employment Statistics is a register database on the whole Finnish population. It combines information from more than thirty different individual registers. Information on each individual in the different registers is linked with the personal identity number. The most important registers for the current essay were the tax files from the Finnish Tax Administration[128], employment information from the Ministry of Labour[129], and pension information from the Central Pension Security Institute (ETK) and the Social Insurance Institute (KELA). Additionally the data had socio-demographic variables from various other sources - the most important being the Population Register.[130]

This essay uses a random sample of Employment Statistics. This sample consists of about 300,000 individuals from ages fifteen to seventy-four in 1996. The sample is about eight per cent of the relevant population. For the purposes of the present study, the data set is restricted to the age group that is eligible for the part-time pension (in 1996 individuals from the age of 58 to the age of 64). Hence, the data in 1996 shrinks to 29,233 individuals. The data are further restricted to those who are either working, partially retired or fully retired.[131] This leaves the final data sample in 1996 with 25,669 individuals. Twenty-two per cent of them are working, less than two per cent are classified as partially retired, and about seventy-six per cent are fully retired.

As was explained in the descriptive section, the first change in the eligibility age was implemented in 1994. Yet Employment Statistics has only registered part-time pensions since 1996.[132] The second eligibility age reform was implemented in 1998. Yet the data from Employment Statistics is currently available only until 1997 (with some variables for 1998). Therefore, in order to analyse

[128] Therefore, the data contain wages and salaries, other earnings, taxable income under municipal taxation, taxable income under state taxation, taxable wealth, tax deductible debt etc.

[129] Employment information contains, for example, dates of the current employment each year, the reason why the employment contract was terminated etc.

[130] Other sources were the population information system of the Population Register Centre, employment registers of the Central Pension Security Institute, the State Treasury and the Municipal Pension Insurance Programmes, the Business Register and Register on the Non-Corporate Public Sector of Statistics Finland, the Pensioner Register of the National Social Insurance Institute, Student Registers, the Register on Degrees and Examinations of Statistics Finland and the Conscript Register.

[131] Unemployed and those on sick leave at the end of the year are removed.

[132] The 1995 information on part-time pensions is erroneous, and there was no information on part-time pensions prior to 1995.

the 1994 and 1998 reforms, I needed another data source. For this, I obtained aggregate shares of the relevant age groups in different labour market states.[133] Consequently, I have employment, unemployment, and pensioner shares of the fifty- to sixty-four-year-olds from 1991 to 1999. The employment and unemployment information came from the Labour Force Surveys of Statistics Finland. The pension information is from the pension registers of the Central Pension Security Institute (ETK).

Because this supplementary data comes from two different sources (ETK and Statistics Finland), and the data is not harmonized by the data collectors, there are problems with the quality of the data. The labour market shares of all of the age groups in each year do not total a hundred per cent. (See the appendix.) I use the sample from the Employment Statistics to track down the potential reason for the missing information. (See the appendix.) Some of the missing information is due to the lack of information on those who are outside the labour force without any compensation. In the appendix, however, I show that this does not explain all the difference. Therefore, some of the missing information (the greater share) must be due to classification differences between the two data collectors. For example, Labour Force Statistics determines the unemployment status of an individual by a survey question on job search activity at a specific time of the year, while the unemployment status in Employment Statistics is defined by whether the individual receives the unemployment benefits at the end of the year (or most of the year).

In the appendix, I show that the problem with the missing information is worse in the later years and with younger individuals.[134] Therefore, the "measurement error" is systematic. I show in the appendix that this systematic error is expected to bias the results in the regression analysis.

4.5 Expected Financial Compensation for Full-Time Work, the Part-Time Pension, and the Full-Time Pension

This section provides predictions of the financial compensations in each of the labour market states considered. In other words, I use the Lee model explained in section 4.3.2. to provide estimates of what the individual would have "earned" in each of the alternative labour market states: in full-time work, in part-time

[133] I wish to thank Riitta Latvio for her assistance in obtaining these data.

[134] Only 91-98% of the labour market states could be identified in 1997-1999 and only 89-96% of the labour market states of the 55-60 year olds could be identified.

retirement and on full-time pension. I first report the first stage of the Lee Model, the multinomial logit model, which provides results on the probability that an individual will be in a specific labour market state. These probabilities are used for the selectivity term in the income regressions. I report the second stage of the Lee model, the income regressions, in 4.5.2. Here, the estimates are corrected for the selection. In 4.5.3., I use the regression results to predict the income in the three labour market states, and I also try to see whether the estimates imply that the financial compensation guides the choice of labour market states.

4.5.1 The Multinomial Logit Model of the Channel Selection

The multinomial logit model regresses the probability of choosing a particular labour market state on the individual properties and the labour market state attributes. This model gives the participation probabilities. Later, these participation probabilities are used to construct the selectivity term that corrects for the truncated distributions of income in each of the alternatives.

As the Lee model is a Heckman type of a selectivity model with participation and income regressions, the estimates have to be well identified.[135] I need an exclusionary restriction, that is, a variable that affects the labour force participation, but not the income.[136] I assume that the joint time of leisure for a couple increases their utility. So, a spouse's labour market status affects labour force participation, but not the income directly. Hence, a spouse's labour market status is a suitable exclusionary restriction.[137] I also use the wealth variable as a second exclusionary restriction. The idea is that wealthy individuals have more of an option on whether to participate in the labour force, and therefore wealth affects labour force participation. Yet wealth does not affect the wages.[138]

Because the Lee model is a selectivity model with multiple labour market options, the probability of choosing one of the three alternatives should be affected differently by some of the explanatory variables. In other words, some of the

[135] Because participation in the labour markets and the income tend to be explained by the same set of explanatory variables, exclusionary restrictions can be hard to find.

[136] If it is assumed that reservation wages determine labour force participation, the similarity of labour force participation and income equations becomes more apparent.

[137] Because many of the aged spouses are retired, there should be enough variation in a spouse's labour market status for the older population.

[138] This exclusionary restriction, however, is not as good as a spouse's labour market status. It is quite possible, and even likely, that wages affect wealth, even if wealth does not affect wages.

controlled properties should "reward" the individual more for making the specific choice. My hypothesis is that the part-time pension is a particularly "good deal" for the self-employed and, therefore, I would expect that self-employment increases the probability of the part-time pension. I also assume that there are several variables (for example, age, education, a spouse's labour market status) that affect the full-time retirement probability differently from the other two options.

The estimated multinomial logit model is given in equation 70,

$$P_{ij} = \frac{\exp(\beta_j X_{ij})}{\sum_{j=1}^{3} \exp(\beta_j X_{ij})}, \tag{70}$$

where X stands for the explanatory variables, and β is the estimated coefficient vector. Because the model can only identify the variable effect with respect to the other labour market states, β vector for the full-time retirement is normalized to zero. The marginal effect gives the change in probability due to the change in the explanatory variable. It is $\frac{\partial P_j}{\partial x} = P_j(\beta_j - \overline{\beta})$, where $\overline{\beta} = \sum_{j=1}^{3} P_j \beta_j$.

The results of the multinomial regression using data from 1996 are in Table 27. Marginal effects are in square brackets.

A spouse's labour market status has the expected impact on the probability of employment and part-time retirement. If the spouse is retired, the individual is less likely to work full- or part-time, and more likely to be in full-time retirement. If the spouse works, the individual is more likely to work, and less likely to be in full-time retirement. Hence, couples make choices that show that the joint time of leisure increases their utility. The wealth coefficient also confirms the expectations. Higher wealth increases the probability of full-time retirement.[139] Even if these identifiability restrictions cannot be tested, the results in this respect seem promising.[140]

The differential impact of the explanatory variables on the choice probability, however, does not seem as promising. The self-employment dummy works contrary to my expectations. I expected that the nature of the work for the

[139] Ownership of one's own home is included here as an additional measure of wealth. It increases the probability of part-time retirement, but reduces the employment probability. So this control for wealth contradicts the expectations. Yet the coefficient on employment is not statistically significant.

[140] The exclusionary restrictions are not testable. Even if the variables were to get statistically significant coefficients independently in the income regressions, this effect could be due to the participation effect, not to the effect on income directly.

Variable	Employed	Part-time ret	Full-time ret
Economic incentive	(SE) [Marg]	(SE) [Marg]	[Marg]
- income at the age of 57 or two years earlier ('0,000 FIM)	1.00 (0.03) [0.12]	0.94 (0.06) [0.01]	[-0.13]
- wealth ('00,000 FIM)	-0.02 (0.005) [-0.002]	-0.02 (0.01) [-0.0002]	[0.002]
- owns own home	-0.01 (0.06) [-0.001]	0.37 (0.16) [0.004]	[-0.003]
Individual properties			
- age	-0.62 (0.01) [-0.07]	-0.38 (0.03) [-0.004]	[0.08]
- female	0.48 (0.05) [0.06]	0.60 (0.11) [0.006]	[-0.06]
- years of education	-0.04 (0.01) [-0.005]	0.03 (0.02) [0.0004]	[0.004]
- no spouse	-0.16 (0.06) [-0.02]	-0.30 (0.14) [-0.003]	[0.021]
- spouse is			
* retired	-0.40 (0.06) [-0.05]	-0.42 (0.14) [-0.004]	[0.050]
* working	0.14 (0.06) [0.02]	0.21 (0.14) [0.002]	[-0.018]
* unemployed	ref	ref	ref
- geographical location			
* Northern Finland	-0.22 (0.07) [-0.02]	-0.03 (0.18) [-0.000]	[0.024]
* Eastern Finland	-0.18 (0.08) [-0.02]	-0.34 (0.21) [-0.003]	[0.023]
* Southern Finland	0.09 (0.05) [0.01]	0.37 (0.13) [0.005]	[-0.015]
* degree of unempl. in the home com. (%)	-0.04 (0.01) [-0.004]	-0.01 (0.02) [-0.000]	[0.004]
Work-related			
- self-employed	5.37 (0.11) [0.81]	4.85 (0.20) [0.04]	[-0.855]
- public sector employee	0.16 (0.05) [0.02]	0.47 (0.12) [0.06]	[-0.025]
- occupational sector			
* agriculture	-0.39 (0.08) [-0.04]	-1.07 (0.23) [-0.009]	[0.049]
* industry	ref	ref	ref
* construction	0.02 (0.08) [0.001]	0.58 (0.18) [0.009]	[-0.010]
* services	0.75 (0.05) [0.09]	1.44 (0.12) [0.02]	[-0.113]
* finance	-0.20 (0.13) [-0.02]	0.55 (0.26) [0.009]	[0.014]
* trade	0.54 (0.06) [0.07]	0.64 (0.15) [0.008]	[-0.079]
* transpt and communic	0.21 (0.08) [0.03]	-0.19 (0.23) [-0.002]	[-0.024]
constant	35.57 (0.76)	16.57 (1.64)	
# of Observations	25,669		
Likelihood value	-10,381.73		

Table 27: Multinomial Logit Results on the Channel Selection in 1996 (reference channel: full-time retirement)

Notes: Standard errors are in brackets. Marginal effects are in square brackets. Marginal effects are evaluated at the mean of the continuous variable and at zero for a categorical variable.

self-employed would be such that they would be better rewarded in the part-time pension scheme. Therefore, I expected that the self-employed would have a greater probability to be on a part-time pension. Yet looking at the marginal effects of the dummy on self-employment, I see that self-employment has a greater effect on the employment probability than on the part-time pension probability. Altogether, because there are so few individuals on a part-time pension, the marginal effects of all the variables in that option are very small (and many of the estimated coefficients are not significant). Therefore, it is not clear that the model can identify the part-time pensioners from the full-time workers.

Other controls have relatively plausible effects. Older individuals are more likely to be fully retired than working full- or part-time.[141] As everyone eventually ends up in full-time retirement, this sounds very plausible. Women are more likely to work full- or part-time. This is in line with earlier findings that indicate that women who work tend to do so longer than men. The education variable gives results contradictory to the previous studies. (See, for example, the two previous essays.) Education reduces the probability of employment. This effect is, however, very small and sensitive to the other controls and zero wage observations.[142] Out of the geographical controls, work is less likely in the economically troubled areas of the Northern and Eastern parts of Finland. This is also in line with my earlier findings (Hakola, 2000). Part-time retirement is more common in the South (which includes the capital region). The local community unemployment rate does not have a statistically significant effect on the part-time retirement probability. Finally, public sector employees[143] are more likely to work full or part-time. Specially, the part-time pension is relatively common among public sector employees. Out of the occupational sectors, Takala (1999) finds that the part-time pension is relatively rare among workers in manufacturing and more common in services, trade and finance. The same results hold in this study - most notably in services.

[141] This finding is not sensitive to restricting the data sample to the younger spectrum of the age category (58 to 61).

[142] If education is the only explanatory variable, education increases both the employment and the part-time retirement probabilities. If zero wages are not excluded and age and income are controlled, this education reduces the employment probability.

[143] Public sector employment here included both municipal and government employees.

4.5.2 The Selectivity Correction of the Income Estimates

In this section, I present the selectivity corrected income equation estimates following the Lee methodology. Lee's selectivity correction mechanism was explained in section 4.3.2., and the income equation is reproduced below:

$$Y_j = \beta_j' X_j - \rho_j \frac{\phi[J_j(\widehat{\gamma} Z_j)]}{[F_j(\widehat{\gamma} Z_j)]} + \nu.$$

Y_j is the taxable income and X_j has a set of the explanatory variables. The second explanatory variable ($\frac{\phi[J_j(\widehat{\gamma} Z_j)]}{[F_j(\widehat{\gamma} Z_j)]}$) is Heckman's lambda, and ρ_j is its coefficient. Z_j is the set of the explanatory variables in the participation equation (the multinomial logit model above), and it has all the variables that are in X_j plus dummies on the spouse's labour market participation (retired, employed or unemployed/sick) and the wealth variables.

The results of this income regression are in Table 28. The dependent variable for the income equations is taxable income. In Finland pension benefits are subject to the same income taxation as wages. Therefore, all income is treated symmetrically for the three options. [144]

Looking at the coefficients in Table 28, I see that none of the selectivity terms gets a statistically significant coefficient. Therefore, either the distribution does not need to be corrected (unlikely), or there is not enough variation in the participation equation to do the correction.

Other coefficients are largely as expected. Women earn significantly less in each of the options, education raises earnings, earnings in the capital region of the South are higher than in the rest of the country. Higher public sector earnings for the employed are somewhat puzzling. Korkeamäki (1999) produces contrasting results with the same data source.[145] The positive coefficient on the public sector dummy in the part-time and full-time retirement income regressions is plausible, because of the more favourable pension systems in the public sector.

[144] Progressivity of taxation and deductions mean that disposable income is not derived in the same manner in the three options. Yet this is ignored in the current essay.

[145] My data set is restricted to older individuals whereas Korkeamäki has all the age groups. Because public sector employees have the option to retire earlier, it could be that the public sector workers in my sample suffer more from the selectivity. (Only the higher income individuals stay at work.)

Variable	Employed	Part-time retired	Fully retired
Constant	-40.89 (8.00)	-2.07 (14.78)	3.73 (1.87)
Lambda	-0.001 (0.008)	-0.002 (0.02)	-0.002 (0.002)
Age	1.55 (0.26)	0.19 (0.49)	-0.01 (0.06)
Age squared	-0.01 (0.002)	-0.001 (0.004)	0.000 (0.000)
Female	-0.23 (0.01)	-0.22 (0.03)	-0.28 (0.004)
Years of schooling	0.08 (0.003)	0.08 (0.004)	0.10 (0.001)
Deg. of unempl. in home com.	-0.01 (0.002)	0.001 (0.004)	-0.004 (0.005)
House ownership	0.02 (0.02)	0.07 (0.04)	0.15 (0.004)
Lives in Eastern Finland	0.0001 (0.03)	0.09 (0.05)	-0.04 (0.01)
Lives in Northern Finland	0.07 (0.03)	-0.05 (0.05)	0.005 (0.006)
Lives in Southern Finland	0.13 (0.02)	0.08 (0.03)	0.09 (0.01)
Public sector employee	0.20 (0.02)	0.07 (0.03)	0.18 (0.01)
Occupational sector			
* agriculture	-1.01 (0.02)	-0.21 (0.05)	-0.18 (0.01)
* industry	ref	ref	ref
* construction	-0.08 (0.03)	-0.16 (0.05)	0.03 (0.01)
* services	0.06 (0.02)	0.06 (0.03)	0.18 (0.004)
* finance	0.31 (0.05)	0.12 (0.07)	0.39 (0.01)
* trade	-0.22 (0.02)	-0.22 (0.04)	0.08 (0.01)
* transport and communic	-0.08 (0.03)	0.10 (0.06)	0.15 (0.01)
Number of Observations	17,019	1,542	58,446
Log Likelihood value (R^2)	-21,905 (0.31)	-959 (0.40)	-30,175 (0.40)

Table 28: Second Stage Selection Corrected Income Equations (Dependent Variable: Taxable Income)

Notes: Standard errors are in brackets.

4.5.3 Predicted Income when at Work, on Part-time Pension and on Full-time Pension

Estimated coefficients from the second stage (selectivity corrected earnings equations) are then used with the data on the observed characteristics of all individuals in the expected income calculations. These are done for all the three options: employment, part-time pension and full-time pension.

The formula that is used to derive the expected income in each of the three alternatives is given below (individual indicator i is dropped for clarity):

$$\begin{aligned} E(income_j) \quad = \quad & \beta_0 + \beta_1 \times age + \beta_2 \times age^2 + \beta_3 \times D_{female} \\ & + \beta_4 \times school\ years + \beta_5 \times community\ unempl.\ rate \\ & + \beta_6 \times D_{\hom e\ owner} + \beta_6 \times D_{agriculture} + \beta_7 \times D_{construction} \\ & + \beta_8 \times D_{services} + \beta_9 \times D_{transport} + \beta_{10} \times D_{trade} \\ & + \beta_{11} \times D_{finance} \\ & + \beta_{12} \times Heckman's\ lambda\ estimate_j \end{aligned} \tag{71}$$

The formula highlights the need to have sufficient variation in the term for Heckman's lambda. As none of the other variables varies between the three options, the model is asking a lot from Heckman's lambda. Moreover, as the income estimations showed above, the coefficient on Heckman's lambda (β_{12}) in all the labour market states is tiny. It therefore seems that the Lee model works poorly in this context.

Nevertheless, the expected income for each individual in each of the three labour market states is calculated. These are in Table 29. The table gives the mean, the standard error, the minimum and the maximum value of the earnings expectations in each of the labour market states. The expected income values are given for all individuals, as well as for those who are (or are not) in a particular labour market state. The expected part-time retirement income is reported separately for individuals in all three labour market states.

The table shows that, on average, the part-time pension is the most attractive choice financially for all individuals.[146] Those who are at work and those who are on part-time retirement get, on average, a greater financial compensation than those who are not in these labour market states. This is not the case

[146] The average expected part-time pension benefit is 103,670 FIM per year, which is higher than the expected income in the other two options.

Expected income for	mean	se	min	max
- work (all)	**93.84**	47.68	15.01	591.70
* if working	108.08	63.02	15.01	540.31
* if not working	89.79	41.44	15.22	591.70
- part-time pension (all)	**103.67**	34.41	46.87	417.71
* if on part-time pension	130.22	52.51	53.66	367.55
* if not on part-time pension	103.13	33.73	46.87	417.71
* if working	109.08	43.46	51.00	378.43
* if on full-time pension	101.40	30.09	46.87	417.71
- full-time pension (all)	**76.46**	37.46	32.50	610.51
* if on full-time pension	72.59	31.31	32.50	610.51
* if not on full-time pension	88.65	50.39	35.29	521.98

Table 29: Predicted Income for All Channels in 1996 ('000 FIM per year)

for those on full-time retirement. Those who are not fully retired would have a higher full-time pension, on average, than those who are fully retired.

Comparing the expected part-time pension income between those in the different labour market states, we see that the average expected compensation is the highest for those who are partially retired. Yet if those individuals who are working obtained the part-time pension, they could expect to get a greater financial compensation than what they expect to get from work. Therefore, it seems surprising that the part-time pension is not more popular.

Applying the principle of comparative advantage to the pay-off for the part-time pension, I derive two equilibrium conditions. These are in equations 72 and 73.

$$\frac{part-time\_pension\_income}{full-time\_pension\_income}|_{pret} > \frac{part-time\_pension\_income}{full-time\_pension\_income}|_{fret} \tag{72}$$

$$\frac{part-time\_pension\_income}{wage}|_{pret} > \frac{part-time\_pension\_income}{wage}|_{work} \tag{73}$$

The equations state that the advantage of the part-time pension income over either of the other two options should be greater for those who actually chose part-time retirement than for those who did not. I calculated these expected payment ratios from the expected income for all individuals. In Table 30, I give the mean, the standard error, the minimum and the maximum of these ratios both for those who are on part-time pension and for those who have selected the specific alternative.

Variable	mean	se	min	max
$\frac{part-time\_pension\_income}{full-time\_pension\_income}$				
- partially ret	1.39	0.25	0.81	2.22
- fully retired	1.57	0.38	0.54	3.29
$\frac{part-time\_pension\_income}{wage}$				
- partially ret	1.12	0.43	0.54	3.27
- working	1.33	0.76	0.37	6.92

Table 30: Comparative Advantage of Partial Retirement vs. Others

The table shows that the partially retired do not have, on average, a comparative advantage in their expected income over those who are fully retired or those who are in full-time work. There is less variance in the ratios for the partially retired. The minimum values in both cases are higher for those on a part-time pension, but so are the maximum values.

4.6 The Effect of the Eligibility Restrictions of the Part-Time Pension Scheme on the Other Labour Market States

This section assesses the impact of the part-time pension eligibility restrictions on the other labour market states. First, I derive evidence from the logit model, and predict the share of the partially retired who would have ended up in full-time retirement, had the part-time pension scheme not existed. Then I look at the past eligibility changes in the part-time pension scheme, and assess the impact of these changes on the other labour market states.

4.6.1 Predictions of the "Second Most Preferred Labour Market State" for Part-time Pensioners

Using the multinomial logit model that was presented above, it is possible to derive the probability that an individual will be in a certain labour market state. Moreover, if the independence of irrelevant alternatives (IIA) assumption holds (see section 4.3.1.), the ratio of the predicted probabilities of two labour market states is independent of the existence of the third labour market state. Hence, if the IIA holds, individuals with exactly the same observables have the same probability ratio of employment to the full-time pension, regardless of whether the part-time pension is available.

If the IIA holds, the predictions can actually use the binomial logit model where the choice is only between the two alternatives. If the binomial logit model were used to predict the probability of being in either of these two alternatives, the predictive accuracy should be fairly good (McFadden, 1984). In this essay, however, I experiment with the model one stage further. I will derive predicted probabilities between the two alternatives for those who are in the third, "the irrelevant", alternative. That is, I use the binomial logit model of full-time work and full-time retirement to predict the probability of full-time retirement for those who are on a part-time pension.

First, however, in order to use the binomial logit model, I needed to test whether the IIA assumption was valid for the part-time pension. I did both the Hausman test and the Small-Hsiao tests for the IIA assuming that the part-time pension was the "third alternative".

For the Hausman test, I did the multinomial logit model of full-time work, part-time retirement and full-time retirement. Then I ran the same variables on the binomial logit model on full-time retirement and full-time work. With both of these coefficients and the variance-covariance matrices I constructed the Hausman test statistic. This test statistic was highly sensitive to the covariates included. Most of the time, the test statistic provided nonsense negative χ^2 values.[147] Therefore, the model did not meet the asymptotic conditions of the test. The difference between the variance-covariance matrices of the restricted and the unrestricted versions was not a positive semidefinite. Hausman and McFadden interpret the negative test values as evidence that the IIA cannot be rejected.[148]

The Small-Hsiao test could not reject the IIA, either. Because neither of the tests rejects the IIA, and because the coefficients of the binomial and multinomial logit models were close, the IIA could not be rejected for the part-time pensions. This is plausible (and likely even at the outset) because those who are on the part-time pension make up only about two per cent of the sample. Hence, the exclusion of the part-time pensioners is unlikely to have a huge impact on the ratios of the probabilities of the other two labour market states.

[147] Hausman and McFadden (1984) find that it is rather common to obtain negative values for the test statistic in finite samples (see page 1226 fn 4). They propose a fix that ensures that the difference between the variance-covariance matrices is always a positive semidefinite. Yet they also state that this "alternative" variance-covariance matrix is always a small positive number, and in no case do they find it to "come close to any reasonable value for a χ^2 test".

[148] Freese, Jeremy and J. Scott Long, Tests for the multinomial logit model, Stata Technical Bulletin 58, 2000.

Using the coefficients of the binomial logit model and the observed characteristics, I construct the probabilities of full-time retirement for those individuals who are on the part-time pension scheme. This construction with the maximum number of explanatory variables is in equation 74.

$$\begin{aligned}\hat{P}(full\ retirement) = {} & \hat{\beta}_0 + \hat{\beta}_1 \times income_{55-57} + \hat{\beta}_2 \times wealth \\ & +\hat{\beta}_3 \times D_{\text{hom}\,e\ owner} + \beta_4 \times age + \beta_5 \times D_{female} \\ & +\beta_6 \times education + \beta_7 \times D_{\sin gle} \\ & +\beta_8 \times D_{spouse\ retired} + \beta_9 \times D_{spouse\ working} \\ & +\beta_{10} \times D_{North} + \beta_{11} \times D_{South} + \beta_{12} \times D_{East} \\ & +\beta_{13} \times community\ unempl.\ rate \\ & +\beta_{14} \times D_{self-employed} + \beta_{15} \times D_{public\ \sec tor} \\ & +\beta_{16} \times D_{agriculture} + \beta_{17} \times D_{construction} \\ & +\beta_{18} \times D_{services} + \beta_{19} \times D_{finance} \\ & +\beta_{20} \times D_{trade} + \beta_{21} \times D_{transport}\end{aligned} \tag{74}$$

To see the sensitivity of the predictions, I experiment with different sets of the explanatory variables. If there are no explanatory variables in the prediction, but only the constants, the prediction of the model is close to the original split of the sample (78% in retirement, 20% in employment and 2% in part-time pension in 1996). When explanatory variables are added to the prediction, the predicted split share changes. In the appendix, I present the means of the observed variables for those in each of the three labour market states. I then claim that the observables indicate that the part-time retirees resemble the full-time employees more closely rather than the full-time retirees. Therefore, once I add explanatory variables to the prediction of the share of the full-time retirees, I expect that increasingly more of the part-time retirees are predicted to stay at work rather than retire full-time. This is confirmed by the results in Table 31. If I have only the constant terms in the predictions, I predict that, in 1996, seventy-seven per cent of the part-time retirees retire full-time. If I have all of the variables from equation 74 in the prediction, I predict that only fifty-six per cent of the part-time retired retire full time. At the maximum, I predict that forty-seven per cent of the part-time retirees would work if there were no part-time retirement (1997 data, with all the explanatory variables). At minimum, twenty-three per cent of them would have continued with full-time work (1996

	Included variables	1996	1997
1	all variables from equation 74	56%	53%
2	all economic incentives and individual properties	61%	58%
3	all economic incentives, age, gender, years of education, civil status, spouse's status	61%	58%
4	all economic incentives, age, gender, years of education	62%	58%
5	income, age, gender, years of education	62%	58%
6	income, gender, years of education	67%	64%
7	no explanatory variables	77%	75%

Table 31: Average Predicted Probabilities for the Partially Retired to Retire Full-Time

data, with no explanatory variables).

4.6.2 The Effects of the Past Eligiblity Restriction Changes

The eligibility criteria of the part-time pensions have been changed twice, in 1994 and in 1998. Because these regulatory changes bring independent variance to the part-time pension eligibility (independent of age and year), I can use the differences in eligibility to compare the labour market choices of those who are eligible for the part-time pension to the labour market states of those who are not eligible. If some alternative labour market share is more affected for those who become eligible for the part-time pension than for the so-called control group, the part-time pension reform has an impact on the choice of that alternative labour market state. In other words, if employment falls more for those individuals who become eligible for the part-time pension scheme than for those who are not eligible, employment was substituted for the part-time pension. Then the part-time pension reduces the working years and hastens retirement. I test this substitution effect on employment, unemployment, full-time retirement and, "voluntary" full-time retirement.

In order to get reliable comparisons, I need to find an appropriate control group for those who are eligible for the part-time pension. The appropriate control group is such that there are no other major changes that affect this group differentially from the target group, except for this part-time pension eligiblity change. In order to facilitate the search for the control group, I listed all the recent pension scheme reforms that affected the age cohorts that were also affected by the part-time pension scheme reforms. These are in Table 32.

Year	**Cohort**	**Regulatory changes**
1994	1940-	Individual early retirement eligibility from 55 to 58
1994	1935-	Part-time pension eligibility from 60 to 58 (private sector)
1994	1929-1934	Incentive changes in the part-time pension scheme
1994	1934-	Accrual % increase to 2.5 if working and age>60 years
1994	1934-	Unemployment requirement for the unemployment pension from 200 to 500 days
1996	1943-	Individual early retirement, disability, unemployment pension accrual were reduced during the future time
1997	1942-	Unemployment tunnel eligibility from 53 to 55
1998 (1.7.)	1940-	Part-time pension eligibility from 58 to 56 (temporary to 2002)

Table 32: Regulatory Changes that Affected the Relevant Cohorts in 1994-1999

In 1994, there were a number of changes. The eligibility age for individual early retirement was increased, the part-time pension eligibility age was decreased, there were incentive changes in the part-time pension scheme, the pension accrual percentage was increased for those over sixty years of age who continued at work, and the required number of days of unemployment prior to the unemployment pension was increased. In 1996, the future time pension accrual was reduced, and, therefore, the pension benefits of the unemployment pension, individual early retirement and the disability pension were decreased.[149] In 1997, the eligibility for the unemployment tunnel was restricted (the age limit was increased from 53 to 55), and in 1998 the part-time pension eligibility age was increased.

Because the unemployment rates also differ greatly between different cohorts in this period, it is important to take the unemployment regulations also into account while one is choosing the control group. Unemployment pension is available from sixty years on, so unemployment rates fall suddenly at this age. Because there is no fall in unemployment benefits if unemployment starts at the age of fifty-five, the unemployment rates for those aged from fifty-five to fifty-nine are high. These effects were particularly strong in the 1990s when Finland experienced a huge recession.

[149] The future time is the time between early retirement and old age retirement. (Old age retirement in Finland takes place at the age of 65.)

Age in 1994	Cohort	Age in 1998	Cohort
64	1930	64	1934
63	1931	63	1935
62	1932	62	1936
61	1933	61	1937
60	1934	60	1938
59	1935	59	1939
58	1936	58	1940
-		57	1941
-		56	1942

Table 33: Relevant Age Cohorts for the 1994 and 1998 Eligibility Reforms

Graphical Evidence First, I show graphically what happens to the labour market shares of the relevant age groups in the years 1994 and 1998, when the part-time pension system was reformed.

To ease the interpretation of the graphical exposition, I first provide Table 33, which shows the relevant cohorts for the two reforms. The 1994 eligibility age change affected the age groups of fifty-eight and fifty-nine, that is, the cohorts that were born in 1935 and 1936. The incentive reform also improved the incentives of the cohorts born in 1933 and 1934. The cohort born in 1934 qualifies for the unemployment pension in 1994 (age 60), so there should be a big change in the unemployment rates between 1993 and 1994 for this cohort. The eligibility age reform in 1998 affected the age groups fifty-six and fifty-seven, that is, the cohorts born in 1941 and 1942. The big change in the unemployment rates in 1998 hits the cohort born in 1938 (age 60).

Figure 9 gives the shares of the part-time pensioners in the 1990s by cohorts. In 1994, there is a big increase in the shares of the part-time retirees, specially in the younger cohorts. The share of the part-time pensioners of the oldest cohort (born in 1931) actually falls. This favours the conclusion that the regulation changes in 1994 were effective.

Figure 10 demonstrates the effects on the employment rates.[150] The 1994 minimum age reform affected the birth cohorts of 1935 and 1936. The financial incentive change affected the birth cohorts of 1933 and 1934. Cohorts 1937 and 1938 can be held as control cohorts. In order for there to be substitution between the part-time pension and employment[151], there should be a greater *fall* in the

[150] Part-time pensioners are excluded from the employed.

[151] That is, the part-time pension reduces employment and hastens retirement.

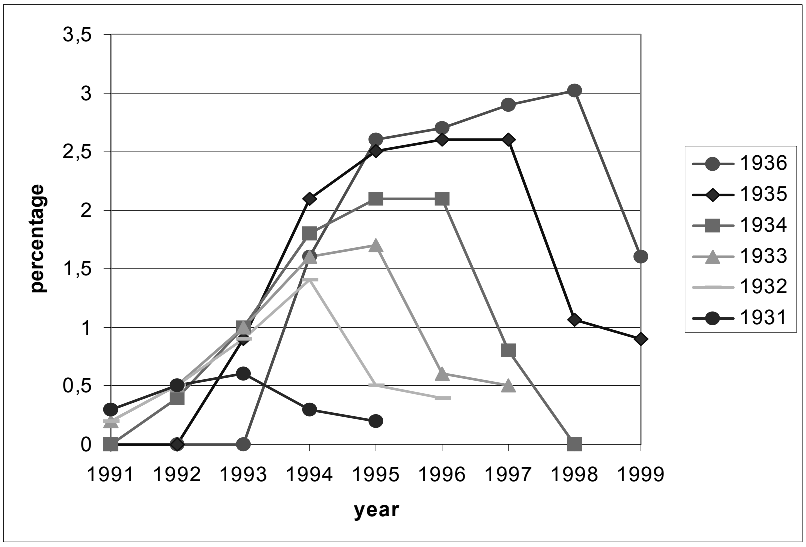

Figure 9: Part-time Pensioner Shares by Age Cohorts (Source: Central Pension Security Institute)

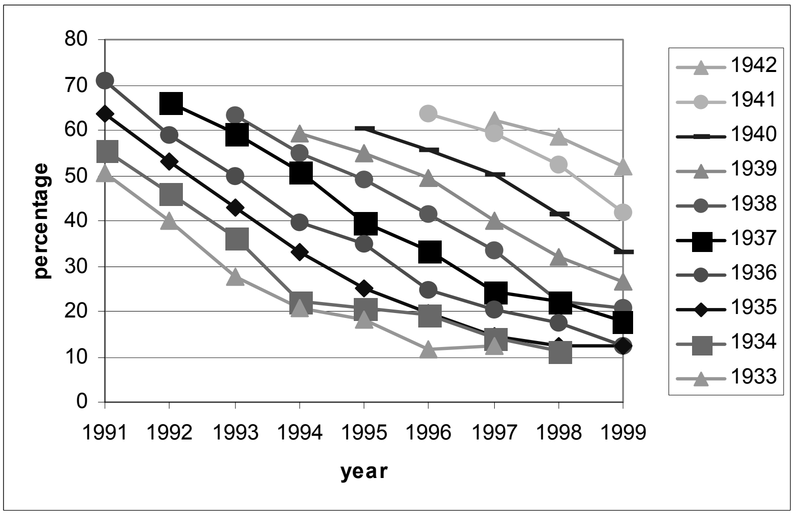

Figure 10: Employment Rates by Age Cohorts (Excluding Part-time Pension) (Source: Labour Force Survey, Statistics Finland)

employment rates when the eligibility for the part-time pension is granted to the target group. In 1994, there is a bigger fall in the employment rates of the 1934 cohort than any of the other cohorts. Otherwise, no such evidence can be found. Because the 1934 cohort is the cohort that also becomes eligible for the unemployment pension, changes in the employment rates of this cohort are not the result of the part-time pension reform. So this graph does not provide evidence in favour of the part-time pension substitution for full-time work.

The 1998 reform's target cohorts were those born in 1941 and 1942. Older cohorts can be used as control cohorts. Again, there is a greater fall in the employment rates of the cohort of 1938 that qualifies for the unemployment pension. Yet there is not much of a difference with the other control cohorts. Hence, neither does the 1998 reform provide evidence of the substitutability with employment.

Figure 11 shows the effects of part-time retirement on the full-time retiree shares (again excluding the part-time pensions). Because the part-time retiree

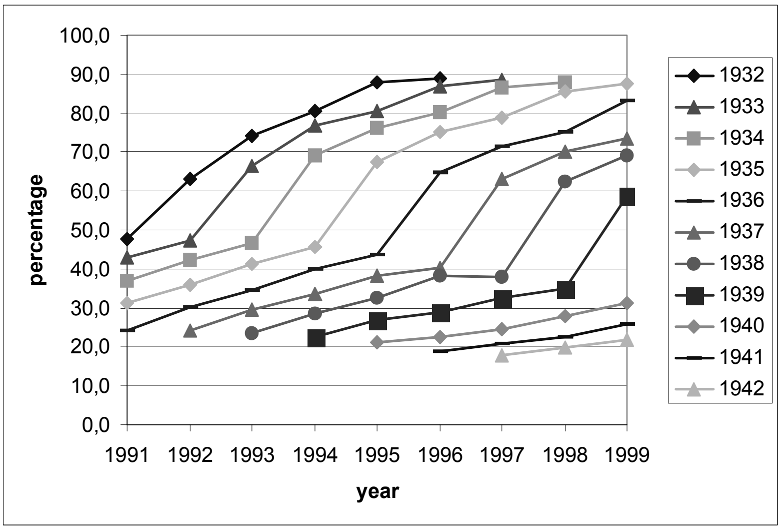

Figure 11: Retiree Shares (excluding part-time pensions) by Age Cohorts (Source: Central Pension Security Institute)

shares are rising by age, there should be a smaller increase in the full-time retirement shares in the target group than in the control group, if part-time retirement were to delay full-time retirement.

In 1994, the retirement shares of the oldest target cohorts (1933 and 1934) rise most of all. These are again first cohorts when the unemployment pension is available. The difference between the rates for the younger target cohorts and the control cohorts is not visible. Nor is the difference visible in the 1998 reform. (Target cohorts are 1941 and 1942.)

Finally, the idea was to include in the retirement shares only those retirements that have a stronger voluntary aspect. Individual early retirement and early old age pensions were introduced around the same time as the part-time pensions. They also appear to be more voluntary than the unemployment and the disability pensions. Therefore, it could be that there is more substitutability between the voluntary pensions and the part-time pension. Hence, the same analysis was repeated for the "voluntary" sub-group of pensions. This is in figure 12.

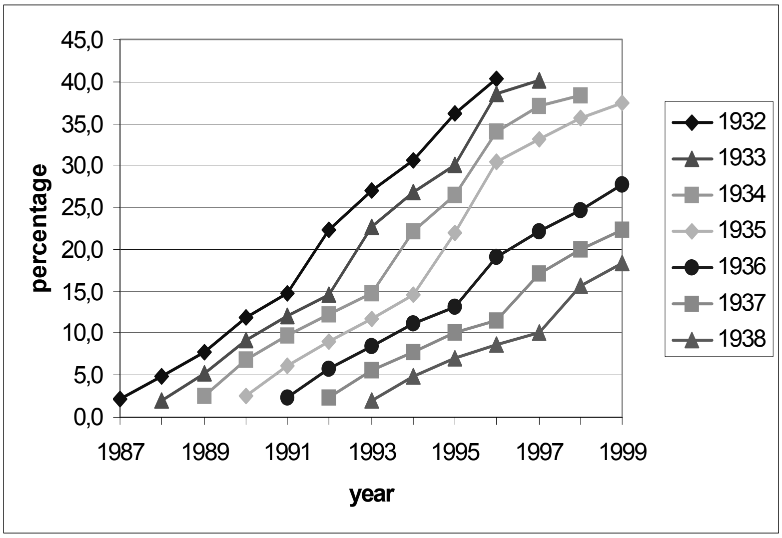

Figure 12: Voluntary Pensions (Early Old Age and Individual Early Retirement) by Age Cohorts (Source: Central Pension Security Institute)

Yet again there is not much evidence of the substitutability of these pensions after the 1994 reform.[152] Increased voluntary retiree shares are still the highest in the older target groups (especially 1934), even when the unemployment pen-

[152] Instead, the figure clearly shows the effect of the individual early retirement eligibility change in 1994 and after on the cohort born in 1936 and later.

sion is excluded. The age changes of the 1998 reform lowered the age limits of the part-time pension for the age groups that are not eligible for the alternative voluntary pension schemes at the time.[153] Hence, this reform can have no effect on the voluntary pensions.

Estimates of the Eligibility Restrictions Even if graphically the evidence on the substitutability is certainly not clear, it was tested with difference-in-differences regressions. In these regressions, I regress the share of those in the labour market state I am interested in, on the year and the age dummies, and a variable indicating whether the age group is eligible for the part-time pension in that year. Hence, the regressions that are run are the following:

$$LMS_{ik} = \sum_{i=50(55)}^{64} \beta_i Di + \sum_{k=1991}^{1999} \gamma_k Yk + \delta Eligibility_{ik}, \tag{75}$$

where LMS is the share of the labour market state in a specific year for a specific age group. Ds are the age dummies that run from 50 to 64 for employment and unemployment, and from 55 to 64 for the pensions. Ys are the year dummies.

The labour market states that are considered are employment, full-time retirement, unemployment and voluntary retirements. The coefficient of the interest is that of the eligibility indicator (δ), because that will give the extent of the substitution between the labour market state and the part-time pension. The identifying variance for the eligibility indicator comes from the eligibility age changes in 1994 and in 1998.

In Table 34, the target group consists of all those who are eligible for the part-time pension. There are no age-specific restrictions on the control group, so the control group consists of all the non-eligible individuals. These are all those who are younger than the eligible in all of the years (in 1991-1999, 50-55 for employment and unemployment and 55 for the pensions). In addition, the control group includes the cohorts that are affected by the changes, but only prior to the changes took place (56-59 pre-1994 and 58-59 pre-1998).

The first column of the table gives the estimates on the employee share. The second deals with the full-time pensioner share, the third with the unemployment share and the fourth with the voluntary retirement share. Voluntary

[153] The minimum eligiblity age for individual early retirement was 58 and for early old age retirement 60.

	Employed	Fully Retired	Unemployed	Volunt retired
Variable	Estimate (SE)	Estimate (SE)	Estimate (SE)	Estimate (SE)
D50	14.93 (.90)		0.32 (0.69)	
D51	14.01 (.94)		0.28 (.66)	
D52	11.78 (1.06)		0.56 (.64)	
D53	9.69 (1.08)		0.93 (0.73)	
D54	6.74 (.99)		2.94 (1.08)	
D55	ref	ref	ref	ref
D56	-5.88 (1.0)	5.93 (1.18)	-0.05 (0.88)	3.10 (1.51)
D57	-12.58 (.93)	10.65 (1.22)	0.05 (.84)	5.42 (1.52)
D58	-20.58 (.92)	19.43 (1.14)	-0.45 (.86)	10.58 (1.42)
D59	-27.62 (1.04)	24.48 (1.04)	-1.23 (.79)	13.69 (1.33)
D60	-36.53 (1.15)	48.74 (1.17)	-7.67 (1.03)	20.66 (1.73)
D61	-40.50 (1.07)	57.67 (1.13)	-8.69 (1.03)	23.48 (1.66)
D62	-43.75 (1.14)	62.75 (1.18)	-8.79 (1.07)	25.45 (1.72)
D63	-49.27 (1.05)	70.81 (1.25)	-9.62 (1.15)	27.48 (1.96)
D64	-50.60 (1.01)	73.26 (1.35)	-10.26 (1.12)	27.86 (2.51)
Y1991	ref	ref	ref	ref
Y1992	-3.07 (.52)	0.10 (1.23)	3.15 (.83)	1.38 (2.06)
Y1993	-5.88 (.54)	0.69 (1.03)	5.81 (.79)	2.49 (1.88)
Y1994	-7.57 (.55)	1.99 (1.13)	6.77 (.94)	4.20 (1.86)
Y1995	-6.72 (.53)	0.89 (1.10)	6.51 (.93)	4.38 (1.80)
Y1996	-6.43 (.47)	-1.10 (1.28)	7.51 (.89)	3.85 (2.05)
Y1997	-6.56 (.58)	-3.37 (1.35)	4.83 (.79)	2.05 (2.16)
Y1998	-5.25 (.62)	-4.13 (1.25)	3.32 (.81)	1.19 (2.12)
Y1999	-3.86 (.77)	-5.74 (1.36)	2.11 (.86)	-0.52 (2.13)
Eligibility	-1.76 (.65)	-5.23 (.84)	1.29 (.68)	-4.84 (1.23)
Constant	69.44 (.86)	21.85 (1.15)	5.55 (.88)	-1.13 (1.81)
# of obs	135	90	135	90
F(23, 111)	2,252.05		34.24	
F(18, 71)		738.84		46.80
R2	0.996	0.994	0.885	0.884

Table 34: Difference-In-Differences Estimates (Dependent Variables: (1) Employee Share, (2) Full-Time Retiree Share, (3) Unemployed Share, and (4) Voluntary Retiree Share)

Notes: Standard errors are in brackets (White corrected).

retirements include early old age retirement and individual early retirement.[154]

As we see in the table, the coefficients on the eligibility terms are negative and statistically significant in all other regressions, except for the one on unemployment. Hence, those who have a right to the part-time pension are less likely than the rest of the sample to be in the alternative labour market states. The magnitude of the coefficients is higher for the pension alternatives than for the employment alternative. All of the interaction coefficients in the table, however, are too small to be credible. We saw in section 4.2. that the part-time pensioner shares increase by less than four per cent in any age group. Yet the retiree coefficients in the table are of a greater magnitude than this. As is explained in the appendix, this negative bias can be explained by the data errors.

Looking at the coefficients of the other variables, we note that the employment shares fall with age. We can also see the effect of the recession on the employment shares. The recession in Finland started in the early 1990s, and reached its peak in 1994. Since 1994, the recovery has been pretty fast. The results of the table show that the unemployment rates for the older age groups reached their peak a few years after the recovery had started (1996). The unemployment share at the age of fifty-four (and 53) is considerably larger and, since the age of sixty, considerably smaller. This is because of the unemployment regulations. Since the age of fifty-three (prior to 1997) or of fifty-five (since 1997), the unemployed have been eligible for extended unemployment benefits. At the age of sixty, they are eligible for the unemployment pension. Hence, this so-called unemployment tunnel increases unemployment at the lower age limit (53-55), and decreases unemployment at the age of sixty. Full-time retirement increases with age and fluctuates with the economic conditions (and peaks at the worst recessionary year).

In order to test the robustness of the eligibility results, I restricted the control group to a smaller number of more homogeneous age groups. The main purpose of this exercise was to try to isolate the comparison for those who face otherwise similar macroeconomic and labour market state conditions. The only difference between the target and the control groups should be the change in the eligibility for the part-time pension. As I concentrated on the 1998 change in eligibility, the target group was 56 and 57 year olds. The control group in Table 35 was

[154] Additionally, regressions were run on disability and individual early retirement shares. There results are similar to the full-time retiree results.

restricted to the younger (55[155] in the top part of the table) and older (58 and 59-year-olds) age groups. I concentrated only on the 1998 change in the law as this had potentially a greater impact. Moreover, in 1998 the macroeconomic situation was more stable, and there were fewer other changes in the labour market and pension regulations that could affect the results. (Changes are listed in Table 32.) Therefore, insulating the effect of the part-time pension age eligibility change should have been easier. As from the above, we would expect all the coefficients of the eligibility terms to be negative if there were substitutability.

Table 35 shows that the coefficients of the other controls largely maintain the same features as in Table 34. Employment falls with age and increases after the recession. Retirement, in contrast, increases with age and falls after the recession. Unemployment also falls after the recession. Because the age groups that were included in this table do not include the limiting eligibility ages for the unemployment regulations, unemployment increases with age. Part-time retiree shares also present an interesting pattern. They increase in age and in time.

The coefficients on the eligibility variables are negative for all comparison groups when fifty-five-year-olds are used as the reference group (top part of the table). The magnitude of these coefficients is more reasonable than in Table 34. The magnitude of the coefficients also suggests that slightly more of the part-time retirees substitute part-time retirement for full-time retirement than for employment. When only the voluntary retirement schemes are considered, the coefficients are virtually equal to those in the employment regression. Hence, substitution of part-time retirement for full-time work and full-time voluntary retirement is virtually equal. Those who go for the part-time pension instead of unemployment are considerably fewer. These estimates, however, are not precise, and only the coefficient on the full-time retirement channel is statistically significant.

The lower part of the table contains the same regressions with the older age groups (58 and 59) as a control group. The eligibility coefficient in the part-time pensions regression is positive, indicating that part-time retirement is more common in the age group that becomes eligible in 1998 than in the rest of the

[155] Employment and unemployment regressions were also tested for a larger reference group for the younger ages (50-55). Qualitatively, this made no difference to the results.

	Part-time	Employee	Full-Time retiree	Unemployed	Volunt retiree
Variable	Estim (SE)	Estim (SE)	Estim (SE)	Estim (SE)	Estim (SE)
	1	2	3	4	5
D55		reference	reference	reference	reference
D56		-5.52 (1.25)	4.75 (1.06)	0.86 (0.61)	2.09 (1.64)
D57		-12.15 (1.06)	8.89 (1.24)	1.58 (0.50)	3.77 (1.84)
D1995		-7.49 (3.19)	5.32 (1.29)	7.07 (1.24)	1.94 (1.91)
Y1996		-6.09 (3.36)	1.99 (0.96)	7.11 (1.33)	0.01 (1.44)
Y1997		-5.16 (3.32)	-0.41 (1.38)	2.87 (1.25)	-1.96 (1.93)
Y1998		-2.51 (2.35)	0.40 (0.77)	2.53 (1.22)	0.00 (0.82)
Y1999		ref	ref	ref	ref
eligibility		-2.87 (3.22)	-3.02 (1.23)	-0.84 (1.34)	-2.93 (1.75)
constant		68.28 (3.10)	16.9 (0.44)	6.78 (1.19)	0.00 (0.41)
# of Obs		15	15	15	15
F (7, 7)		25.06	38.96	54.19	.
R^2		0.941	0.956	0.946	0.710
D56	-1.11 (0.38)	25.21 (0.84)	-13.69 (1.15)	0.53 (0.80)	-5.93 (1.75)
D57	-0.73 (0.45)	18.57 (0.85)	-9.55 (1.15)	1.25 (0.81)	-4.25 (1.75)
D58	-0.64 (0.21)	7.49 (0.88)	-4.94 (0.81)	1.22 (0.44)	-3.42 (0.98)
D59	reference	reference	reference	reference	reference
Y1995	-3.12 (0.38)	-0.55 (1.20)	12.32 (0.83)	7.06 (0.57)	9.57 (1.23)
Y1996	-3.22 (0.34)	0.28 (0.74)	9.54 (1.23)	8.24 (0.60)	7.35 (1.28)
Y1997	-3.14 (0.34)	0.50 (1.04)	5.97 (0.72)	2.69 (0.51)	5.17 (1.27)
Y1998	-2.4 (0.37)	-0.24 (0.59)	1.75 (0.90)	1.53 (0.71)	1.48 (1.33)
Y1999	ref	ref	ref	ref	ref
eligibility	1.32 (0.40)	2.13 (1.04)	3.28 (1.16)	-0.03 (0.82)	3.69 (1.60)
constant	4.08 (0.57)	31.42 (1.38)	28.36 (1.69)	6.80 (1.10)	0.66 (2.66)
# of Obs	20	20	20	20	20
F (8, 11)	50.41	283	116.89	56.90	40.43
R^2	0.973	0.989	0.983	0.964	0.921

Table 35: Difference if Differences Estimates, Restricted Control Groups (Dependent variables: (1) Part-Time Pensioner share; (2) Employee share; (3) Full-Time retiree share; (4) Unemploymed share; and (5) Voluntary retiree share)

Notes: Standard errors are in brackets (White corrected).

sample. This is the same result that was shown earlier graphically.

The eligibility coefficients for most of the alternatives are also positive. In other words, eligibility for the part-time pension *increases* the use of the alternatives. This, of course, is counter-intuitive. The reason for the positive coefficients is likely to be the eligibility for individual early retirement. Because the eligibility age for individual early retirement was fifty-eight, the eligibility dummy that is meant to control for the part-time pension eligiblity actually picks up the eligibility of individual early retirement.

There are at least three possible reasons why there could be problems with the difference-in-differences regressions. First, there must be similar macroeconomic and similar labour market conditions for both the control and the target groups. As there are huge changes in the unemployment rates in this period, I also tried to take the age-specific swings in them into account. Secondly, it is possible that there are cohort-specific effects. For example, it is possible that the relevant option is not whether the part-time pension is available, but instead it matters how long it has been available. The third, and actually the most likely, problem for the estimations is in the data. As explained previously, not all of the labour market states could be identified for all of the age groups in all years. This problem in the data set was more severe for the fifty-eight and fifty-nine-year-olds than for the fifty-five-year-olds. (See the appendix.)

4.7 Conclusions

The part-time pension scheme differs quite considerably in nature from the full-time pension schemes. The part-time pension scheme offers an additional consumption (or income) - leisure -combination that is not available either in full-time work or with the full-time pensions. Therefore, the part-time pension can be analysed as the third, a distinct, option in a retirement decision.

Part-time retirees receive a combination of wages and pension benefits. Because there are a number of work arrangements that are in accordance with the part-time pension law, the employee's expected part-time pension benefit and the part-time pensioner's expected full-time salary are not straightforward to calculate. As even the calculation of the full-time pension benefits, and forecasting the expected wages can be problematic, I imputed the expected wages and benefits in each of the three labour market states with a probability model. This model (Lee, 1982) corrects for the sample selection that is caused by the assumption that individuals choose the option where their properties are "rewarded" the best. For example, if the self-employed expect to gain more from the part-time pension in comparison to the rest of the population than they would from the other labour market states, I would expect to find more self-employed receiving the part-time pension than elsewhere.

The Lee model in this paper showed that, on average, those who are on part-time retirement expect to get more income from this arrangement than do the others who are not on the part-time retirement. Because of the financial attractiveness of the part-time pension scheme, it is surprising that it has attracted so few people.

Yet there were features in the results that indicated that the model was not working well. The model predicted that the average part-time pension income (pension benefits plus wages) was expected to be greater than the average salary. Even if this was true only on average (the maximum expected salary was higher than the maximum expected part-time income), the result seems rather strange. After all, the part-time pension implies a reduction in the work hours, and a consequent reduction in wages. Therefore, the expected wage should always be higher than the expected income from part-time retirement. I showed in the text that the variation of the participation equation was unlikely to be sufficient to control for the truncation in the distributions. Therefore, the model did not perform well in this problem setting.

In addition to analysing the economic incentives, I considered the effect of the part-time pension eligibility restrictions on the other labour market states. I predicted that about a half of the part-time retirees would have remained in full-time employment, had the part-time pension not been available. This prediction was based on the worker-retiree shares and the individual properties of the population in the relevant age groups. The great majority of the individuals in the age groups that are eligible for the part-time pension are already on full retirement. Yet many of the part-time retirees resemble the full-time workers more closely than the full-time retirees, at least with their characteristics that are observed. I showed that the predicted share of the part-time retired who would retire full time, had there not been any part-time pension scheme, is dependent on the explanatory variables that are taken into account in these predictions.

Past eligibility changes in the part-time pension scheme also predicted that the trade-off between full-time work and the part-time pension on the one hand, and between full-time retirement and the part-time pension on the other, was about fifty-fifty. In other words, the part-time pension increased the years of work for about a half of the part-time retirees, and decreased it for another half.

The analysis in this essay suffered from a number of data problems. Even if the ideal data set for this issue had existed, the analysis would have nevertheless been difficult. Because the part-time retirement is rare in comparison to the other two options, in order to work well, the statistical models would have to account for this "size" difference between the options. In this essay, I also showed that the data that I used for the eligibility analysis was far from ideal. There were a number of measurement/classification errors that could not be rectified.

The Finnish part-time pension scheme has so far attracted only a minor share of the age groups that are eligible for this pension. In 1999, the share of the part-time pensioners of the relevant age cohorts was no more than five per cent at the maximum. Since then, however, the number of part-time pensioners has almost tripled.[156] Yet at the end of 2001, the Pension Reform Committee recommended that the economic incentives for the part-time pensions were to be reduced and the eligibility age for the scheme was to be raised back to fifty-eight. Therefore, it is likely that the part-time pension scheme will continue to be of minor importance.

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Appendix

Missing Data in the Labour Force Survey and the ETK Data Set The data set that was used in the analysis of the eligibility changes was collected from the Labour Force Surveys (LFS) of Statistics Finland and from the pension registers of the Central Pension Security Institute (ETK). In the pension registers the retiree shares are calculated from the total population. The Labour Force Survey interviews about 12,000 randomly sampled individuals. Because the two data sources are different, there are differences in how labour market states are defined and what the exact point in time is when each observation (both the labour market state and age) is valued.

Table 36 gives the sums of the explained labour market states for the age-year groups that are used in the estimations. As we see in this table, the quality of the data deteriorates rather drastically until the age of 58 and 59 in the later years.

Data on the Labour Market State Shares - Comparison of the Two Data Sets As the labour market states (employment, unemployment, and pensions) of each age group in each year do not total a hundred per cent, I compare the LFS and ETK data on the aggregates of another data sample where I have more detailed information on the labour market states. The comparative data are the sample that is used for the other analysis, a sample from the Employment Statistics (ES) (300,000 individuals). This data sample covered a

	year	1995	1996	1997	1998	1999
age						
55		95.6	95.6	89.9	90.4	93.5
56		96.5	94	90.3	87.9	89.32
57		96.9	93.7	86	87.7	86.75
58		93.7	97.7	84.8	82.3	80.63
59		95.4	91.4	92.6	77.7	76.3
60		98.9	97.8	93.2	90.2	92.56
61		101.3	103.2	97.6	98.1	95.43
62		102.2	104.9	98	97.6	95.8
63		101.7	101.4	102.8	99.8	98.37
64		100.5	102.3	101.9	100.5	101.72

Table 36: Sums of the Explained Labour Market States by Age and Year (per cent of the age/year category)

limited number of years, and therefore it could not be used for the analysis of the past eligibility changes.

Table 37 reports the labour market state shares both in the supplementary data (LFS+ETK) and the more detailed data (ES).

Table 37 shows that the employment shares are fairly close in most of the years in both of the data samples (at most a four per cent difference). Yet exploring the data also outside the table, it is easy to see that there is a systematic difference in the two data sets. Employment rates in the Labour Force Survey and ETK data (LFS+ETK) are greater than in the Employment Statistics (ES) for the younger individuals, and vice versa for the older individuals. Unemployment shares are almost always greater in the ES. Retiree shares, in contrast, are always greater in the LFS+ETK, and sometimes the difference is fairly large. This difference in the retiree shares gets worse with age and falls in time. Due to their small number, shares of the partially retired are virtually equal for the two data sets.

Because the LFS+ETK data do not have information on the "out of the labour force shares" (that is, out of the labour force without a pension), this share is also calculated from the ES. The share is around two to four per cent for most age groups in most years. There is, however, clearly a higher share (10%) for the sixty-year-olds in 1997. I could not find a clear explanation for this jump. The adjacent shares of the out-of-the-labour-force are not nearly as big.

	LFS+ETK	ES	LFS+ETK	ES	LFS+ETK	ES
AGE	55	55	60	60	64	64
1996						
employed	63.6	60.7	24.6	23.7	11.3	9.2
unemployed	13.3	18.1	5.8	7.2	1.7	1.3
fully retired	18.7	18.1	64.7	64.1	88.9	86.9
partially ret	0	0	2.7	2.8	0.4	0.6
out of lf		2.8		2.2		2.0
1997						
employed	62.0	62.6	24.5	25.7	12.4	9.4
unemployed	10.0	16.9	2.9	7.4	0.5	1.7
fully retired	17.9	16.6	63.1	53.0	88.5	86.7
partially ret	0	0	2.7	3.1	0.5	0.3
out of lf		3.4		10.7		1.7
1998						
employed	63.0	66.7	22.4	26.7	11.2	10.1
unemployed	10.3	14.4	2.4	7.0	0.7	1.7
fully retired	17.1	15.5	62.3	60.5	88.0	86.0
partially ret	0	0	3.1	3.1	0.6	0.6
out of lf		3.0		2.5		1.5

Table 37: Labour Market State Shares in the Distinct Data Sets (per cent of the age group)

Notes: LFS+ETK is the data set with labour market state shares by age and by year, ES is the data set from Employment Statistics. LFS+ETK is used in the analysis of the past changes in the eligibility restrictions.

The purpose of this data comparison is to find potential direction of the bias when the LFS+ETK data set is used in the estimations. If there is measurement error in the dependent variable and this measurement error is correlated with one of the independent variables (as it is here with age and year), positive correlation implies positive bias for the coefficient and vice versa. The formula for this is given below.

$$\begin{aligned} y - a &= x\beta + \varepsilon \\ \beta &= (x'x)^{-1}(x'y) \\ &= (x'x)^{-1}(x'(x\beta + \varepsilon + a)) \\ &= \beta + (x'x)^{-1}(x'a) \end{aligned}$$

The observed share of the employed is less than the true share (y). By a simple formula, we see that the observed coefficient is the true coefficient plus the term dependent on the correlation between the explanatory variables and the measurement error. For example, the employment share in the LFS+ETK data falls more with age when compared with the ES employment share. Also, the difference in the retiree shares of the two data samples falls in time. If some of this fall is due to the measurement error, there is a negative correlation between age and the measurement error in the employment share, and time and the measurement error in the retiree share estimations. If the true coefficient is negative, and the correlation between the explanatory variables and the measurement error in the dependent variable is negative, the observed coefficient is smaller than the true coefficient. This could explain the coefficients that are too "big" in absolute terms.

Differences in Means of the Observables Means of the observable characteristics for individuals in each of the three alternative channels in 1996 are given in Table 38. I also test whether the mean of each observable characteristic in employment and in full retirement is statistically significantly different from the mean of the observable characteristics for the part-time pensions. The test regresses the observed characteristics on the constant, a dummy of full-time employment, and a dummy of the full-time pension.[157] If the coefficients on the dummies are statistically significant, it is concluded that there is a difference in

[157] For example, $D_{female}{=}\alpha + \beta D_{work} + D_{Full-timeretirement}$.

the specific characteristic between the part-time pensioners and the other alternatives. Significant differences are starred, ** indicating a significant difference with ninety-nine per cent certainty, and * with ninety per cent certainty. Results for the observables in 1997 are fairly similar to the results for the observables in 1996.

As Table 38 shows, part-time pensioners differ in their observable characteristics from the individuals choosing either of the alternative channels. These differences are largely statistically significant. Differences with most of the explanatory variables are not only more frequent, but also greater between the part-time retirees and the full-time retirees than between the part-time retirees and full-time workers. Therefore, I claim that the partially retired bear more resemblance to the full-time workers than to the full-time retired - at least with regard to the observable variables.

Part-time pensioners have a higher taxable income, on average, than either the employed or the fully retired. If I remove the self-employed,[158] the taxable income in 1996 for the employed is higher than for the part-time employed (but the difference is not statistically significant). Therefore the "reverse ordering" of incomes for the part-time retired and employed is sensitive to the exclusion of the self-employed. In other words, there are some self-employed persons with a particularly high income who have chosen the part-time pension. Taxable income prior to the age of the part-time pension (55-57) is higher for the part-time pensioners than for the full-time employed, even when I drop the self-employed. Part-time retirees are therefore, on average, individuals with relatively high income. They are not, however, significantly wealthier than those who remain full-time employed, but they are wealthier than the full-time retirees. Yet the part-time pensioners have also incurred more debt than the full-time retirees. On average, spouses of the part-time retired also have higher taxable income than either the spouses of the employed or the fully retired. All in all, the part-time retirees are, on average, financially better off than the others.

Considering the individual properties, the part-time retirees are, on average, as healthy as the employed.[159] The fully retired are considerably less healthy than others. This is plausible because most of the full-time retirements in these

[158] These results are not presented here.

[159] This variable is from a different, somewhat smaller data sample. Yet even this sample is a random sample of the whole population.

Health is measured by the use of the reimbursed costs of medicine. Information on diseases was classified by a medical professional into diseases that reduce work ability.

Variable	Employment	Part-time	Full Retirem
Economic incentives			
- taxable income 1996 ('000 FIM)	127,337**	138,817	77,585**
- taxable income 1990	113,274**	142,809	66,509**
- max taxable income age at 55, 56, 57	123,115**	152,047	74,736**
- self-empl income 1996	18,043**	7,335	1,631**
- wealth ('000 FIM)	206,995	226,202	122,425**
- debt	53,742	50,582	14,509**
- ownership of housing	87%**	90%	82%**
- spouse's taxable income	85,445**	108,245	65,564**
Individual properties			
- health limitation[!]	39%	45%	62%*
- age	59.8**	60.4	61.5**
- female	51%*	55%	52%
- education (years)	10.8**	12.1	10.0**
- no spouse	28%	25%	34%**
- spouse is			
* retired	31%	34%	50%**
* working	36%	36%	17%**
* unemployed	8%*	6%	6%
- geographical location			
* Northern Finland	8%	9%	11%
* Eastern Finland	8%	6%	12%**
* Southern Finland	30%**	39%	20%**
* degree of unempl. in the home community %	18.8%	18.5%	20.1%**
Work related			
- self-employed	28%**	12%	1%**
- public sector employee	39%**	65%	34%**
- size of the company	94**	68	-
- occupational sector			
* agriculture	20%**	6%	13%**
* industry	22%**	12%	20%**
* construction	6%	8%	7%
* services	44%**	69%	30%**
* finance	2%*	4%	2%*
* trade	17%*	14%	12%
* transport and communic	9%**	4%	6%*
Number of observations	5,673	514	19,482

Table 38: Means of the Observed Characteristics for Individuals in Each of the Channels in 1996

Notes: ! from a smaller sample.

age groups are due to disability. Retirement is a gradual process. Those from this age group who are at work are, on average, younger than retirees. Part-time retirees are, on average, younger than the full-time retirees. Genderwise, the distribution is fairly even. There are not significantly more women in any of the labour market states. Part-time retirees have had significantly more education than either those who remain at work or those who retire fully. This matches the observation of the relatively high income of the part-time retirees. Part-time retirees are less likely to have a retired spouse, and more likely to have a working spouse than those who have retired full time. In other words, spouses tend to stay at work together - be it, as it may, only in part-time work. This is fairly symmetric for males and females. Yet the female spouses of the employed men are somewhat less likely to be retired than the female spouses of the part-time retirees.

Of the work-related observables, I conclude that part-time retirement is rather common in the public sector. Of the occupational sectors the part-time pension is most common in services. Larger firms might have more organizational lee-way in sharing tasks among several employees, but this so far has not been used in the part-time pension arrangements. Those individuals who remain employed, work, on average, in bigger firms than those individuals who take up the part-time pension. This difference is even greater if I drop the self-employed from the sample.

5 Let's Make a Deal. The Impact of the Social Security Provisions and Firm Liabilities on Early Retirement Decisions[160]

5.1 Introduction

Extensive literature on economic incentives for retirement treats the retirement decision essentially as a labour supply issue. Accordingly, workers who approach retirement age evaluate their prospective wage and pension streams, and choose the retirement age that maximizes their expected utility. Substantial empirical evidence shows that incentives provided by social security systems have a strong impact on the age of the labour force withdrawal. (See Lumsdaine and Mitchell (1999) for a recent survey.) Actuarially unfair pensions encourage early retirement, and countries with more generous social security benefits tend to have a lower average retirement age (Gruber and Wise (1999)).

Yet the majority of the current retirement literature misses an important aspect of early retirement. Employer is absent from the retirement models. In a pure labor supply model, worker is free to choose the retirement date that is optimal for him. However, also firms may have strong incentives to encourage early retirement of their workers. When demand falls, early retirement may provide a way to reduce the workforce.

The firm induced early retirement can take different forms depending on the institutional setting. Hutchens (1999) suggests that the early retirement provisions of the US social security system can be used as a form of unemployment insurance. Since social security benefits are not experience-rated, early retirement benefits effectively subsidize workforce reductions. Even more explicit subsidies exist in other countries. For example, before the recent pension reform in Germany long-term unemployed could retire at the age of sixty. According to the so-called 59er rule, firms often laid off workers as many months before the age of sixty as the unemployment benefits would last (Antolin and Scarpetta (1998)).

In this paper we analyze early labor market exits via long-term unemployment in Finland. The Finnish unemployment benefit system provides extended unemployment benefits for the workers who lose their job after the age of fifty-five. These benefits last until the age of sixty. Thereafter the unemployed may

[160] Joint work with Roope Uusitalo

draw unemployment pension which lasts until old-age retirement at the age of sixty-five. As the unemployment benefits and unemployment pensions are relatively generous, and the re-employment prospects are slim, a job loss after the age of fifty-five often leads to a permanent withdrawal from the labour market.

If long-term unemployment is an important exit route out of the labour force, a comprehensive study on early retirement should also account for the firms' decisions. Furthermore, as the transition from an unemployment benefit recipient to an unemployment pension recipient is almost deterministic, the focus should be on the factors that influence the initial exit from employment.

In this paper, we show that neither the supply nor the demand analysis alone can explain the labour market exit. Instead we follow the ideas of Feldstein (1976, 1978), Topel (1984) and Hutchens (1999), and model the retirement decision as a joint optimization problem for the worker and the firm. A risk-neutral firm maximizes profits by entering into an implicit contract with a risk-averse worker. This contract specifies wages, firing rules and severance payments, so that the contract maximizes the sum of the expected utilities of the worker and the firm. An efficient contract guarantees a certain utility level for the worker, irrespective of the aggregate demand conditions. These demand conditions, however, influence firms' displacement decisions. The firm displaces workers when the joint value of employment for the worker and the firm falls short of the outside opportunities. The social security system influences the optimal contract by providing social security benefits for the displaced workers. The system also determines firm liabilities for these benefits. If the benefits are not fully experience-rated, the social security system effectively subsidizes the displacement of older workers.

In this essay, we test the implications of a simple optimal contract model of early retirements. For this, we use a large worker-firm panel. The data cover about 12,000 Finnish firms with all their employees over the period of 1989 - 1996. The worker data include a wealth of information on wages, employment spells and transitions between employment, unemployment and retirement. The firm data contain the balance sheets and income statements. The key feature of these data sets is the ability to link the worker and the firm records. Such data have not been used before in early retirement studies.

We find that both the worker and the firm incentives matter for early retirement. An increase in the unemployment benefits (or pensions) and a decrease in the firm liability for these benefits encourages displacements and leads to an increase in early retirement. Yet changes in the product demand conditions are the driving force in early retirement. When the demand is high, the social security benefits have little effect on early retirement. In a major recession, in contrast, incentives have a huge impact on early withdrawal from the labor market.

The paper proceeds in the following order: After this introduction, we describe some of the features of the social security system for the aged in Finland. We also show that the labour market behaviour of the aged cannot be explained by the labour supply or by the labour demand in isolation. In the third section, we develop an implicit contracts model, and derive empirically testable implications. Next, in section four, we introduce the data, and present the estimation results. The essay is concluded in the fifth section.

5.2 Social Security for the Aged in Finland

The official retirement age in Finland is sixty-five. Yet only a small fraction of workers actually stays in the labour force until this age. This is mainly due to the early retirement provisions. Early retirement is primarily available for disabled and long-term unemployed.[161] In 1998, approximately half of the fifty-five to sixty-four-year-olds received pension benefits (Central Pension Security Institute et al. (2000)).

Figure 13 shows the distribution across different labour market states in different age groups in 1998. The share of the employed falls with age - especially after the age of fifty-four. After the age of sixty-five, virtually all individuals receive old-age pension. This is not only because the conditional probability of retirement is high at this age, but also because all early retirement benefits are converted to old-age pensions at the age of sixty-five.

A disability pension is the most common form of early retirement. In 1998, almost thirty per cent of the fifty-five- to sixty-four-year-olds were on a disability pension (Central Pension Security Institute et al. (2000)). In Finland, there are two types of disability pensions: a "normal" disability pension and individual early retirement. The normal disability pension is available for all

[161] In addition to the early retirement provisions due to unemployment and disability, there are some occupational pension schemes where retirement can occur before the official retirement age. Until 1995, the biggest such scheme was in the public sector, where old age retirement was allowed at the age of 63.

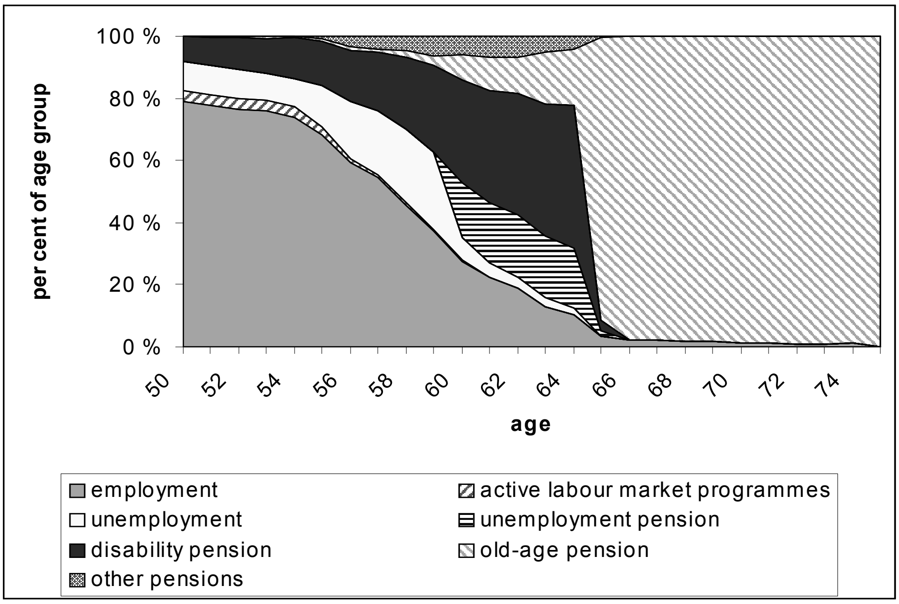

Figure 13: Labour Market State Shares by Age in 1998

severely disabled, regardless of age. Individual early retirement has a minimum eligibility age. The minimum eligibility age for individual early retirement was fifty-five prior to 1994, fifty-eight from 1995 to 1999 and sixty from 2000 on. Both types of disability pensions require a medical evaluation by a pension insurance physician. Yet the health criteria for individual early retirement are less stringent. For example, exhaustion at work, strain of the current job, ageing in general, and the length of the career can be taken into account when granting the individual early retirement pension. Disability pension benefits are roughly equal to the pension benefits that a person is entitled to were he to retire with an old age pension. Until recently, no actuarial adjustments were made for early retirement.

Figure 13 also shows that unemployment rates are high in older age groups, particularly after the age fifty-five. The share of those in active labour market programmes phases out at the age of fifty-five. At the age of sixty, virtually all the unemployed convert to the unemployment pension. This can be received until old age retirement.

Unemployment pension is available for long-term unemployed after the age of sixty. The only other requirement is that the person has received unemployment benefits for minimum of 500 days. The level of the unemployment pension benefits is again almost equal to the old age pension benefits. Until 1996, no actuarial adjustments were made for early retirement. In 1998, almost twenty per cent of the sixty to sixty-four year-olds received unemployment pension benefits (Central Pension Security Institute et al. (2000)).

Another important feature of the unemployment insurance system is the extension of the maximum duration of the unemployment benefits for those workers who lose their jobs after the age of fifty-five[162]. These workers are entitled to the unemployment benefits beyond their normal duration. Extended unemployment benefits are not depleted after the normal 500 days, but instead last until the age of sixty. At this age the unemployed become eligible for the unemployment pension. The combination of extended unemployment benefits and unemployment pension benefits is commonly called the "unemployment tunnel".

The unemployment tunnel generates strong incentives to withdraw permanently from the labor market up to ten years before old age retirement. Since it is possible that a new job, if available at all, yields lower unemployment and pension benefits, the unemployed often have minimal incentives to search for work. Therefore, a job loss after the age of fifty-five often leads to permanent non-employment.

Table 39 shows the annual unemployment benefits and their duration for a median income worker who loses his job at or after the age of fifty. If the employee loses his job before the age of fifty-five, he may receive earnings-related unemployment insurance benefit for a maximum of two years. After this, he is entitled to the labour market support until the old age pension. As shown in the table, the labour market support is considerably smaller than the unemployment insurance benefit. If the employee loses his job at or after the age of fifty-five, he receives an extension on the duration of the earnings-related unemployment insurance benefits until the age of sixty, and then the unemployment pension until the old-age pension at the age of sixty-five. Because the combination of unemployment insurance benefits and unemployment pension benefits is considerably greater than the combination of unemployment insurance benefits

[162] The age limit changed from 53 to 55 in 1997. For simplicity we descibe the system in text as it was in 1998. In calculating the estimates, we naturally account for the changes in the age limits at the appropriate times.

Age at job loss	Unempl. benefits		Labour market support		Unempl. pension		Average benefit p.a. until age 65
Age	Duration	Amount	Duration	Amount	Duration	Amount	Amount
years	years	FIM/year	years	FIM/year	years	FIM/year	FIM/year
50	2	86,592	13	30,960	-	-	38,378
51	2	86,592	12	30,960	-	-	38,907
52	2	86,592	11	30,960	-	-	39,519
53	2	86,592	10	30,960	-	-	40,232
54	2	86,592	9	30,960	-	-	41,075
55	5	86,592	-	-	5	63,097	74,845
56	4	86,592	-	-	5	63,097	73,539
57	3	86,592	-	-	5	63,097	71,908
58	2	86,592	-	-	5	63,097	69,810
59	2	86,592	-	-	4	63,097	70,929
60	2	86,592	-	-	3	63,097	72,495

Table 39: Unemployment Benefits and Unemployment Pensions by the Age of the Job Loss

Notes: Annual unemployment benefits are calculated for a full-time worker who earned the median annual income in 1998 (135,600 FIM), and who is covered by the unemployment insurance system. Pension calculations use the same median wage as a base wage and assume that the worker has had the same private sector job with 1.5 per cent pension accrual rate for thirty years. Moreover, he is assumed to be single and living in the most expensive community grouping.

and labour market support (see the final column of Table 1), there is a discrete jump in the average annual benefits if the job loss occurs at or after the age of fifty-five.

Figure 14 presents unemployment rate time series for older age groups in

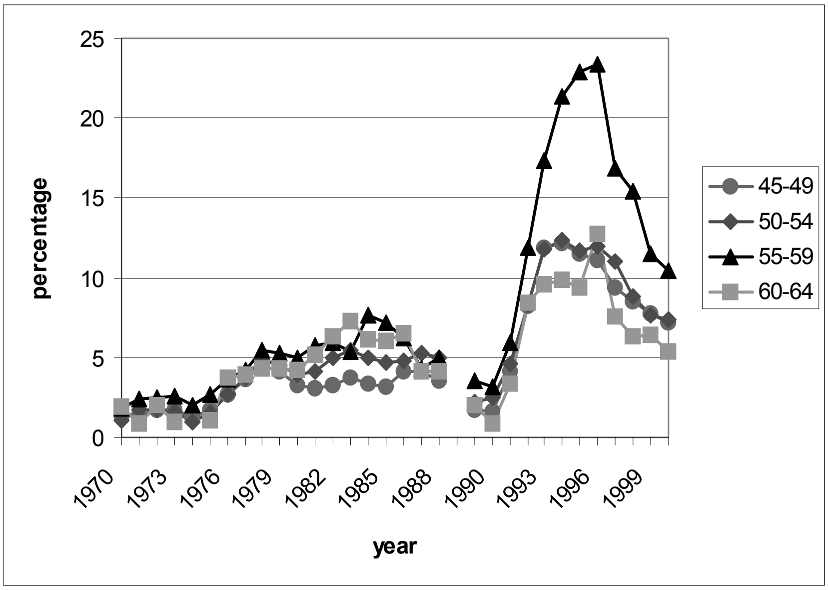

Figure 14: Unemployment Rates by Age Groups

Finland. The figure shows how the Finnish economy experienced its largest peacetime recession in the beginning of the 1990s. Unemployment rates rose rapidly in all age groups. Yet the rise in the unemployment rate is much greater for the workers who are eligible for the extended unemployment benefits (the age group 55-59 in the figure). Unemployment rates are lower after the age of sixty, because most individuals in this age group already receive the unemployment pension. Without the financial incentives of the unemployment tunnel, it is difficult to explain why the unemployment rates for the fifty-five- to fifty-nine-year-olds were more than ten percentage points higher in the nineties than the unemployment rates for the younger workers. This difference in the unemployment rates between the age groups does not occur in the previous decades. Yet the incentive structure of the unemployment related social security has not substantially changed.

The difference in the unemployment rates is even more striking if we change the x-axis from years to age - as in Figure 15. In the late 1980s and early 1990s, unemployment rates were similar in all age groups until the minimum age for the unemployment pension (60). During and after the recession, starting in 1992, there is a hump in the unemployment rates around the minimum age for the unemployment tunnel. Hence, the financial incentives created by the tunnel matter, but only since the recession.

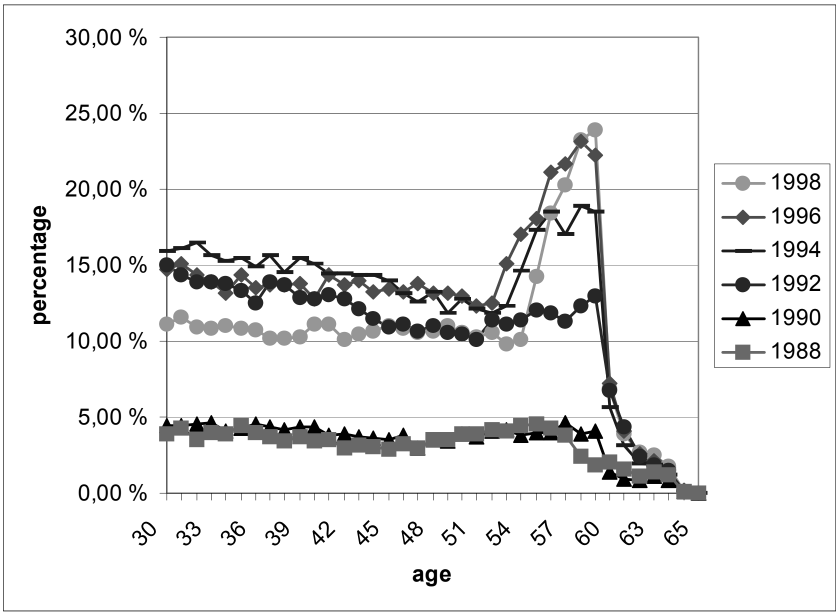

Figure 15: Unemployed by Age

To demonstrate that a job loss after the eligibility age for the tunnel often leads to a permanent withdrawal from the labor market, we also looked at the labour market paths for a number of years after the individuals became unemployed. In Table 40, we follow employees who lost their jobs in 1992. The upper part of the table is for those who were eligible for the unemployment tunnel (age groups 54 to 64), and, the lower part is for a younger age group (40 to 45).

One year after becoming unemployed (that is, at the end of 1993), fewer than eight per cent of the older cohorts were re-employed. The corresponding share of the younger age group is more than thirty-two per cent. Over time the

	Eligible	for the	tunnel	(54-64)		
Year	*Empl*	*Unempl*	*Unempl Pension*	*Active Labour Market Programs*	*Disability Pension*	*Old Age Pension*
1993	7.8	65.77	23.96	0.22	2.08	0.17
1994	6.81	50.61	40.2	0.06	1.8	0.52
1995	5.54	37.92	42.36	0	7.35	6.83
1996	4.94	23.83	54.75	0	7.85	8.62
1997	5.16	15.12	48.1	0.12	9.21	22.28
1998	4.77	2.72	54.1	0.06	7.87	30.49
Not	**eligible**	**for the**	**tunnel**	**(40-45)**		
Year	*Empl*	*Unempl*	*Unempl Pension*	*Active Labour Market Programs*	*Disability Pension*	*Old Age Pension*
1993	32.55	65.63	0	1.65	0.18	0
1994	46.82	50.99	0	1.66	0.53	0
1995	53.58	44.23	0	1.2	0.99	0
1996	57.82	39.79	0	0.99	1.4	0
1997	64.48	32.91	0	0.9	1.72	0
1998	68.61	28.62	0	0.64	2.12	0

Table 40: Labour Market States after Becoming Unemployed in 1992 - by the Unemployment Tunnel Eligibility

share of the re-employed of the younger age cohorts increases. The reverse is true for the older age cohorts. Most unemployed in the older cohorts end up in the unemployment pension, and later in the old age pension.

Unemployment benefits in Finland are financed by unemployment insurance funds. The funds collect unemployment insurance contributions from employees and employers, and receive fiscal transfers directly from the government. Early retirement pensions are mainly financed by the employers' contributions. There is no experience-rating in the unemployment insurance contributions. In contrast, early retirement pension contributions (both the unemployment and the disability pensions) are partially experience-rated. The degree of the experience-rating depends on the firm size. Small firms with fewer than fifty employees pay a fixed rate pension contribution, irrespective of how many of their employees retire. The largest firms, with more than a thousand employees, pay the full cost of the disability pensions received by their former employees. For the medium size firms disability pension contributions are a weighted average of the flat rate of the small firms and the full liability of the largest firms. Liabilities for the unemployment pensions are calculated similarly, except that the maximum liability is fifty per cent of the pension benefit. This maximum applies to all firms with more than three hundred employees.[163]

5.3 An Implicit Contract Model for Early Retirements

In the previous section, we showed that the displaced workers in Finland are eligible to extended unemployment benefits and unemployment pension at the age of fifty-five. This creates a discrete jump in the financial incentives if the job is lost after the age of fifty-five. We also showed that the unemployed rates jump just at this age. We, therefore, concluded that the financial incentives have an impact on the timing of the labour market withdrawal. However, because the incentives mattered only in a recession, a pure labour supply explanation seems insufficient. Therefore, the aggregate demand conditions must also play a role in early retirement. A pure labour demand explanation is equally unsatisfactory, since it is hard to argue that the productivity of a worker suddenly falls at the age of fifty-five. Moreover, targeting the displacements to this age group seems irrational because laying off workers after they are fifty-five yields an unemployment pension liability for the firms. It would be cheaper for the firms to fire younger workers. The firm behaviour can only be rational, if we assume that even if the firm makes its decisions based on the demand conditions, it also takes into account the welfare of its employees. Because neither the supply side nor the demand side explanation is alone sufficient, we seek an explanation in a model where firms and employees decide on early retirements cooperatively.

To explain the stylized facts presented in the previous chapter we formulate an implicit contract model. The model is a simplification of models presented by Hutchens (1999) and Arnott et al. (1988). Some empirical implications of the model will be tested in the next section.

The model assumes risk-neutral firms and risk-averse workers, with no private information. The two parties, firms and employees, enter into a contract in the first period. In the first period, there is uncertainty about the productivity and the value of leisure in the second period. The contract specifies wages in both periods, a firing probability and severance payments.

In the second period, the marginal product of labour (θ) and the monetary

[163] The experience rating changed in 2000. Currently, both disability and unemployment pensions yield, at the maximum, an 80 per cent liability for the firm. Experience-rating does not, even today, extend to the unemployment benefit period.

equivalent of the workers' valuation of leisure (z) are publicly revealed. The firm then makes firing decisions based on this information. The marginal product of labour is a function of the aggregate demand conditions. We assume that the marginal product can be either high (θ_H) or low (θ_L), high productivity occurring with the probability φ.

The government offers pension (social security) benefits for unemployed (g_u), out of which firms pay a share (l_u). To account for the widespread use of disability pensions, we assume that each employee has an exogenous probability (d) of becoming disabled, and obtaining a disability benefit (g_d). The firm pays a share (l_d) of this disability benefit, and the rest is paid by the government.

All employees work in the first period. In the second period, if the productivity is high, the firm retains its workers with certainty and pays them a wage (w_H). If the productivity is low, the firm either keeps the worker and pays the worker a wage (w_L), or fires him. Firing decisions are made in each period prior to the incidence of disability. Below, we denote the firing probability by p. Since we assume that all workers are identical, we could equally state that the firm fires a fraction p of its workers. The firm pays the displaced workers severance pay (s). In the case of disability, individuals obtain a comparable lump sum payment (i). This can be thought of as a private disability insurance.

The firm maximizes its profits, but also takes into account the workers' reservation utility as well as the disability risk. These are both exogenous. If the firm keeps a worker, and the worker is not disabled, the firm's profits are the difference between the marginal product of labour and the wage paid to the worker ($\theta_i - w_i$). If the worker is fired, the firm pays the severance payment (s) and a fraction of the unemployment benefits ($l_u g_u$). The firm's profits are then $-(s + l_u g_u)$. If the worker is disabled, the firm similarly pays private insurance (i) and a fraction of the disability benefits ($l_d g_d$). Hence, the firm's profits are then $-(i + l_d g_d)$. The firm's expected profits in the case of high and low productivity are given in equations 76 and 77.

$$\Pi_H = (1-d) \times (\theta_H - w_H) - d \times (l_d g_d + i) \tag{76}$$

$$\Pi_L = (1-p) \times [(1-d) \times (\theta_L - w_L) - d \times (l_d g_d + i)] - (p) \times (s + l_u g_u), \tag{77}$$

where Π_H are the profits in the high productivity case, and Π_L the profits in the low productivity case. The rest of the notation is as given above.

The worker's expected utility consists of three elements. If the worker is not fired and not disabled, he receives utility from wages ($U(w_i)$), where $U(.)$ is the standard concave utility function with $U\prime > 0$ and $U'' < 0$. In the case of disability, the worker receives the disability benefits (g_d), the insurance payment (i) and the value of leisure (z). Because the value of leisure (z) in the second period is not known in the first period, we have to integrate over all its possible values in order to calculate the expected utility. If the worker is fired, he receives the unemployment benefit (g_u), the severance pay (s), and the value of leisure (z). The expected worker utilities in the low and high productivity scenarios are given in equations 78 and 79.

$$U_H = \int_z [(1-d) \times U(w_H) + d \times U(g_d + i + z)] f(z) dz \tag{78}$$

$$\begin{aligned} U_L &= \int_z \{(1-p) \times [(1-d) \times U(w_L) + d \times U(g_d + i + z)] \\ &\quad +(p) \times U(s + g_u + z)\} f(z) dz, \end{aligned} \tag{79}$$

where U_H is the utility when the productivity is high, and U_L is the utility when the productivity is low. The rest of the notation is given above.

The optimal contract sets (p, s, i, w_H, w_L) to maximize profits. Hence, the firm maximizes its expected profits ($E(\Pi)$) subject to the utility constraint by the worker ($E(U) \geqslant \overline{U}$) and the lay-off constraint ($0 \leq p \leq 1$). The disability risk (d) is exogenous. The benefit levels for disability and unemployment (g_d, g_u), as well as the liability shares of the firm (l_d, l_u), are decided by the government. So from the firm's perspective, these are not decision variables.

The Lagrangian of the firm's maximisation problem is given in equation 80.

$$\begin{aligned} L &= \varphi \times [(1-d) \times (\theta_H - w_H) - d \times (l_d g_d + i)] \\ &\quad +(1-\varphi) \times [(1-p) \times [(1-d) \times (\theta_L - w_L) - d \times (l_d g_d + i)] - [p \times (s + l_u g_u)]] \\ &\quad +\lambda_1 \times \{\varphi \times \int_z [(1-d) \times U(w_H) + d \times U(g_d + i + z)] f(z) dz \\ &\quad +(1-\varphi) \times \int_z [(1-p) \times [(1-d) \times U(w_L) + d \times U(g_d + i + z)] \\ &\quad +p \times U(s + g_u + z)] f(z) dz - \overline{U}\} \\ &\quad +\lambda_2 \times p \\ &\quad +\lambda_3 \times (1-p) \end{aligned} \tag{80}$$

The first two rows of the Lagrangian give the firm's expected profits when the product demand is high (the first row), and when it is low (the second row). The next three rows account for the utility constraint of the worker.

λ_1, λ_2 and λ_3 are the Lagrange multipliers. If the constraint is binding, the λ term is equal to or greater than zero. If the constraint is not binding, the multiplier must be equal to zero.

The first order conditions of the constrained maximisation are given in equations 81-85.

$$L_{w_H} = -\varphi \times (1-d) + \lambda_1 \times \varphi \times (1-d) \times U'(w_H) = 0 \tag{81}$$

$$\begin{aligned} L_{w_L} &= -(1-\varphi) \times (1-p) \times (1-d) \\ &\quad +\lambda_1 \times (1-\varphi) \times (1-p) \times (1-d) \times U'(w_L) = 0 \end{aligned} \tag{82}$$

$$\begin{aligned} L_p &= (1-\varphi) \times [-(1-d) \times (\theta_L - w_L) + d \times (l_d g_d + i) - (s + l_u g_u)] \\ &\quad +\lambda_1 \times (1-\varphi) \times [-(1-d) \times U(w_L) - d \times U(g_d + i + z) + U(s + g_u + z)] \\ &\quad +\lambda_2 - \lambda_3 = 0 \end{aligned} \tag{83}$$

$$L_s = -(1-\varphi) \times p + (1-\varphi) \times \lambda_1 \times p \times U'(s+g+z) = 0 \tag{84}$$

$$\begin{aligned} L_i &= -\varphi \times d - (1-\varphi) \times (1-p) \times d + \lambda_1 \times \varphi \times d \times U'(g_d + i + z) \\ &\quad +\lambda_1 \times (1-\varphi) \times (1-p) \times d \times U'(g_d + i + z) = 0 \end{aligned} \tag{85}$$

From 81, 82, 84 and 85, we see that the worker receives the same utility in each of the possible scenarios ($U(w_H) = U(w_L) = U(g_d+i+z) = U(s+g_u+z)$). Using this equality, equation 83 reduces to

$$\begin{aligned} L_p &= (1-\varphi) \times [-(1-d) \times \theta_L \\ &\quad +(1-d) \times z - d \times (1-l_d) \times g_d + (1-l_u) \times g_u] \\ &\quad +\lambda_2 - \lambda_3 = 0 \end{aligned} \tag{86}$$

Since the Lagrange multipliers λ_2 and λ_3 must be non-negative

$$(1-d) \times \theta_L < (1-d) \times z - d \times (1-l_d) \times g_d + (1-l_u) \times g_u$$

implies that $\lambda_3 > 0$. In order for the contract to hold, p must equal to one, implying that the worker is displaced with certainty. In contrast, if

$$(1-d) \times \theta_L > (1-d) \times z - d \times (1-l_d) \times g_d + (1-l_u) \times g_u,$$

then $\lambda_2 > 0$ and $p = 0$, and the worker is retained with certainty.

As the value of leisure (z) is an unobserved random variable, it is useful to write the displacement rule as in equation 87.

$$z > \theta_L + \frac{d}{1-d} \times (1 - l_d) \times g_d - \frac{1 - l_u}{1-d} \times g_u \tag{87}$$

The worker is displaced if the value of leisure exceeds the threshold point given by the right hand side of the inequality 87. Denoting this critical value by k, the probability of displacement can be written as:

$$P(z > k) = 1 - F(k),$$

where $F()$ is the cumulative distribution function of z, and $k = \theta_L + \frac{d}{1-d} \times (1 - l_d) \times g_d - \frac{1-l_u}{1-d} \times g_u$.

The model yields straightforward predictions for the effect of the exogenous variables on the displacement probability. First and trivially, the probability of displacement depends negatively on the productivity. Second, the social security provisions affect displacements only when the productivity is low. (All workers are retained when the productivity is high.) Third, if the firm is not fully liable for the unemployment benefits ($l_u < 1$), an *increase* in the unemployment benefits *increases* the displacement probability. In contrast, if the disability risk is positive ($d > 0$), and the firm is not fully liable for the disability benefits ($l_d < 1$), an *increase* in the disability benefit level *decreases* the displacement probability. Similarly, it can be verified that an *increase* in the firm's liability share of the unemployment benefits, or a *decrease* in the firm's liability share of the disability benefits, *decreases* the displacement probability.

Finally, we can derive the effect of the disability risk on the displacement probability. Differentiating the displacement rule with respect to the disability risk yields:

$$sign\left[\frac{\partial P(z > k)}{\partial d}\right] = sign\left[\frac{-(1 - l_d)g_d + (1 - l_u)g_u}{(1-d)^2}\right] \tag{89}$$

As the unemployment and the disability pension benefits are approximately equal in Finland, the sign of the derivative depends on the relative size of the firm liabilities for the unemployment and the disability benefits. If the firm liability for the disability pensions is higher (as it is for the big companies in Finland), an exogenous increase in the disability risk increases the displacement probability. The firm tries to avoid costly disability pensions by increasing its displacements.

The assumption of full information by both parties in the second period guarantees that the optimal contract yields efficient outcomes. A risk-averse worker is fully insured, and separations are efficient because they occur only when the joint value of continuing employment (for the worker and the firm) is less than the joint value of the separation. However, the contract may be socially inefficient, since the contracting parties do not bear the full cost of the job termination.

5.4 Data and the Estimation Results

5.4.1 Data

The data that are used in the empirical section come from a longitudinal linked employer-employee data set for Finland. This data set was created from the Register of Enterprises and Establishments, Financial Statements Statistics, and Employment Statistics; all constructed and maintained by Statistics Finland.

The Register of Enterprises and Establishments (REE) covers practically all Finnish enterprises and their establishments. It collects basic information on all companies subject to the value-added tax. The main purpose of this register is to serve as a sampling frame for company surveys. Financial Statements Statistics (FSS) is a compulsory annual survey that collects the corporate income statements and the balance sheets of the firms. The FSS survey is a stratified sample of the enterprises in REE. All large companies with more than one hundred employees are surveyed. Smaller companies are surveyed as a rotating sample where a fraction of the sampled companies is replaced each year. Employment Statistics (ES) is the annual census of the Finnish population. It is based on administrative registers, most important of which are the Population Register, Tax Registers, Employment Register of the Central Pension Security Institute, pension registers of the Social Insurance Institution and the Register of Job Applicants of the Ministry of Labour. ES contains a wealth of demographic information, detailed information on employment and unemployment spells, pension benefit information and annual income of the individuals. Most importantly, ES contains the firm code which reveals the firm where the individual was working at the end of the year.

The linked panel was constructed by collecting all firms in manufacturing, construction, services and trade from the FSS survey. Comparable data were available for manufacturing and for construction from 1989 to 1994, for services from 1990 to 1995, and for trade from 1989 to 1995. The full sample contains 11,700 firms, with 4,000-6,000 firms in each year. Individuals from ES were selected to the linked panel if they had a firm identifier at the end of the year, at least in one of the years between 1988 and 1996. There were about two million employees who satisfied this condition in the ES data. About half of these individuals could be linked to the firms in the FSS survey. The data exclude public sector employees, those individuals who were not employed at the end of the year in any of the years in the sample, and the individuals who had a missing firm identifier. If the individual could be linked to the firm data at least once, the rest of the information on him was collected from all the available years (1987-1997), irrespective whether the link could be made every year. The data set is fully described in Korkeamäki and Kyyrä (2000).

For reasons of confidentiality, Statistics Finland does not allow the use of the data set outside its premises. A smaller sample, however, was released for preliminary analysis. In this sample, the firm identifiers were re-coded, information on the largest companies was deleted, and noise was added to the balance sheet data. The final estimates were obtained from the original data set at Statistics Finland.

In this paper, we restrict the sample to individuals who were between forty-five and sixty-five years of age. Our unit of observation is an individual-firm-year combination. An individual is present in the sample in the years when he is employed in one of the companies and fulfils the age criteria. The final sample size is 953,365 person-firm-year observations, with 295,473 individuals. There are on average 3.23 observations per individual (maximum 7).

The dependent variable for our analysis is a transition from employment to unemployment. To be more specific, we define a transition to take place in year t, if a worker who is employed in the last week of year t, is unemployed in the last week of year $t+1$. Explanatory variables for this transition are evaluated in year t.

Employee productivity (θ) is estimated from the firm data as output (value added) per worker. The value-added is calculated by subtracting the cost of raw materials from the sales, and adjusting this with the change in the inventories. When calculating the average productivity per worker, we use the average number of workers in the firm over the accounting period. We also experimented with adjustments to the productivity using the book-value of capital and within firm wage differences.[164] This did not influence the results.

We use the change in this value-added as a measure of the demand shock faced by a firm. This is simply a percentage change in the value-added without any correction for inflation. Differencing the data reduces the sample size because we lose one year in the differencing and there are a number of firms that do not appear in the data more than once.

5.4.2 Results

In our implicit contract model, the firm decides on displacements by comparing expected profits and expected costs of retaining its workers. The contract makes the worker indifferent between being displaced and continuing in employment. Social security benefits influence the displacement decision by subsidizing displacements. If the worker is eligible for the unemployment tunnel, displacement costs for the firm are reduced and the displacement probability increases. The firm's liability for the benefits also plays a role. The higher the firm's liability for the unemployment benefits is, the more expensive are the displacements, and the lower is the displacement probability.

In this section we test two implications of the model. First, we show that displacements are more common in firms with decreasing sales. More interestingly, we show that the incentives of the social security system have a larger effect on the workers that are in firms that are hit harder by a negative demand shock. Second, we show that the size of the firm pension liability has an effect on displacements.

Differences in the effect of the financial incentives across firms

The worker incentives to retire depend on the expected stream of wages and benefits (unemployment benefits+pensions). An additional year of work may increase pensions, depending on the worker's age, wage, and the eligibility rules of the different pension schemes. By far the largest increase in the available benefits occurs when the worker turns fifty-five, and becomes eligible for the

[164] The purpose of the capital adjustment was to account for the differences in the capital stock between the firms. We deducted from the value-added the book value of capital multiplied by the market interest rate. We also made an adjustment for the within-firm productivity differences of the individuals by multiplying the average worker productivity by relative wages within the firm. With these two adjustments, the worker productivity is $\widehat{\theta}_{it} = [Y_f - (r * K)]/(N) * (w_i/\overline{w})$, where Y_f is the value added, r the Helibor interest rate, K the book value of machinery and buildings, N the number of workers, w_i the individual monthly wage, and $\overline{w}$ the firm average wage.

unemployment tunnel. In section 5.2, we showed that the displacement rates at this age increased dramatically during a recession. In this section, we test whether the displacement probability depends on the product demand conditions of individual firms.

We use the change in output (value-added) as an indicator of a demand shock, and divide the workers into four quartiles, based on the output change of the firms where they work. We do this separately in each year so that, for example, in 1990 the workers in the first quartile are in firms where the output *decreased* by at least 5.5%, and the workers in the fourth quartile are in firms where the output *grew* by at least 12.4%. We estimate the effect of the incentives by running simple probit models where the probability of displacement is explained by the tunnel eligibility. This is done separately for each quartile and each year.

Table 41 shows the marginal effects of the eligibility dummy in the estimated models. Marginal effects are obtained by scaling the probit coefficients so that the entries refer to the change in the probability of displacement due to the tunnel eligibility. According to the estimates, the fraction of the displaced workers appears to be inversely related to the output change of the firm. The firms with the lowest output growth (column I) displace most workers. The effect of the tunnel eligibility is positive and statistically significant in all output growth quartiles in all years. In other words, workers who are eligible for the extended unemployment benefits are clearly more likely to end up unemployed.

The most interesting results in the table are the differences in the effect of the tunnel eligibility across the years and across the firms with different output growth. The effect of the tunnel eligibility before the recession in 1990 is rather small. Workers who are eligible for the tunnel are three to five percentage points more likely to be displaced than their ineligible co-workers. In contrast, in the first years of the recession, 1991-1992, the eligibility for the unemployment tunnel increases the displacement probability by approximately ten percentage points. There is also a clear pattern within each year. The tunnel eligibility increases the displacement probability in the firms with lowest output growth (quartiles I and II) much more than in firms with higher output growth.

These results are surprisingly consistent over the whole period. They do not change when we control for a number of firm and individual specific characteristics. On the right hand side of the table, we estimate the same model but control

	Without	controls			With	controls		
	worst			best	worst			best
	I	II	III	IV	I	II	III	IV
90	.058	.030	.041	.038	.047	.026	.035	.031
	(.003)	(.003)	(.003)	(.003)	(.003)	(.002)	(.003)	(.003)
	[.100]	[.056]	[.074]	[.106]	[.099]	[.056]	[.074]	[.106]
91	.117	.109	.064	.069	.108	.100	.058	.061
	(.004)	(.004)	(.003)	(.003)	(.004)	(.004)	(.003)	(.003)
	[.143]	[.146]	[.091]	[.079]	[.143]	[.146]	[.091]	[.079]
92	.126	.100	.083	.089	.117	.090	.079	.080
	(.004)	(.004)	(.003)	(.003)	(.004)	(.003)	(.003)	(.003)
	[.176]	[.101]	[.088]	[.073]	[.176]	[.101]	[.088]	[.073]
93	.096	.088	.048	.042	.085	.081	.043	.048
	(.004)	(.003)	(.002)	(.003)	(.004)	(.003)	(.002)	(.002)
	[.112]	[.062]	[.039]	[.043]	[.111]	[.062]	[.039]	[.043]
94	.099	.071	.055	.088	.088	.060	.047	.080
	(.003)	(.003)	(.003)	(.003)	(.003)	(.003)	(.002)	(.003)
	[.078]	[.048]	[.044]	[.088]	[.077]	[.048]	[.044]	[.070]
95	.068	.056	.039	.045	.056	.051	.036	.040
	(.006)	(.006)	(.005)	(.006)	(.006)	(.005)	(.004)	(.005)
	[.067]	[.051]	[.039]	[.061]	[.066]	[.051]	[.039]	[.061]

Table 41: The effect of unemployment tunnel by quartiles of sales growth

Notes: The entries in the table are changes in the firing probability due to the eligibility for extended unemployment benefits (the unemployment tunnel). The estimates are based on the probit equations estimated separately in each quartile and year. In columns labeled "with controls" the equations also include controls for sex, education, earnings, industry, firm size, average wages in the firm and labor share of value added in the firm. Standard errors of the estimates are in parentheses. The numbers in square brackets are the average fraction of workers in each group that become unemployed.

for sex, education, annual earnings, industry, firm size, average wages and the labor share of the value-added in the firm. We find that women are less likely to be displaced. Education does not seem to have a large effect. A high wage has a significant negative impact on the displacement probability. As for the firm characteristics, we find that workers in large firms have a lower, and workers in the construction industry a higher, displacement probability. Average wages in the firm do not have a significant effect, but the workers in labor intensive firms have a larger displacement probability.[165] Adding all these control variables decreases the effect of the tunnel eligibility by about one percentage point. Yet the controls do not affect the pattern of the results. Incentives created by the unemployment tunnel clearly have the largest effect on displacement in the firms with lowest output growth, and these effects are largest during the recession.

The output change is probably the best available indicator of the demand shocks faced by the firm. However, to check the robustness of the results, we repeated the analysis classifying firms according to average worker productivity. The pattern of the results (not reported here) was identical. The effect of the tunnel eligibility was much stronger in the low productivity firms.

Firm liabilities

The second prediction of the theoretical model that we wanted to examine is the importance of the firm liabilities on displacements. Our model predicts that the higher firm liability for the unemployment pension reduces the displacement probability. In Finland, the liability depends on the firm size. Large firms have a higher liability for the unemployment pension, and could, therefore, be expected to be more reluctant to displace their older workers. However, estimating the effect of the pension liabilities based on the differences in displacement rates across firms that differ in size may yield spurious results. The firm size is likely to affect a number of other features of the employment contract as well, and the displacement rates may vary across small and large firms for reasons unrelated to the pension liabilities.

A typical identification strategy in empirical research relies on changes that affect different groups differently. Also, the effect of pension liabilities could then be estimated using a difference-in-differences approach. Unfortunately, no changes in pension liabilities occurred in our data. However, there was a change

[165] The results are not presented here, but they are available from the authors upon request.

in the eligibility criteria for the disability pensions. Our approach exploits this change to identify the effects of the pension liabilities.

In addition to the higher liability for the unemployment pensions, large firms have also a higher liability for the disability pensions. Since the unemployment pension liability is capped at fifty percent of the total cost of the unemployment pension, but there is no such cap on the cost of the disability pensions, the unemployment pension is typically the cheaper of the two exit routes for the biggest firms. Moreover, because the unemployment benefits are not experience-rated at all, the cost difference between the disability and the unemployment pensions is even higher when all expenses of the two exit routes are compared. For example, a firm that displaces a worker at the age of fifty-five becomes liable for the worker benefits only when the worker starts receiving the unemployment pension at the age of sixty. If the same worker becomes disabled at the age of fifty-five, the firm is liable for the disability pensions for the whole ten year period (55-65) when the worker receives the disability pension. This difference in the liabilities may encourage big firms to increase their displacements when the disability risk is high.

As mentioned in section 5.2, there are two kinds of disability pensions in Finland. Normal disability pension (DI) is available for severely disabled in all age groups. Individual early retirement (IER) has less strict health criteria, but the eligibility is restricted to older workers only. In 1994, the minimum eligibility age for IER changed. Previously, IER could be granted to fifty-five to sixty-four -year olds. After the change only fifty-eight to sixty-four -year olds were eligible. Because of the change in the criteria, the cohort born in 1939 could retire with IER in 1994, but the cohort born in 1940 could not go to IER until 1998. All cohorts could still retire on DI if their disability was severe enough. The change in the minimum age requirement for IER reduced the incidence of disability when both disability pensions (DI and IER) are considered. From the firm's point of view, the change effectively reduced the disability risk for the age groups that were no longer eligible for IER. Our model predicts that a decrease in the disability risk should reduce "pre-emptive" dismissals in firms that have a higher liability for the disability pensions. In Finland, this would be the larger firms.

A simple estimator for the effect of the pension liabilities could, therefore, be formulated as an interaction between the IER eligibility and the firm size.

Constructing a dummy variable ($ELIG$) equal to one if the individual is eligible for individual early retirement, and interacting this dummy with the firm size, yields a simple probit model for displacements

$$\Pr(Displ) = \Phi(\beta_0 + \beta_1 ELIG + \beta_2 FSIZE + \beta_3 (ELIG \times FSIZE)) \quad (90)$$

A positive coefficient on the interaction term would indicate that the impact of the IER eligibility has a larger effect on displacements in large firms. We would like to interpret this as evidence on the effect of the pension liabilities. However, there is an important caveat to this approach. The eligibility dummy is an interaction between age and cohort. Workers become eligible for IER when they turn fifty-five, if they belong to the cohorts born by 1939. Therefore, the interaction term between the eligibility and the firm size is, in fact, a triple interaction between age, cohort and firm size. A consistent estimate of the triple interaction requires that all lower level interactions, and all main effects are included in the model. We, therefore, add also the interaction terms $(FSIZE \times (AGE \geq 55))$ and $(FSIZE \times (BIRTH \leq 1939))$ and the main effects $(AGE \geq 55)$ and $(BIRTH \leq 1939)$ to the model.

This approach can also be interpreted as a difference-in-differences estimator. Let us define the older cohorts (born by 1939) as the treatment group and the younger cohorts as the comparison group. The treatment group becomes eligible for the IER when they turn fifty-five. We can estimate the treatment effect by comparing the change in the displacement rates when workers turn fifty-five in the treatment group with the corresponding change in the comparison group. In a probit model

$$\begin{aligned} \Pr(Displ) = \Phi(&\gamma_0 + \gamma_1 (AGE \geq 55) + \gamma_2 (BIRTH \leq 1939) \\ &+ \gamma_3 ((AGE \geq 55) \times (BIRTH \leq 1939))) \end{aligned} \quad (91)$$

the parameter γ_3 provides an estimate of the treatment effect. We have argued that the treatment effect should be larger in the large firms. A simple way of testing this hypothesis is to estimate the above model separately for the small and large firms, and compare the coefficients. Alternatively, we can pool the data and estimate

$$\begin{aligned} \Pr(Displ) = \Phi(&\gamma_0 + \gamma_1 (AGE \geq 55) + \gamma_2 (BIRTH \leq 1939) + \gamma_3 (ELIG) \\ &+ \gamma_4 FSIZE + \gamma_5 [FSIZE \times (AGE \geq 55)] \\ &+ \gamma_7 [FSIZE \times (BIRTH \leq 1939)] + \gamma_8 [FSIZE \times ELIG] \end{aligned} \quad (92)$$

In Table 42, we report these results. In the first column, we include only

	1	2	3	4
	Coef (s.e.)	Coef (s.e.)	Coef (s.e.)	Coef (s.e.)
ELIG	0.068	0.030	0.029	0.028
	(.001)	(.002)	(.003)	(.003)
FSIZE	-0.008	-0.008	-0.009	-0.006
	(.000)	(.000)	(.000)	(.000)
ELIG×FSIZE	0.006	0.002	0.002	0.002
	(.000)	(.001)	(.001)	(.000)
FSIZE×(AGE≥55)		0.004	0.005	0.004
		(.000)	(.000)	(.000)
FSIZE×(BIRTH≤1939)		0.001	0.002	0.001
		(.000)	(.000)	(.000)
AGE≥55		0.026		
		(.002)		
BIRTH≤1939		0.011		
		(.001)		
age dummies	no	no	yes	yes
cohort dummies	no	no	yes	yes
individual controls	no	no	no	yes
firm specific controls	no	no	no	yes
number of person years	953,365	953,365	953,365	953,365
observed probability	0.077	0.077	0.077	0.077
Pseudo R^2	0.036	0.038	0.069	0.101

Table 42: The Effect of the Individual Early Retirement Age Limit Change on the Displacement Probability

Notes: The entries in the table are marginal effects, i.e. changes in the displacement probability when the explanatory variables change by one unit. The firm size is divided by 1000. Standard errors of the marginal effects are in parentheses. They are robust for clustering of repeated observations of the same individuals.

the eligibility dummy and the firm size and the interaction of these two variables. The results indicate that the workers eligible for IER are more likely to be displaced. Larger firms appear to be more secure employers; displacement probability decreases with the firm size. The interaction term between the firm size and the eligibility dummy is positive and significant. Eligibility for IER increases the displacement probability more in the large firms. This result confirms our prediction that the firm liabilities have an impact on displacement.

In the second column we add the main effects ($AGE \geq 55$) and ($BIRTH \leq 1939$), and the interactions of these variables with the firm size. The point estimate of the interaction term between the firm size and the eligibility dummy decreases, but remains statistically significant. This result also holds in the third column where we replace the dichotomous age and cohort variables with a full set of age and cohort dummies. Finally, in column 4, we add controls for sex, education, annual earnings, industry, average wages and the labor share of the value-added in the firm. Adding these variables has almost no effect on the estimates.

5.5 Conclusion

The observation that the firm liabilities of unemployment benefits affect layoff decisions is not new. Feldstein (1976, 1978) and Topel (1984) show that imperfect experience-rating of unemployment benefits effectively subsidizes lay-offs, and increases the incidence of unemployment. Hutchens (1999) constructs a theoretical model, applying this idea to early retirement. To our knowledge, the effect of the firm liabilities on early retirement has previously not been examined empirically. As many early retirement schemes, particularly in the European countries, share features of unemployment insurance programs, accounting for firm incentives in early retirement decisions is crucial.

A negative demand shock may force firms to reduce their employment. In the implicit contract framework, firms arrange their displacements so that the losses to the workers are minimized. Therefore, firms encourage those workers to leave who are eligible for early retirement benefits. The worker incentives to retire are not better in bad times, but if the firm has an active role in the retirement decisions, early retirement schemes are jointly more profitable for the worker and the firm when the productivity is low. Hence financial incentives have a larger effect on retirement when the aggregate demand is low.

There are a number of possible extensions to the analysis that was performed in this paper. We have treated the disability risk as exogenous. It could be argued that also disability pension applications depend on the financial incentives. It should be reasonably straightforward to extend the model so that the workers and the firms maximize joint profits by choosing between three options: employment, early retirement with the unemployment pension, or early retirement with the disability pension.

The model could also be made more realistic by dropping the full information assumption. Full information on workers' evaluation of leisure allowed the firms to tailor the individual retirement benefits. While dropping this full-information assumption would force the firms to offer the same benefits to all of their workers, it would not change the key predictions of the model.

Another obvious extension would be to replace the once-and-for-all decision with a dynamic programming model as in, for example, Rust and Phelan (1997) or an option value model as in Stock and Wise (1990). This would make the model more realistic by allowing the firms to postpone the displacement decision, keeping the option to lay off the worker in the next period if the demand conditions do not improve. Yet a dynamic programming model would be considerably more complicated as one would need to make a number of assumptions regarding, for example, the expectations on future wages and productivity. In addition, the stream of the unemployment and pension benefits would have to be calculated for each worker at each possible retirement age. While the dynamic programming approach could be extremely useful in making predictions on the effects of changes in the financial incentives or the eligibility rules, our simpler approach is sufficient to demonstrate that both the worker and the firm incentives matter.

As the population ages and the labor force participation rates of the aged have decreased, many countries face serious challenges in funding their Pay-As-You-Go pension systems. There is a widespread consensus that in order to mitigate the financial pressures on the pension systems, it would be best to increase the average retirement age. We show that in addition to improving the work incentives, an increase in the average retirement age might also require tampering with the implicit incentives provided for the firm. Experience-rated unemployment benefits and unemployment pensions would lessen the firm incentives to fire older workers. Full experience-rating should, however, be used with caution, because it could further discourage hiring of older workers.

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Appendix

Descriptive Statistics Descriptive statistics of the sample are in Table 43. These statistics are calculated over the whole sample. The unit of the observation is person-year. Some individuals appear several times in the sample, whereas some others appear only once. As noted in the text, the data for manufacturing and construction was available from 1989 to 1994, for services from 1990 to 1995 and for trade from 1989 to 1995.

Variable	*Mean*	*Sd*	*Min*	*Max*
Age	50.95	4.56	45	64
Year of birth	40.65	5.02	25	50
Earnings (FIM/year)	131,432	82,289	0	5,453,710
Productivity (FIM/year)	277,297	221,603	-3.1×10^7	4.6×10^7
Firm size (number of co-workers)	1,966	2,655	0	13,678
Years of Education	10.34	2.01	9	22
Female	0.42	0.49	0	1
Labour share in a firm	0.67	0.47	0	1
Transition from employment to unemployment	0.08	0.27	0	1
Average wage in a firm	120,055	28,673	102	845,657
Change in the value-added (%)	12.59	435.86	-36405	51802
Eligible to the IER	0.27	0.45	0	1
Eligible to the unempl tunnel	0.41	0.49	0	1
Works in manufacturing	0.64	0.48	0	1
Works in construction	0.07	0.25	0	1
Works in services	0.05	0.22	0	1
Works in trade	0.25	0.43	0	1
Number of observations	1,001,638			

Table 43: Descriptive Statistics of the Employer-Employee -Panel

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