VATT-KESKUSTELUALOITTEITA
VATT-DISCUSSION PAPERS

224

NAVIGATING THROUGH THE FINNISH PENSION SYSTEM

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Helsinki 2000

Early estimations that are in this paper were published by the Ministry of the Social Affairs and Health (Julkaisuja 2000: 11). The support in the Ageing project by the Ministry is gratefully acknowledged. In additional work, done for the purposes of this paper, the author wishes to express her thank you to the Yrjö Jahnsson foundation.

The Central Pension Security Institute and the Social Insurance Institution made a specific registry match possible, making the used data set even more appropriate to the retirement research. Efforts with the data, by both of the institutions (and their collaborators), as well as by the Statistics Finland, were greatly appreciated. Special thanks go to Reijo Vanne and Jari Kannisto, as without their dexterity with the data work, the match with some of the crucial variables would never have been successful.

ISBN 951-561-322-1

ISSN 0788-5016

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Yliopistopaino Oy

Helsinki, June 2000

HAKOLA, TUULIA: NAVIGATING THROUGH THE FINNISH PENSION SYSTEM (Suunnistaen suomalaisessa eläkejärjestelmässä). Helsinki, VATT, Valtion taloudellinen tutkimuskeskus, Government Institute for Economic Research, 2000 (C, ISSN 0788-5016, No 224) ISBN 951-561-322-1.

ABSTRACT: The paper constructs a competing risks duration model, explaining the probability of retirement due to old-age, ill health or long-term unemployment. It also attempts to measure the degree of substitution between the various retirement channels, among other things, by using data on pension application rejections.

The e¤ect of the economic incentives was tested in a number of alternative speci…cations. In addition to simple replacement ratio, life-cycle incentives were calculated for each exit channel separately. Both the grace period compensations (unemployment bene…ts and sick allowances) and the actual pension bene…ts were considered.

The paper concludes that the baseline hazards as well as the e¤ects of a number of explanatory variables di¤er sign…cantly between the distinct retirement channels. It also …nds some evidence on the channel substitutability between di¤erent retirement channels.

Keywords: Unemployment pension, disability pension, old-age pension, substitutability of the pension channels

TIIVISTELMÄ: Tutkimuksessa kilpailevien riskien duraatiomallilla testataan työkyvyttömyys- (tavallinen työkyvyttömyyseläke tai yksilöllinen varhaiseläke), työttömyys- tai vanhuuseläkkeelle siirtymiseen vaikuttavia tekijöitä. Lisäksi tutkimuksessa arvioidaan missä määrin työttömyys- ja työkyvyttömyyseläkkeet (sisältäen yksilöllisen varhaiseläkkeen) korvaavat toisiaan.

Eläkekannustimien vaikutusta eläkkeelle siirtymistodennäköisyyksiin testattiin useilla eri kannustinmittareilla. Yksinkertaisen korvaussuhteen lisäksi jokaiselle kanavalle laskettiin pidemmälle ajalle ulottuva ”elinaikakannustin”. Tämän kannustimen konstruoinnissa huomioitiin niin eläkettä edeltävä, muun sosiaaliturvan varassa eletty jakso (työttömyyskorvaus tai sairauspäiväraha) kuin itse odotettu eläkkeellä olo aika.

Tutkimuksen mukaan eläkkeelle siirtymisen ajankohta eroaa eri eläkevaihtoehdoissa ja eri eläkemuodoille ajautuu erilaisia yksilöitä. Työttömyys- ja työkyvyttömyyseläkekanavat osoittautuvat myös osittain vaihtoehtoisiksi joillekin yksilöille.

Asiasanat: Työttömyyseläke, työkyvyttömyyseläke, yksilöllinen varhaiseläke, vanhuuseläke, eläkekanavien vaihtoehtoisuus

Contents

1 Introduction

There has been an increase in the early retirements in recent years in the industrialized countries. In Finland, the employment share of the age group of 60 to 64 years, fell from 46 per cent in 1970 to 19 per cent in 1996. The corresponding fall for the age group of 55 to 59 years, was from 67 per cent to 48.5 per cent.[1] These changes in the labour market participation are exacerbated by parallel changes in the underlying demographic structure of the population. The baby boom generations of the late 1940's and early 1950's are about to reach the retirement age. The Finnish working age population starts to fall in 2010[2].

There are at least three obvious ways to meet the higher pension expenditures in a Pay-As-You-Go pension system. First, one can increase the social security contributions of the working population. This can be seen as equivalent to a tax increase. Secondly, existing pension commitments can be cut. Both, increases in the social security contributions and cuts in the pension benefits can have undesirable economic and political consequences. Henceforth, increased focus has been shifted to policies targeting to raise the average retirement age[3]. Late retirement would improve public finances, not only because those who are still at work, are a non-materialized pension liability, but also because tax contributions of the workers are higher than they would be from the corresponding pensions.

Finnish early retirements and the response to the economic incentives was already examined in my previous study (Hakola, 1999). Yet, the Finnish pension system consists of a multitude of retirement channels for early retirement. These channels differ in terms of their availability, accessibility and attractiveness to the older workers. Analysis that ignores these differences between the channels, not only wastes information, but can actually lead to erroneous conclusions. Henceforth, this paper builds on my earlier work,

[1] As of late there seems to be some increase in the proportion of the aged employed in Finland. According to the new classification criteria by the Statistics Finland (which is not directly comparable to the figures given in the text), employment rate for the 55 to 59 year olds was 47.3 per cent in 1994 and 54.7 per cent in 1999. Corresponding rate for the 60 to 64 year olds were 20.5 per cent and 23.3 per cent.

[2] The most disadvantageous old age dependency ratio, from the perspective of a PAYG pension system, could therefore be reached as early as 2010.

[3] In essence, if the pension system is "actuarilly unfair", later retirement can also imply a cut in the pension benefits corresponding to each individual. Yet, this cut is less explicit than a direct cut in the pension benefits.

but separates the channels of exit. Moreover, an attempt is made to assess substitutability of some of the retirement channels. Channel substitutability is an important policy question as there is a debate on whether entrance to some of the exit channels should be tightened, or whether specifically the unemployment pension channel should be closed altogether. If there is significant substitution between the channels, closing one channel is likely to yield only a cosmetic change, where merely the exit channel changes, but the number of retirees remains the same.

Models separating the early exit channels have not been very common in the microeconometric retirement literature. This is because most of the microeconometric retirement papers have been written for the US, and the US pension system (or the data that is available) does not lend itself easily to this type of analysis[4]. In Europe, multichannel analysis of the early retirements have recently become very popular. For example, OECD (1998) published a study which included micro-econometric analysis of five OECD countries (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 produced further value in explaining early retirement.

There have been three multi-channel studies on the Finnish pension system. Lilja's (1994) study covered the late 1980s, Pyy-Martikainen (2000) focused on those ending unemployment in 1992 and 1994, and Gould (1996) concentrated on the 1990s. Out of these, only Pyy-Martikainen attempts to model the channel substitutability.

Lilja (1994) divided the exit channels into four categories: retired early[5], retired due to long-term unemployment, retired due to ill health and left the labour market without an immediate pension. In her estimations, she used a data set that consisted of pooled Finnish Labour Force Surveys from 1984 to 1987. She focused on the private-sector employees and self-employed. Her explanatory variables were related to the pension level, to the working conditions and to the socioeconomic status. Lilja denoted that retirement has a clear positive duration dependence, even if she didn't find a statistically significant difference in the duration dependence for the different exit

[4]In the US, multi-channel frameworks, such as the competing risks models, have been used more for the study of unemployment, defining the exit channels as part-time and full-time work or new job versus recall (see, for example, McCall, 1996 or Juradja and Tannerey, 1998).

[5]It is presumed that this refers specifically to the early old age retirement.

channels. Some of her covariates had a different impact on the different exit channels, justifying her use of the competing risks model. Perhaps the most unfortunate drawback of the data set was the lack of any direct measure of the pension or the income levels. Moreover, her data set dated further back than the erection of a major new exit channel (individual early retirement) and the start of the mass use of the unemployment pension.

Pyy-Martikainen (2000) restricted her study to the labour market transitions of the older unemployed. Her alternative exit channels were a) employment, b) active labour market programmes, c) unemployment pension, d) other pension, and e) withdrawal from the labour market without a pension. She analysed the problem of multiple channels in a nested logit model. The model structure allowed her to assess substitutability between different channels out of unemployment. She found that active labour market programmes and unemployment pension were the closest alternatives. Consequently, she deduced that active labour market programmes had been used as an extension of the unemployment benefits.

The third paper, that of Gould (1996), used survey data, combined with some information from registries of the private sector employment pension scheme (tel). The core of her paper was implemented with logistic regression models - both for the probability of an early exit as a whole, as well as a separate equation for each of the three exit routes (in her paper: disability, unemployment and other pensions). Gould found that the use of different exit pathways tended to be best explained by somewhat different explanatory factors. The economic incentive effect (a variable being somewhat rudimentary) entered significantly only in the pathway that consisted of other than the disability and unemployment pensions. Gould's study provided stronger role for the labour demand variables.

The present paper contributes to the Finnish empirical retirement literature by extending the multi-channel analysis to both employed and unemployed. It uses a data set that was specifically modified to cater the needs of this type of a retirement study. In contrast to the earlier papers, the implemented model also takes heed of the panel properties of the data.

The paper proceeds as follows: After the introduction, there is a descriptive section on the different exit channels of the Finnish pension system. Availability, accessibility and attractiveness of each of the main exit channels is assessed. Because the paper takes a somewhat reduced model approach, explanation of the underlying general lifetime utility maximisation framework is virtually left out (see Hakola 1999), and instead there is a description of

the statistical model that was used (a competing risks duration model). Section three includes also the description of the data set that was used in the empirical analysis. The fourth section gives the results of the model. The final section, the fifth, concludes.

2 Finnish Early Exit Channels - Availability, Accessibility and Attractiveness

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

2.1 Availability and Use of the Exit Channels

In the Finnish public pension system, there are at least eight different retirement schemes, differing mainly by the reason of retirement. These schemes with their date of introduction and the target group are listed in table 1.

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
Individual Early Retirement	January 1986	Reduced work ability and/or long work history
Early old-age pension	January 1986	
Part-time pension	January 1987	
Farmer's pension	January 1974	Farmers
War veterans' pension	1982 (male) 1983(female)	Veterans of the war

Table 1: Employment Pension Schemes

The most common retirement routes are the old-age pension, the disability pension, the unemployment pension and the individual early retirement. Sometimes both the disability pension and the 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.

Table 2 gives shares of the relevant age cohorts in the different retirement categories in 1996. As it demonstrates, the greatest bulk of the early retirees[6] receive a disability pension. The data allowed distinction between the disability pension and individual early retirement only for some years, but not for 1996. Hence, both disability retirement and the individual early retirement are included under the heading for disability pensions. Because the individual early retirement is available only to the older age categories[7] 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 for 62 year olds). Unemployment shares in the age categories just prior to the unemployment pension eligibility have been growing, implying possibly higher shares of unemployment pensioners in the future[8]. All of the early retirement pensions are converted to the old age pension at the age of 65, explaining the huge jump in the old-age retirees at this age.

2.2 Accessibility

With the intention to restrict the accessibility to the specific retirement channel only to the target group, all retirement systems have specific eligibility criteria. For disability pensions the main criterium is sickness or reduced work ability. For unemployment pension, it is long-term unemployment. In addition to these main criteria, however, all retirement schemes have age restrictions. These age restrictions and their changes in recent years are given in table 3.

Old age pension constitutes the official retirement at the age of 65. The benefits can be collected early in the form of the early old age pension. The early old age pension, however, leads to permanently actuarially reduced pension benefits. As it is the only pension scheme with this feature, it has been less popular than the other early retirement schemes.

Disability pension is the only pension that is available in practically all age groups. Individual early retirement is also a disability pension, but it has a minimum age restriction. Medical requirement for the individual early

[6] that is, those who retire before the official retirement age for the old age pension, age 65

[7] 58-64 with some phasing from the earlier lower minimum age restriction

[8] Based on the own cross-tabulations of the 1987-1997 sample of the Employment Statistics.

Age	*Unemployment Pension*	*Disability Pension and Individual Early Retirement*	*Old Age Pension*
53	0	10.7	0.6
54	0	11.9	0.5
55	0	14.1	0.4
56	0	15.8	1.2
57	0	22.8	1.4
58	0	26.1	1.3
59	0	30.8	1.9
60	12.7	30.6	5.5
61	21.4	37.9	8.4
62	24.6	39.6	9.7
63	20.7	46.1	12.1
64	22.8	43.7	18.2
65	1.5	2.8	87.7
66	0	0	97.8

Table 2: Shares of the Age Group in Different Retirement Channels in 1996

Notes: Correction for the appearance in two categories is done in the preference order of 1) employed/unemployed 2) unemployment pension/disability pension and 3) old-age pension. Source: Own calculations on the sample of the Employment Statistics of the Statistics Finland.

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

Table 3: Eligibility Ages for Employment Pensions

retirement is also less stringent than the medical requirement for the normal disability pension. According to the law lower working capacity and long career are the pre-conditions for the individual early retirement.

Unemployment pension eligibility age has been subjected to most changes in recent years. It remains, together with the individual early retirement scheme, the retirement route that is most likely to face most changes in the future. The eligibility age for the part-time pension has been lowered in the hope of delaying the full-time retirement.

Disability and unemployment pensions entail a grace period, prior to the eligibility to the actual retirement scheme. For the disability pension (but not for the individual early retirement) the grace period is 300 days of sick allowance. This corresponds to one calendar year[9], as sick allowance is received six days a week. The grace period for the unemployment pension has been in a state of a flux in the recent years. Currently it stands at 500 days of unemployment assistance or unemployment insurance, with the possibility of extension for older workers[10].

Grace periods can also be viewed as extensions of the incentives to withdraw from work. Accordingly, it has become customary to talk of the "un-

[9] if sick allowance is received in consequent days

[10] Prior to 1994 the grace period was 200 days and the recipiency of the benefits didn't have to be consequent days.

employment tunnel"[11] for the unemployed in Finland. The tunnel consists of the earnings-related unemployment benefit, extended unemployment benefit, and the unemployment pension until the old-age retirement. The start of the tunnel is currently at the age of 55 years and one month[12]. Hence, it is possible to stop work at this age and live on the social security without a large drop in welfare. The minimum starting age of the tunnel has been subject to some changes in recent years. Prior to reforms in 1997, it was at 53 years and 1 month.

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

Figure 1 plots a time series of the unemployment rate for the aged and the number of unemployment pensioners. The change in the age limit changes the composition of the labour market withdrawal path for the unemployed. Accordingly, a rise in the unemployment pension age limit leads to a situtation where more years are spent in unemployment before the exit from the labour force to the unemployment pension. The number of the unemployment pensioners fell from 1986 onwards. This reflects the fact that the lower age limit for the unemployment pension was gradually raised from 55 to 60 starting in 1986. 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[13].

[11] or the unemployment pipe

[12] Earnings-related unemployment benefit is paid for 500 days at the maximum (five days a week). If the 500 day limit doesn't 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.

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

[13] Unemployment pension after a specified number of days on the unemployment benefit.

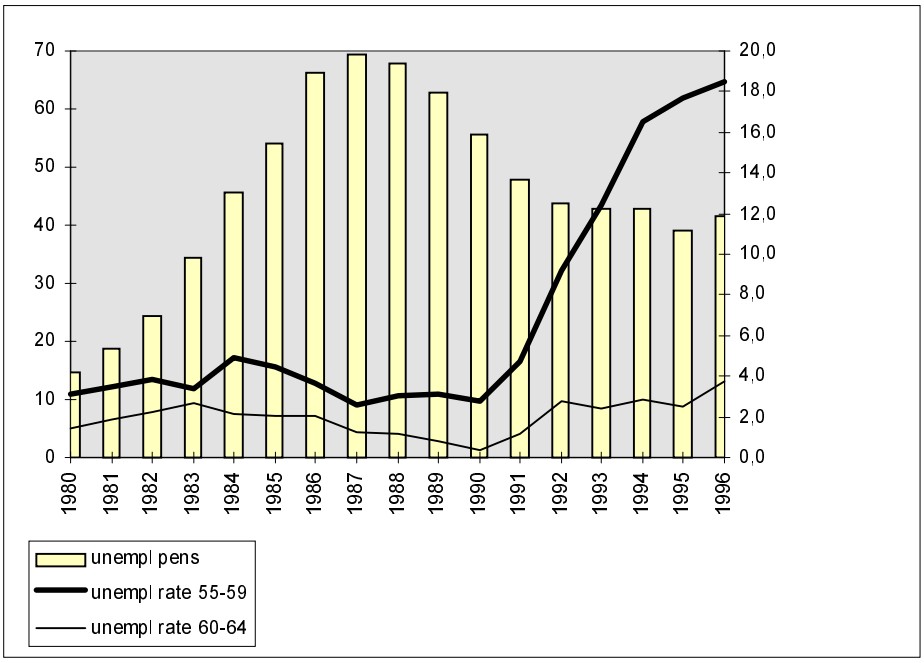

Figure 1: Unemployed (right hand scale, per cent) and Unemployment Pensioniers (left hand scale, '000) (Source: Labour Force Statistics, Statistics Finland)

Use of the disability route presents a pattern that is almost a mirror-image of the unemployment picture (figure 2). In 1982, recipiency of the disability pension was subjected to the recipiency of the maximum number of days of the sick allowance (300). Hence, the number of those receiving sick allowance was high, contrasting to a low amount of the disability pension recipients. In 1986[14], another type of disability pension, the individual early retirement, was established. Individual early retirement had less stringent health criteria. Moreover, this scheme did not require the preceding period of sick allowance. Consequently, there was a growth in the number of the disability retirees, contrasted by the fall in the number of those on sick allowance. Due to the financing crisis of the early 1990s, the lower age limit to the individual early retirement, was raised from 55 to 58 years in 1994. Therefore there was again a fall in the number of the disability retirees.

There have been claims that the acceptance criteria for the disability pensions was tightened during the years of recession, increasing the number of rejections on the disability applications. This claim, however, is not based on

[14]1986 private sector, 1989 in the public sector

a conscious policy change, and, therefore, it calls for empirical verification. As also the criteria for the unemployment pension (or the start of the unemployment tunnel) have been in a state of flux, uncertainty on the availability of the unemployment channel can be significant.

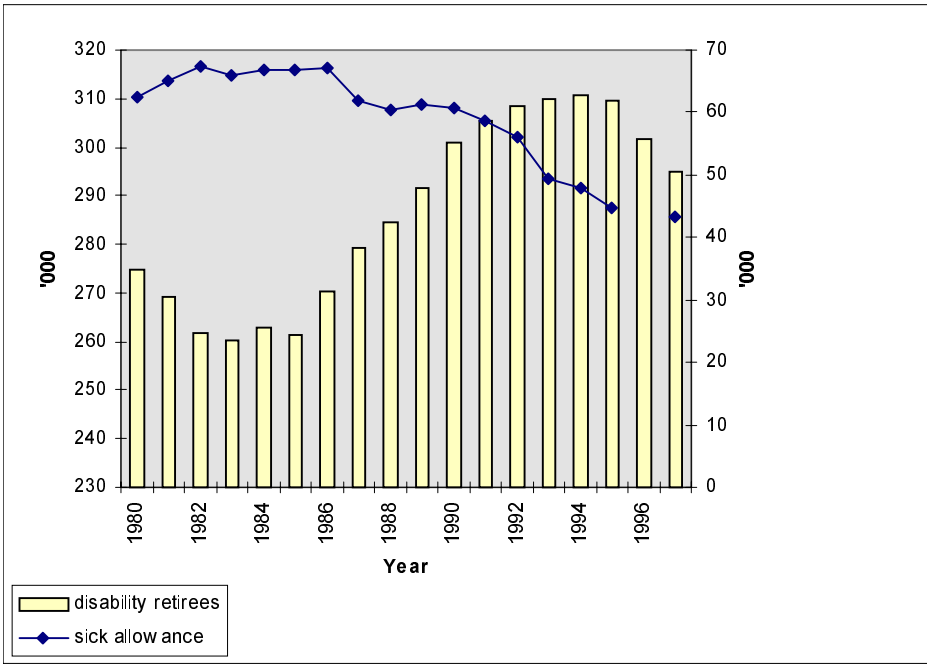

Figure 2: Number of Disability Retirees (thousands, left scale) and the Number of Those who Received Sick Allowance (thousands, right scale) (Source: Statistics Finland, Central Pension Security Institute and Social Insurance Institution)

2.3 Attractiveness

In order to analyse the attractiveness of the exit channels, from the viewpoint of the utility maximization, both the leisure and consumption implications of the alternative channels need to be assessed. These are given only for the main retirement schemes. The time of withdrawal from employment[15] gives the "leisure" implications[16]. Consumption implications, in contrast, are, as is the custom, analysed through income. For this, both the grace period income and the actual pension income need to be taken into consideration.

[15] Possibly differs from withdrawal from the labour force.

[16] Possibility of earlier withdrawal causing longer life expectancy is ignored in this paper.

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 4: Minimum Ages for Labour Market and Labour Force Exits

Notes: * Prior to 1997 start of the grace period was at 53 years, 1 month. Other age limit changes in the table 3.

Table 4 gives the earliest age that an aged employee can quit work as well as the earliest age when he actually can start to collect the pension. The table shows that the earliest exit from work and labour force (or the maximum "leisure time") 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[17]. Withdrawal from employment can take place earlier in the case of the unemployment route, but the time of the actual labour *force exit* is the same for the unemployment route and the individual early retirement[18]. Because of a very low re-employment probability for the older workers[19], labour *market exit* has often come to be equated with the labour *force exit*. Henceforth, it is possible that the unemployment channel has higher "leisure" implications.

Moving on to the consumption implications of the different exit channels, it is useful to look first at the grace period compensation. As stated before, grace period compensations consist of a sick allowance for the disability pension and an unemployment benefit[20] for the unemployment pension. For the individual early retirement scheme or the old age pensions, there is no grace

[17]Early old age pension scheme being less popular because of the permanent actuarial reduction in the pension benefits.

[18]Until this year, the labour force exit was earlier for the individual early retirement.

[19]None of the so-called "unemloyment tunnel aged" individuals receiving unemployment insurance benefit in the sample actually got employed.

[20]which can be either unemployment assistance or unemployment insurance

period. Out of the grace period compensations, unemployment insurance and sick allowance are, to some extent, functions of previous wages. Table 5 compares the sick allowance and unemployment insurance for certain income categories in 1999. For the sense of magnitude, corresponding pension levels[21] were also included in the table, even if the direct comparability of the pension calculations is more questionable. As the table shows, unemployment insurance is more advantageous than the sick allowance for the lower income category, but quite soon the sick allowance starts to dominate. The sick allowance is more advantageous, higher is the base income. Yet, it seems that the pension benefit dominates both the sick allowance and the unemployment insurance in the lower income categories, but levels off with the sick allowance in the higher income categories.

From the point view of the grace period financial incentives, the best retirement route would then be the individual early retirement which yields directly the pension benefit. The second most desirable route would be the disability or the unemployment pension, depending on the base income level.

Pension benefit for each of the channels has been the same until this year (2000): reference wage, multiplied by the accrual percentage and by the years of work[22]. Reference wage, years of work and indices used for inflation correction are not functions of the choice of the exit channel. The recent reforms (effective this year), however, reduce the accrual percentage during the so-called future time for the unemployment pension, lowering the financial attractiveness of the unemployment pension benefit.

This basic incentive framework is further complicated by severance pay, adjusted unemployment benefits for temporary work during unemployment and different wage/salary limits for the recipiency of different types of pension benefits[23]. For the purposes of this essay, however, these are ignored. They could not be reliably traced from the data and their effect was considered to be more marginal. Furthermore, for the purposes of this essay also the

[21] pension levels that correspond to the given income category

[22] This formula is applied to each job separately and all of the accrued pension rights are 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 the 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).

[23] Generally 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 limits.

income per month (FIM)	sick allowance (FIM)	unemployment insurance (FIM)	pension* (FIM)
4,000	2,660	3,096	
5,000	3,325	3,483	
6,000	3,990	3,891	4,673
7,000	4,655	4,300	5,104
8,000	5,320	4,687	5,702
10,000	6,650	5,482	6,899
12,000	7,980	6,170	8,095
15,000	9,150	6,751	

Table 5: Sick Allowance and Unemployment Insurance by Income Categories in 1999

Notes: Pension benefit levels are CPI-inflated values from Viitamäki (1995). Others are calculated according to the Social Security Insititutions Yearbooks' guidelines. Sick allowance is calculated for six days a week (25 days per month), whereas unemployment insurance is received only five days a week (21.5 days per month). Base wages in the sick allowance and unemployment insurance calculations include a 5 per cent deduction for pension and unemployment contributions. For the basis of pension benefit calculations see Viitamäki (1995).

impact of taxation is ignored. Taxation would, however, dampen further the income differences between the channels.

3 Data and Methodology

3.1 Data

The data that was used in the empirical analysis, is a sample from the Employment Statistics of the Statistics Finland. The Employment Statistics was created by the Statistics Finland in 1987. It combines information from a number of existing registries, from a variety of sources[24]. Altogether, about thirty different registries are brought together to provide wide-ranging information on economic activity and employment.

The specific sample consisted of 32,619 individuals in the age group of 51 years and above in 1996. There were more than 150 variables attached to each individual - containing information on socio-economic and employment status for the individual, as well as for the spouse. Most of the variables were reported from 1987 to 1996 (some to 1997). Because of a specific data match, the sample also contained detailed information[25] on the accrued pension rights, rejected pension applications and use of refunded medication by the Social Insurance Institution.

In order to be able to calculate the economic incentive for all individuals, at least one wage observation was required for each individual, and hence, the analysis sample was restricted to those who were working in 1987. In order to further facilitate the assessment of the economic incentives, a single failure model was used. Henceforth, the sample was further restricted to those individuals who would have been entitled to withdraw from work

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

[25]Data from the Central Pension Security Institute and from the registry of the Diseases Conferring Entitlement to Free or Nearly Free Medicines under National Health Insurance (erityiskorvattavat lääkkeet) by the Social Insurance Institution were specifically matched to this sample that consisted information from the existing registry base of the Statistics Finland.

without further need for employment before retirement. This implied an age a restriction of 53 (and above), as the start of the so-called unemployment tunnel was at this age during most of the sample years. Most of the analysis was therefore done with 12,685 individuals. Data sample was modified somewhat differently for the analysis of the rejected pension applicants (see section 4.2.2).

3.2 Methodology

The Basic Model Because retirement in Finland tends to be fully absorbing, duration model was considered a highly appropriate modelling device for the retirement problem (see Hakola, 1999). Duration in this essay was defined as years of work after 1987[26]. 1987 was cyclically rather average year which aided the empirical analysis, as the choice of the starting year has distributional implications.

One of the basic tools for the duration model, the hazard function gives an instantaneous rate of leaving per unit time period t, given that the individual has not left before. This is given in the equation 1. In essence, applied to the retirement problem, the hazard function gives the probability of retirement, given that the individual has not yet retired.

$$\theta(t) = \lim_{dt \longrightarrow 0} \frac{P(t \leq T < t + dt | T \geq t)}{dt}, \quad (1)$$

where duration T is a random realisation.

As there were no prior beliefs of the shape of the baseline hazard, the baseline hazard was kept as flexible as possible[27]. 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 allow detection of probability changes within the years anyway. In practise, the non-parametric Cox model and the piecewise constant/exponential model produce results that are very close.

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

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

The piecewise constant model is given in the equation group 2. 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. A probability to retire in a certain year is independent of time within the year, whereas a probability to retire between the years is not restricted in any way.

$$\theta(t) = \left.\begin{array}{r} a_1, \text{ if } 0 \leq t \leq c_1 \\ a_2, \text{ if } c_1 \leq t \leq c_2 \\ \\ a_M, \text{ if } c_{M-1} \leq t \leq \infty \end{array}\right\} \tag{2}$$

The likelihood function for the duration model is given in the equation group 3. The likelihood function is a multiplication of the density function for those who fail *and* the survival function for those who get censored (f is the density function, S is the survival function, c is the censoring indicator, t is the duration and a is the parameter vector required to describe the distribution, $\{a_1, a_2, ...a_M\}$ in the equation group above). The equation group also shows how the log likelihood function can be converted into a function of the hazard and the integrated hazard functions (see Lancaster 1990). The last line gives the formula for the integrated hazard[28].

$$\begin{aligned} L &= \Pi_{i=1}^{n} f(t,a)^{(1-c)} * S(t,a)^{c} \\ \ln L &= \Sigma_{i=1}^{n}[(1-c) * \ln f(t,a) + c * \ln S(t,a)] \\ &= \Sigma_{i=1}^{n}[(1-c) * \ln(S(t,a) * \theta(t,a)) + c * \ln S(t,a)] \\ &= \Sigma_{i=1}^{n}[((1-c) * \ln \theta(t,a)) + \ln S(t,a)] \\ &= \Sigma_{i=1}^{n}[((1-c) * \ln \theta(t,a)) - (H(t,a))] \\ &\quad \text{, where } H(t,a) = \int_0^t \theta_i(t,a) \end{aligned} \tag{3}$$

Competing Risks and Right Censoring Competing risks duration models apply to situations where there are several alternative end states to the

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

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 to another retirement scheme).

The multi-state framework is usually thought to consist of several latent durations - out of which only the shortest is observed. For each duration spell that has ended, the observation consists of the length of the duration and the state, into which the individual exited[29]. Competing risks models generally assume independence of the channels. Destination specific transition intensity (in equation 4) is written as the probability of duration ending and the end state being state k, given that the duration has lasted until the time t.

$$\theta_k(t) = \lim_{dt \to 0} \frac{P(t \leq T < t + dt, D_k = 1 | T \geq t)}{dt} \tag{4}$$

Probability that an individual leaves for destination k at time t is written in the equation 5.

$$\begin{aligned} & P(survival\ to\ t) * P(departure\ to\ k\ in\ t,\ t + dt \mid survival\ to\ t) \quad (5) \\ = \ & S(t) * \theta_k(t) * dt \\ = \ & \exp\{-\int_0^t \sum_{k=1}^{K} \theta_k(u) du\} * \theta_k(t) dt \end{aligned}$$

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 the equation 6.

$$\begin{aligned} p(d_1, d_2, ...d_K, t) &= \exp\{-\int_0^t \sum_{k=1}^{K} \theta_k(u) du\} * \prod_{k=1}^{K} \theta_k(t)^{d_k} \quad (6) \\ &= \exp\{\sum_{k=1}^{K} [d_k * \log \theta_k(t) - \int_0^t \theta_k(u) du]\} \end{aligned}$$

[29] This can also be censoring.

Left Truncation (late entry) and Delayed Entry When the data is sampled from a stock, some of the sampled spells are on-going, and, henceforth, create a problem with left censoring. Left censoring has distributional implications for the specification of the likelihood function. Likelihood function for a stock-sampled individual contains joint probability density functions for both elapsed duration at the time of sampling and the remaining duration (in equation 6 elapsed duration is the first piece and the remaining duration is the second piece).

For observations remote from the origin (or if durations are exponentially distributed), elapsed and remaining durations are identically distributed (see Lancaster, 1990). As for taking a sample of the aged employed in a certain year, they are likely to have been employed for a long time, justifying the assumption of identical distribution for both the elapsed and remaining durations[30].

$$
\begin{aligned}
f(e,r) &= f(r|e) * f(e) && (7)\\
f(e) &= \theta(s-e) * S(e) \; with \; 0 < e < s && (8)\\
&= S(e)/\mu \text{ when s} \rightarrow \infty \\
f(e,r) &= [f(e+r)/S(e)] * [S(e)/\mu] && (9)\\
&= f(e+r)/\mu \\
f(b) &= \int_0^b f(b)dr/\mu = bf(b)/\mu, \; b > 0 && (10)
\end{aligned}
$$

where r denotes remaining duration, e elapsed duration, s the time of sampling, b is the sum of remaining and elapsed durations and μ is the mean for the lifetimes.

Equation 7 gives the density function for the total duration, where total duration is a sum of elapsed and remaining durations. Joint density function is simply a multiplication of the conditional density function (density function for remaining duration conditional on elapsed duration) and the density function for elapsed duration. Equation 8 gives the density function for the elapsed duration. This is multiplication of the hazard function for the

[30]Yet, there is a possibility that employees with irregular careers (short employment spells) are under-represented in the sample. This possibility could be minimized by sampling during a recessionary year. In this case, however, it is not clear whether elapsed and remaining durations would any longer have identical distributions.

time prior to the entry for an elapsed duration spell (sampling time minus elapsed duration). Hence, the distribution function is a multiplication of the probability of an exit prior to the start of the elapsed duration and survival function for the elapsed period. If the elapsed duration were to be equal to the sampling moment, there would be a discrete jump in the density function for the elapsed duration, because the density function would just be equal to the survival function of the sampling time. As the sampling time increases, the survival function for this part, however, reduces to zero (see Lancaster). If lifetimes have mean and finite variance, the hazard function reduces to one over the mean as time approaches infinity. Hence, the equation 8 reduces to survival function of the elapsed time divided by the mean. Equation 9 summarizes the results of the two previous equations and equation 10 gives the density function for both the elapsed and remaining durations. The density function for the total duration is obtained by integrating equation 10 with respect to the remaining duration.

Proportional Hazard Model with Time-Varying Covariates In the 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, to which the hazard functions of the other individuals are then compared. In other words, each hazard function is proportional to the baseline hazard (multiplied by the function k). This is given in the equation 11 ($\theta(t, a|x)$ gives the baseline hazard function).

$$\theta(t, a, x) = k(x) * \theta(t, a|x) \tag{11}$$

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. Taking an exponential of the estimated coefficients, produces a hazard ratio which gives an easy, proportional interpretation to the effect of a specific covariate. The hazard ratio is the 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.

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 the time periods for the time-varying covariates of the data that was used, were also observed yearly, their time-invariance within each year made their inclusion to the piecewise constant model relatively straight-forward.

Unobserved Heterogeneity (Frailty) Unobserved heterogeneity refers to determinants that vary over the individuals (groups of individuals), but are not observable. The most common reason for the need to incorporate the unobservable heterogeneity into the analysis, is the omitted variable bias[31]. As in linear models, exclusion of relevant explanatory variables constitutes a bias in the estimations. In duration models, this bias affects both the estimation of the duration dependency as well as the coefficients of the other explanatory variables.

Equation group 12 gives the conditional hazard function - conditioned on both the observable (x) and unobservable characteristics (v). Because the unobservable factors are, by definition, unobservable, they must be integrated out to produce the unconditional hazard.

$$\begin{aligned} & \theta(t,a|x,v) \qquad (12) \\ \theta(t,a|x) \quad &= \quad \int \theta(t,a|x,v) * dH(v|x) \end{aligned}$$

In order to solve the model, the unobserved heterogeneity term is often assumed to follow a specific distribution. Two distributional candidates that are most commonly used are gamma distribution and mass point distribution (See Lancaster, 1990 and Florens et al. 1996). A model with gamma distributed frailty term (unobserved heterogeneity) was considered for this paper, but the log-likelihood function could not be maximised. Frailty models could also be considered for modelling the substitutability between different retirement channels.

4 Results

4.1 Non-Parametric Kaplan-Meier Estimates

Kaplan-Meier survivor function graphs the proportion of those who didn't fail (=retire) out of the population "at risk", that is, out of those who have

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

not retired thus far[32]. Survival shares are, because of the data, considered yearly. Graph 3 does not distinguish between different retirement routes. Most retirements seem to take place between 1990-1992 and considerably fewer in the final years. The figure shows that there is no particular reason to expect any specific form for the hazard function. Graph 3 doesn't control for the age structure which might explain the differences in the retirement incidence between the years. Kaplan-Meier functions where duration is defined as duration at work after the ate of 54 are given in the appendix.

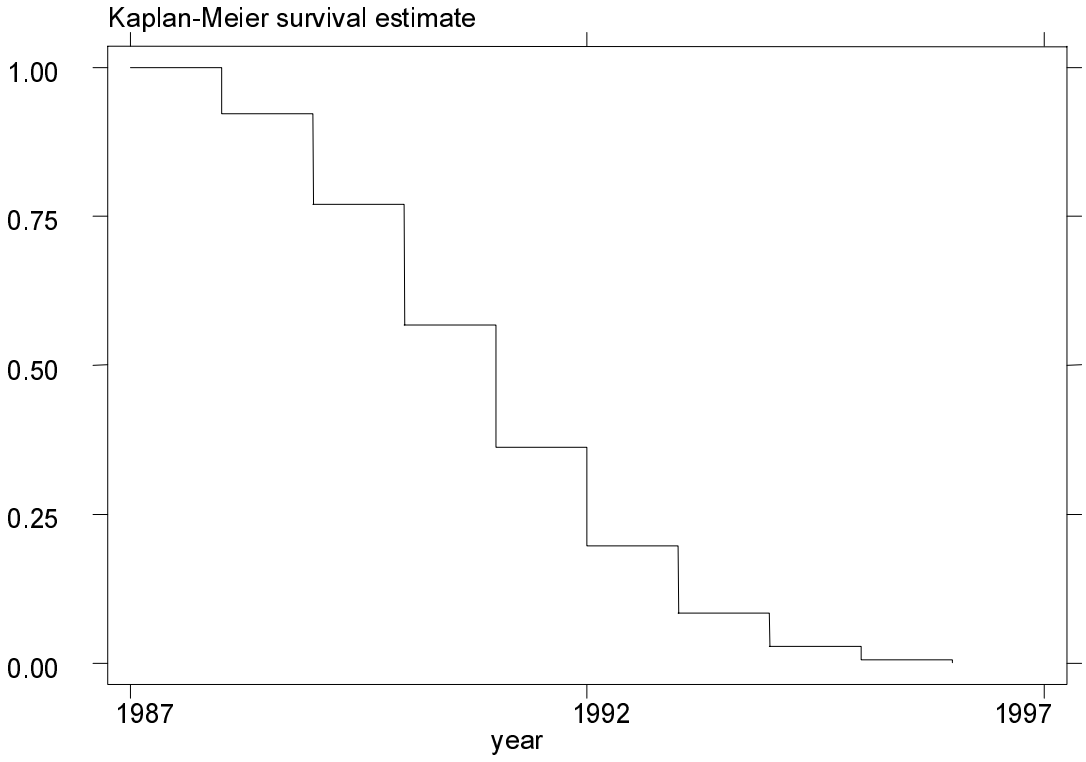

Figure 3: Kaplan Meier Survival Function (considering all retirements)

Kaplan Meier survival function estimates are listed in table 6. The table also gives separate estimates for the major exit routes. As the table shows,

[32] $\hat{S}_{KM} = \Pi_{l=1}^{m} \frac{N_l}{N_l + E_l}$,
where N_l = people who neither failed nor got censored in the l^{th} inverval;
E_l = people who failed in the l^{th} interval.

Year	*All Pensions*	*Unemployment Pension*	*Disability Pension*	*Old Age Pension*
	Surv Fxn (SE)	Surv Fxn (SE)	Surv Fxn (SE)	Surv Fxn (SE)
1988	0.92 (0.00)	0.998 (0.00)	0.96 (0.00)	0.97 (0.00)
1989	0.77 (0.01)	0.986 (0.00)	0.87 (0.00)	0.91 (0.00)
1990	0.57 (0.01)	0.97 (0.00)	0.75 (0.01)	0.81 (0.01)
1991	0.36 (0.01)	0.95 (0.00)	0.62 (0.01)	0.67 (0.01)
1992	0.20 (0.00)	0.92 (0.00)	0.50 (0.01)	0.52 (0.01)
1993	0.08 (0.00)	0.88 (0.00)	0.39 (0.01)	0.36 (0.01)
1994	0.03 (0.00)	0.82 (0.00)	0.34 (0.00)	0.19 (0.00)
1995	0.01 (0.00)	0.76 (0.01)	0.29 (0.00)	0.09 (0.00)
1996	0.001 (0.00)	0.71 (0.01)	0.26 (0.00)	0.03 (0.00)

Table 6: Channel Specific Kaplan Meier Estimates

the Kaplan Meier survivor functions for the different channels seem to take a different shape, justifying the use of the multi-channel framework with differing shapes of the baseline hazard for each channel. The difference in the baseline hazards is more obvious when the durations are given agewise (see the appendix).

4.2 Piecewise Linear Duration Model

Results of a piecewise constant duration model without unobserved heterogeneity are given in table 7[33]. Results are provided for models where the failure is defined as 1) retirement through any of the early retirement channels[34], 2) retirement through the unemployment channel, 3) retirement through a disability channel (either normal disability or individual early retirement), and 4) retirement through old-age pension as the pension scheme of first instance (including also the early old-age pension). In the columns 2 to 4 (where only one channel is considered), exits through other channels are censored. These three columns form the actual competing risks model. In contrast the column 1 is the single risk model. In the competing risks model both baselines and coefficients are allowed to vary according to the exit channel.

[33]The model with a gamma-distributed frailty term failed to find the maximum of the log-likelihood function.

[34]Disability, unemployment, old-age as a first channel and agricultural retirement schemes.

Regressor	*Coef (SE)*	*Coef (SE)*	*Coef (SE)*	*Coef (SE)*
	All	*Unempl*	*Disabil*	*Old-Age*
Economic Incentives				
Life cycle incentive	-0.45 (.02)	-0.44 (.04)	-0.69 (.02)	-0.03 (.01)
Individual Specific				
Bad Health (1/0)	0.27 (.01)	-0.92 (.12)	0.75 (.03)	-0.01 (.01)
Female (1/0)	-0.10 (.01)	-0.07 (.08)	-0.27 (.04)	0.08 (.01)
Years of Education	0.01 (.00)	-0.04 (.03)	-0.04 (.01)	0.01 (.00)
Work Experience	0.00 (.00)	0.02 (.01)	0.00 (.00)	0.01 (.00)
Job Related.				
Public sector (1/0)	-0.02 (.02)	-0.46 (.12)	-0.13 (.05)	0.17 (.02)
Self-empl. (1/0)	-1.18 (.03)	-4.30 (.50)	-1.64 (.05)	-0.60 (.03)
Industrial Field				
- manufacturing (ref)	ref	ref	ref	ref
- agriculture (1/0)	-0.25 (.02)	-0.99 (.14)	-0.59 (.05)	-0.05 (.02)
- construction (1/0)	-0.06 (.03)	-0.00 (.11)	-0.15 (.05)	-0.04 (.02)
- commerce (1/0)	-0.11 (.02)	-0.24 (.09)	-0.17 (.04)	-0.03 (.02)
- transport (1/0)	-0.12 (.03)	-0.77 (.22)	-0.12 (.06)	0.02 (.03)
- finance (1/0)	-0.02 (.05)	-1.26 (.32)	-0.02 (.11)	0.14 (.07)
- services (1/0)	-0.21 (.02)	-0.88 (.14)	-0.32 (.05)	0.00 (.02)
Log likelihood	6,475.4	-1,791.2	-6,286.2	6,450.2
Subjects	12,664	12,502	12,502	12,664
Failures	27,946	1,927	10,747	14,453
Time at risk	80,995	69,649	69,649	80,995

Table 7: Duration Model 1988-1996

Notes: Unemployment and Disability regressions are done for those under 65 only, whereas the other two regressions contain all age groups. The regressions also include the relevant age dummies (and the yearly dummies - which are needed for the piecewise duration model). Standard errors are corrected for heterogeneity.

In what follows, the effects of individual specific and job related explanatory variables are analysed first. Economic incentive effects and substitutability between different retirement channels are analysed in separate sub-sections. As some of the specifications that were estimated included more individual-specific and job-related explanatory variables than are reported in table 7, some of the additional results are given in the appendix

Individual-Specific Characteristics The bad health variable is based on the medical re-imbursement received by an individual with a specific disease[35]. The variable reflecting whether the individual had a disease that was detrimental to his ability to work almost doubles the probability of retirement through the disability channel. Interestingly also, retirement through the unemployment pension is more *un*likely for someone with a health problem. Pyy-Martikainen (2000) gets comparable results for individuals ending unemployment, even if she uses a somewhat different health indicator.

Propensity to retire through the disability channel is lower for women[36], while women are more likely to use the old-age retirement as the first channel of exit. These results match Pyy-Martikainen's findings. More educated individuals have a lower probability of early retirement through disability, unemployment or individual early retirement (but not through the old-age). Hence, higher education prolongs working time prior to retirement. This can be a reflection of higher worker motivation for the better educated, better job opportunities for them or physically less straining working conditions. Work experience, in contrast, seems to be rather neutral in its effect on retirement. The work experience results are close to the results obtained by Lilja (1994).

Job-Related Characteristics Public sector employment has provided security against unemployment. Public sector employees were also less likely than others to end up with the disability pension. This is shown by the lower likelihood of the public sector employees to end up to the unemployment or the disability pension. Yet, as the eligibility age for the old-age pension in the public sector is usually lower than in the private sector, probability

[35] 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. The health variable used in the regressions is a dummy variable on the diseases that have detrimental effect on the work ability of the individual.

[36] In some specifications also unemployment pension propensity was lower for women.

of retirement through the old-age pension is higher for those in the public sector.

Self-employment clearly reduces the probability of retirement through any of the retirement channels. This result 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 choose to exclude self-employed altogether.

The industrial fields were controlled by six dummies, with work in a manufacturing industry as the reference group. Those in manufacturing had a rather high probability of retirement. Low probability of disability or unemployment retirement from agriculture is explained by existence of a number of early retirement schemes that are targeted to the agricultural workers only. Unemployment pension seemed to be most alien to the employees in the financial sector, and somewhat lesser extent to the employees in transport and services. The "least disabled" people were found in services.

4.2.1 Economic Incentives

Economic incentives were tested in the competing risks framework in a number of ways, in order to check for the robustness of the measure. In this sub-section, more specifically in table 8, incentive results for five different model specifications are reported. Due to the fact there is measurement error in wages - problem being particularly severe for the aged - the estimates for the economic incentive effects are hard to interprete. Moreover, it is conceivable that the time and cross-sectional elements of the economic incentive variable work in countering directions.

The effect of the economic incentive variable on the probability of retirement is partly a function of the way the economic incentive variable was included in the regressions[37]. Table 8 gives the incentive coefficients for each channel in the following cases: i) sum of wages, unemployment benefits and sick allowance (labour force compensations) and pension accrual are included separately in the regression, ii) simple replacement ratio (pension accrual/labour force compensation) is included as a continuous explanatory variable, iii) simple replacement ratio is broken into dummies for specified ranges of the previous replacement ratios, iv) constructed lifetime incentives, including the grace period compensation, are used as an incentive measure

[37] or the way that the wage estimate was "cleaned up"

and v) if the previous were included as dummies. The regressions also included the controls given in table 7, but removing them didn't alter the significance or the magnitude of the reported incentive coefficients in table 8 to any significant extent.

The most "rudimentary model", model 1, controlled for the financial incentives if the person continues in the labour force *and* accrued pension rights separately. The availability of the data on the accrued pensions is rather rare because usually the accrued pension rights can be observed only when the pension benefits are actually received. The observation for the pension accrual before retirement was available in the registries of the Central Pension Security Institute in Finland. The Central Pension Security Institute acts as a clearing-house of all pension funds and, therefore, registers total pension benefits (that is, all pension accruals) for all employed individuals. This data was matched to the existing registry base by a special data merge (see section 3.1, footnote 25). Labour force compensation, in contrast, is a sum of wages, unemployment benefits and sick allowance. Because the accrued pension rights were given yearly, also the labour force compensation was included in the model as a yearly measure. Distinguishing the unemployment benefit and sick allowance periods from the working periods proved highly inaccurate, and henceforth, the labour force compensation measure was used as a sum of the compensations for all three.

Accrued pension right seemed to have a larger impact on the retirement probability for the unemployment and disability channels than does the compensation for the labour force participation. Moreover, the impact of the accrued pension right is negative, implying that higher is the pension accrual, lower is the retirement probability (even when experience is controlled). This would seem to provide evidence against the traditional incentive effects. The coefficient for the compensation of the labour force participation (sum of yearly wages, unemployment benefit and sick allowance), in contrast, is more traditional. The higher is the compensation for non-retirement, less likely is the retirement through disability or the old-age pension (non-significant for the unemployment pension[38]). Separate inclusion of the labour force compensation and the pension accrual is likely to suffer from considerable multicollinearity because simple correlation for the two variables is as high

[38]In the case of the unemployment pension channel, it is not clear what is the right incentive measure for active labour force participation. A valid alternative to the measure that was used, is for example, a potential starting wage for the unemployed. See Kyyrä (1999).

	Incentive specification	*All*	*Unempl*	*Disability*	*Old-Age*
		Coef (SE)	*Coef (SE)*	*Coef (SE)*	*Coef (SE)*
1	lf compensation (/1,000) and	-4.67 (.27)	0.60 (.55)	-8.76 (.45)	-1.50 (.21)
	pension accrual (/1,000)	-14.2 (.83)	-36.8 (2.3)	-21.2 (.40)	-0.05 (.50)
2	replacement ratio	0.02 (.00)	-0.01 (.01)	0.04 (.00)	0.01 (.00)
3	replacement ratio dum's				
	- <0.3	0.13 (.02)	0.26 (.09)	0.09 (.04)	0.03 (.02)
	- 0.3 to 0.4	0.06 (.02)	0.19 (.10)	-0.03 (.05)	0.08 (.02)
	- 0.4 to 0.5	ref	ref	ref	ref
	- 0.5 to 0.6	-0.03 (.02)	0.26 (.11)	-0.08 (.05)	-0.01 (.02)
	- 0.6 to 0.7	0.03 (.03)	0.28 (.12)	-0.00 (.06)	0.02 (.02)
	- 0.7 to 0.8	0.18 (.03)	0.63 (.14)	0.35 (.07)	0.08 (.02)
	- >0.8	0.48 (.02)	1.01 (.11)	0.74 (.05)	0.25 (.02)
4	continuous life-cycle	-0.39 (.01)	-0.49 (.04)	-0.58 (.02) DI	-0.02 (.01)
				-0.56 (.02) EID	
5	life-cycle dummies			DI	
	- < 200,000	0.27 (.04)	ref	-4.26 (.60)	0.13 (.03)
	- to 400,000	0.21 (.02)	0.11 (.39)	0.43 (.11)	0.07 (.02)
	- to 1,000,000	0.13 (.01)	0.03 (.12)	0.19 (.04)	0.03 (.01)
	- to 1,500,000	ref	ref	ref	ref
	- to 2,000,000	-0.03 (.02)	0.08 (.08)	-0.06 (.04)	-0.06 (.02)
	- to 3,000,000	-0.53 (.02)	-0.33 (.10)	-0.73 (.04)	-0.15 (.03)
	- to 4,000,000	-1.43 (.05)	-1.53 (.27)	-1.75 (.07)	-0.23 (.06)
	- > 4,000,000	-1.78 (.05)	-4.91 (1.00)	-2.22 (.08)	-0.11 (.06)

Table 8: Coefficients for Economic Incentives

Notes: All values indexed by the CPI to 1990. Controls as in table 7.

as 0.54. This, and a strong correlation with the experience variable, could explain the counter-intuitive coefficient of the accrual variable.

Replacement ratio was a ratio of the two former variables. In other words, it is the accrued pension right divided by the labour force compensation. The underlying utility maximization model implies that because retirement offers leisure implications, the same financial compensation from retirement should have more utility value to an individual than is the financial compensation of the labour force participation. Henceforth, the testable hypothesis was whether a higher replacement ratio yields a higher probability of retirement. This replacement ratio measure was included as an explanatory variable in the models 2 and 3. In the model 2, it was included as a continuous variable, whereas in the model 3, because of the suspected non-proportionality and outlier effects, the replacement ratio was broken into stepwise dummies.

If the replacement ratio variable was included as a continuous variable in the regressions, the hypothesis of higher replacement ratio inducing higher retirement probability was confirmed for the disability and the old-age retirement channels (stronger for disability). The incentive effect on the unemployment pension channel is non-significant. In the dummy specification (model 3), the picture gets more murky. Even if the highest replacement ratio categories seem to increase the retirement probability most, the effects are clearly non-linear. There seem to be replacement ratio categories where increasing the replacement ratio incentive reduces the probability to retire.

The coefficients of the incentive dummies seem most reasonable for the unemployment pension specification. Coefficients increase for the higher replacement ratio categories. For the disability and old age pensions, in contrast, only the two highest replacement categories seem to have a higher probability of retirement than the reference group. These high compensatory categories, however, are beyond the range of "normal" replacement ratios (target levels are 38-66%). Choice of the category limits can also influence the results.

In the most "complete model", models 4 and 5, the framework takes account of the whole life-time utility maximization. Accordingly, life-time incentives were calculated for each channel taking account of both the compensation during the grace period for the specific retirement channel, as well as the compensation when retired. As it was explained in section 2.3, these compensations can differ somewhat between the exit channels. It was also necessary to make assumptions about the life expectancy, in order to yield non-explosive measure of the sum of the arithmetic series of the yearly pen-

sion benefits.

Life-cycle incentives were calculated according to the formula given in 13. Life-cycle incentive is the sum of wages when at work, grace period compensation when in between work and retirement and the expected pension benefit. For the individuals in the sample, grace period compensation can last the maximum for seven years (unemployment channel, see table 4). Pension benefit, in contrast, is received until the end of the life expectancy. Life expectancy was assumed to be 90 years of age in one simulation and in another simulation it was assumed to be 30 years more to the present age. Pension benefit is a sum of the accrued pension rights from all the previous jobs and the current job. The accrued pension rights for the current job are calculated by the multiplication of the accrual percentage (different, for example, for the private and the public sector), years in the job (including the possible right for the future time) and the reference wage. The reference wage is approximated in the calculations by the yearly wage[39]. The yearly wage was corrected[40] for work that lasted for part of the year only. As the months in employment were highly erroneous for those who had been less than four months at work, these individuals were dropped from the sample[41]. The sample also consisted of an indicator whether the individual had a right to the future time. The future time is defined as the time left for the official old-age retirement (see section 2.3). In essence, the future time equals the years remaining to the 65th birthday.

[39] For the years of the sample, it was actually the average of the two median wages for the final four years. Yet, because of the asymmetry of the data, it was deemed sufficient to approximate it by the current wage only.

[40] This correction was avoided in the calculation of the simple replacement ratio, by summing up the yearly compensations for work, unemployment and sick leave.

[41] The limit of four months in employment for the wage correction was set on the basis of data testing. It was noted that doubling the months of employment for the short spells more than doubled the monthly earnings. This was explained by the fact that in the original registries, for example, the months of employment for one category of temporary workers (lel-vakuutetut) had been set to one regardless of the actual employment spell length. Data fit improved considerably after four months of employment.

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

Table 9: Life Cycle Incentives for Different Retirement Channels

$$
\begin{aligned}
\text{Incentive} \;=\; & \sum_{\substack{\text{beginning of grace period} \\ \text{this period}}} \text{corrected wage} + \qquad (13) \\
& \sum_{\substack{\text{end of grace period} \\ \text{beginning of grace period}}} \text{grace period compensation} + \\
& \sum_{\substack{\text{end of life expectancy (90 years)} \\ \text{end of grace period/beg of pension}}} \text{pension benefit} \\
\text{pension benefit} \;=\; & \text{accrued pension rights from previous jobs} + \\
& (\text{accrual percentage for the sector} * \text{corrected wage} \\
& *(\text{years of employment in the current job} + \\
& \text{future time})) \\
\text{corrected wage} \;=\; & \text{wage} * (12 \text{ months/months in employment}), \\
& \text{if more than 4 months in employment} \\
\text{future time} \;=\; & 65 - \text{age, if age}<65
\end{aligned}
$$

Means, maximums and minimums for the life-cycle incentive measure for the different channels for 1990 are reported in the table 9. As it is observed, individual early retirement which has no grace period, produces the highest mean, followed by the measure for normal disability and lastly, the expected income flow in the case of the unemployment route. The unemployment protection is better than the sick allowance in the lower end of the income scale (see section 2.3). This shows up as a higher minimum income flow value for the unemployment route. Maximum values, in contrast, follow the order of individual early disability, normal disability and unemployment flow income.

In table 9, the life-cycle incentive effects seem to work against the expectations - both in the case of the continuous and the dummy incentive

specifications. This is possibly due to the incentive specification formula. If the individual works for one more year and his wages do not grow sufficiently to yield considerably higher pension benefits in the future, his life-cycle incentive automatically falls. Hence, any delay in retirement will yield lower incentives and because of a possible endogeneity problem, will confuse the true incentive effect. Changing the expected lifetime from 90 years to 30 more years to the present age, seemed to have little effect on the result. If the life-cycle incentive was substracted from the individual's life-cycle incentive at another point in time, the results were again intuitive (See Hakola, 2000b).

The most effective specification, due to the data limitations, seemed to be the replacement ratio measure. Even if the life-cycle measure is theoretically more valid, its construction, for the purposes of this essay, proved difficult.

4.2.2 Substitutability between the Unemployment and Disability Pension Channels

The first indication that there is channel substitutability was given in table 7. Here, the health coefficient for the unemployment channel was negative. In other words, if an individual had a health problem, he was less likely to end up in the unemployment channel. Hence, if there were no channel substitutability, the health status should not affect the unemployment probability - or, at least, it should not affect the unemployment probability negatively[42].

Substitutability between the unemployment and disability retirement channels was also tested by including, on one hand, an indicator on whether a suspected-substitute-channel was available, and on the other hand, a "time-to-the-suspected-substitute-channel-availability" measure in the regression estimations. This was done for the individual early retirement availability indicator in the regression where *unemployment* was considered as a failure, as well as, for the *unemployment pension* availability indicator in the regression where transition into the individual early retirement was considered a failure (see availability age limits in table 3). Results of four different substitutability control models are given in table 10. The table reports each model both when age was controlled as a continuous variable and when it was included as step-dummies.

[42] 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.

		Unemployment	*Individual Early Retirement*
		Coef (SE)	*Coef (SE)*
1	individual early retirement available (1/0)		
	- age control continuous	0.73 (.04)	
	- age dummies as a control	-0.24 (.05)	
2	time left until individual early retirement available		
	- age control continuous	-0.33 (.01)	
	- age dummies as a control	-0.01 (.02)	
3	unemployment pension available (1/0)		
	- age control continuous		-0.64 (.07)
	- age dummies as a control		-3.84 (.36)
4	time left until unemployment pension available		
	- age control continuous		-0.65 (.02)
	- age dummies as a control		-2.66 (.04)

Table 10: Effect of the Substitutability Controls in Transition Regressions into Employment and Disability

Notes: As the sample restriction for the unemployment regression uses different age limits the unemployment regressions contain age dummies from 43 years to 64. Moreover, there is no economic controls, as it is not clear what is the correct incentive specification for the unemployment regression. Including the incentive control for the individual early retirement regression changes results only marginally. Other controls on the unemployment and individual early retirement regressions are as in table 7.

Table 10 shows that as there is not enough independent variation in the qualifying indicators (not enough changes in the age restrictions), the variables are badly correlated with the age variables. This made deciphering the true effect of the alternative channel availability on the probability of retirement difficult[43]. If the qualifying indicator (1 if the alternative channel was available and 0 if it wasn't) was included in the regression with age, the coefficient for the qualifying indicator to the unemployment pension was negative in assessing the effect on individual early retirement probability. This negative coefficient for the individual early retirement route points towards substitutability between individual early retirement and the unemployment pension, but the positive coefficient in the unemployment regression for the individual early retirement availability indicator would be more difficult to explain if it wasn't for suspected collinearity between age and the indicator variable. If age is included as dummies in the regression, both indicator coefficients are negative, confirming the hypothesis of substitutability between the channels. Moreover, this substitutability would seem to be much stronger for the older individuals (absolute value of the availability indicator coefficient is greater in the individual early retirement regression where failures are possible only within the individual early retirement age limits).

Coefficients for the time-left-until-the-substitute-channel-becomes-available yield opposite effects[44]. Longer is the time for the other channel to become available, less likely is the retirement through this channel. Hence, these results would run in contrast to the results using channel-availability indicators. Yet, as it was noted in the footnote 42, these coefficients are likely to suffer from severe multicollinearity with age (or be severely biased if age is excluded). As the correlation between the coefficient was highly negative, it is likely that the true sign of the time-left-until-availability coefficient has been reversed.

The third "test" on the channel substitutability was done with somewhat a different variant of the basic data set. This data had information on those who had received a rejection on their pension application[45]. Even if in

[43] Correlation was 0.54 for the availability indicator for the individual early retirement and age (-0.95 for the years-remaining-for-the-availability -control), and 0.45 for the availability indicator for the unemployment pension and age (-0.87 for the years-remaining-for-the-availability -control).

[44] Correlation with the age variable is even worse in this case - see footnote 42.

[45] Here the age limit was 46 years of age, in order to increase the sample size for those who receive a rejection.

Finland, there are no time restrictions on how quickly another pension application can be submitted[46] or how many applications can be submitted to the same channel, the channel substitution can potentially enhance the probability of the pension approval of the applicant. If it were observed that rejected disability applicants transit from employment to unemployment more than the non-rejected individuals, there would be some evidence on the channel substitutability.

Out of the rejected pension applicants, 48 per cent change labour market status within a year[47], whereas out of the non-rejected applicants, only 25 per cent change the labour market status within a year[48]. Almost 56 per cent of the rejected pension applicants were working when they received the rejection[49]. Less than 23 per cent of those who receive a rejection, were unemployed when receiving the rejection[50]. As most of the rejections were given either to the employed or the unemployed, transitions out of either of these two states are considered next.

Table 11 gives the shares of the transitions from employment and unemployment to a number of other states for those who received a rejection as well as to the control group (that is, those who didn't receive a rejection). For channel substitutability for the disability pension applicants, one would mainly look for evidence on whether the applicants from employment ended up in either unemployment or the unemployment pension a year or two after. In this case, there would be channel substitutability. In contrast, if they ended up, despite the rejection, with the disability pension, this could be interpreted that the substitutability between the channels was not perfect, but,

[46] 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 actual applications. Moreover, neither in the case for the re-application nor for the appeal does the applicant incure any extra cost.

[47] Out of the 2,031 rejections in 1988 to 1996 1,727 previous and following labour market statuses could be identified from the sample. 837 times the individual's labour market status changed *from* that in the end of the previous year when the rejection was issued *to* the labour market status in the end of the following year to the issuance.

[48] Out of the 140,052 non-rejected individuals in 1988 to 1996 108,782 previous and following labour market statuses could be identified from the sample. 27,253 times the individual's labour market status changed *from* that in the end of the previous year when the rejection was issued *to* the labour market status in the end of the following year to the issuance.

[49] Almost 65 per cent a year prior to the rejection year.

[50] About 13% in the year prior to the rejection recipiency.

instead, there is persistence in the application to the same channel. A significant proportion (over 17 per cent) fall from employment to unemployment after they have received a disability pension rejection. This is considerably higher than the corresponding share of those who didn't receive a disability pension rejection (7.6%). Hence, also this would point to the channel substitution.

In contrast, more than double of the "pension rejects" still continue with their work the following year (40.2%). Yet, the share of the "non-rejects" who continue work is almost double (78%). Considerably larger percentage out of the rejected applicants (34.3% to the disability pension and 1.2% to the unemployment pension), despite the rejection, end up in either of the early retirement schemes when compared to the control group (5.7% to the disability pension and 0.6% to the unemployment pension). More importantly, considerably higher share of the rejected working applicants in comparison to the control group (34.3% vs. 5.7%), nevertheless, manage to receive the disability pension rather soon (a year) after the rejection. Henceforth, even if there is evidence of some channel substitutability, resubmittance to the same channel would seem stronger.

Out of unemployed "disability pension rejects", gross majority stays unemployed after the application rejection (58.7%). Yet, this share is no higher than the share for those who didn't get a pension rejection (55.5%). The share of the "unemployed disability pension rejects" who end up with the disability pension is considerably higher (17.4%) than the share of the control group (4.1%). In contrast, the control group share (non-rejected unemployed) for those who receive an unemployment pension is higher (18.1% vs. 10.6%). The rejections for the unemployed, therefore, point to less than perfect substitutability.

All in all, the rejection data would seem to show relatively higher persistency in seeking the disability channel.

In addition to the labour market state and the pension application rejection, cross-tabulations are given with regards to the health status[51]. Table 12 shows that there are very few people with the health problem who after applying for the disability pension, get a rejection[52]. Out of these, a gross majority (23 individuals, 55%) end up with the disability pension within a year, despite their first rejection. Even if there are some who despite their

[51] See section 3.1 and 4.2 for the health variable

[52] Hence, very few classical "type I errors".

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

health problem end up in unemployment (5 individuals), the absolute numbers are too small to reach any firm conclusion. Out of the non-rejected individuals[53], some individuals obtain the unemployment pension (2% of all non-rejected with the health problem) despite the fact that they also have the health problem. Those who have fallen unemployed (9%) might be in the unemployment tunnel, and despite their health problem, on the way to the unemployment pension.

Out of those who are rejected and do not have a health problem, greater proportion end up in unemployment (24.3%) than if they were rejected with the health problem (11.9%). As before, however, this comparison suffers from the fact that there were very few rejected applicants who had a health problem. More solid evidence of the channel substitutability is the fact that a greater proportion of the rejected workers who don't have a health problem, still end up in unemployment (17.5%), than is the proportion of the non-rejected workers without the health problem, ending up in unemployment (7.6%). Yet, as before, a greater proportion of those workers who get a rejection, end up with the disability pension, even if they do not seem to have a health problem (33.5%), than do those who don't get a rejection and don't have a health problem (5.5%).

[53] those who have not, despite their health problem, actually applied to the disability pension

	to	employment	unempl	unempl pension	disability pension	old-age pension	unknown
from							
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-reject'd, with't 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 12: Labour Market Transitions of the Rejected and Non-Rejected Pension Applicants, by the Health Status

Two other possibilities to model the substitutability are to specify a common unobserved heterogeneity term (frailty models) for both channels or to use the nested logit model. The common unobserved heterogeneity term approach would be technically interesting. Yet, so far these models have needed to restrict the correlation structure rather severely (see e.g. Jensen et al. 1999[54]).

Nested logit model was estimated by Pyy-Martikainen (2000) for the unemployed. The substitutability measure defining unemployment pension and other pensions as alternatives was out of the sensible range for the substitution parameter. Timing in the recipiency of the unemployment pension is such that it is more likely that disability pensions and the start of the unemployment (not the unemployment pension) are the substitutes. Yet, some of the unemployed in Pyy-Martikainen's sample actually got re-employed. This complicates the model set-up even further.

5 Conclusion

This paper sought to produce answers to two main questions:

1) Is retirement better explained if the differences between those ending up in different retirement schemes are taken into consideration; and

2) Do we find any evidence on the channel substitutability? In other words, if one of the retirement channels is closed, is it likely that those without the opportunity to use that specific channel, will end up using some other?

The answers to these questions, according to the results of this paper, are yes and a qualified yes.

Single risk model quite clearly produced inferior results to the multiple risks model. It was shown that the effects of the explanatory variables were partly hidden if all the channels were considered together in the analysis. For example, public sector employment would seem to have a negative effect on the retirement probability (less likely to retire). Yet, this is true only for the unemployment and disability pensions, the effect of the public sector being reverse for the probability to retire with an old-age pension. Moreover, the shape of the baseline hazard function was rather different for the different

[54]Despite the theoretical identification for their model, Jensen et al. were unable to get empirical identification. In essence, they had to restrict the correlation between the unobservables between different channels either to -1 or 1.

exit channels. Hence, restricting the baseline hazard to be equal in all of the channels could yield erroneous results also for the expected duration prior to retirement.

The advantages of the multi-channel modelling were not as obvious in determining the effects of the economic incentives because of the difficulties in measuring the economic incentive. There seemed to be some differences in the incentive effects between the various channels, but their relative order is not clear. What is clear, however, is that the incentive effects don't seem linear on the probability of retirement in any of the channels. Hence, incentive improvement does not always lower the probability of retirement.

Evidence on the channel substitutability was sought within the basic model, with suspected-substitute-channel-availability indicators and on the pension application rejection data. All of these would seem to confirm the existence of the channel substitutability, the rejection data indicating less than perfect substitutability. It seemed that there was stronger evidence for channel application persistency than for channel substitution. In Hakola (2000), I show that previous rejected pension application on the disability channel increases the probability of retirement. Yet, it is possible that there is channel application persistency until the substitute channel becomes available.

The attempts to include the unobserved heterogeneity in the model produced unfruitful because of maximisation problems. It is often claimed that sufficiently flexible baseline hazard removes the need to include the unobserved heterogeneity in the duration models. It is desirable, however, that this were to be tested empirically. Moreover, with the development of the frailty models, it would be worthwhile to attempt to model the channel substitutability also with the frailty term. The model could also be further developed by incorporating the rejections more fully to the actual duration model. These tasks, however, are left as challenges for the future endeavours.

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A APPENDIX

Kaplan Meier Estimates for Agewise Duration The graph A1 gives the Kaplan Meier estimate of the survival function for duration of work or unemployment after the age of 54. It shows that the biggest jump in the portion of retired takes place at the age of 65 (biggest jump in the curve). It therefore demonstrates that if individuals have not retired through the early retirement channels, most of them retire at the official retirement age. The median time of employment after the age of 54, however, is considerably less. Median age of retirement is somewhere between 61 and 62 years[55]. Indeed, two other significant drops in the survival curve are around the ages of 60 and 61.

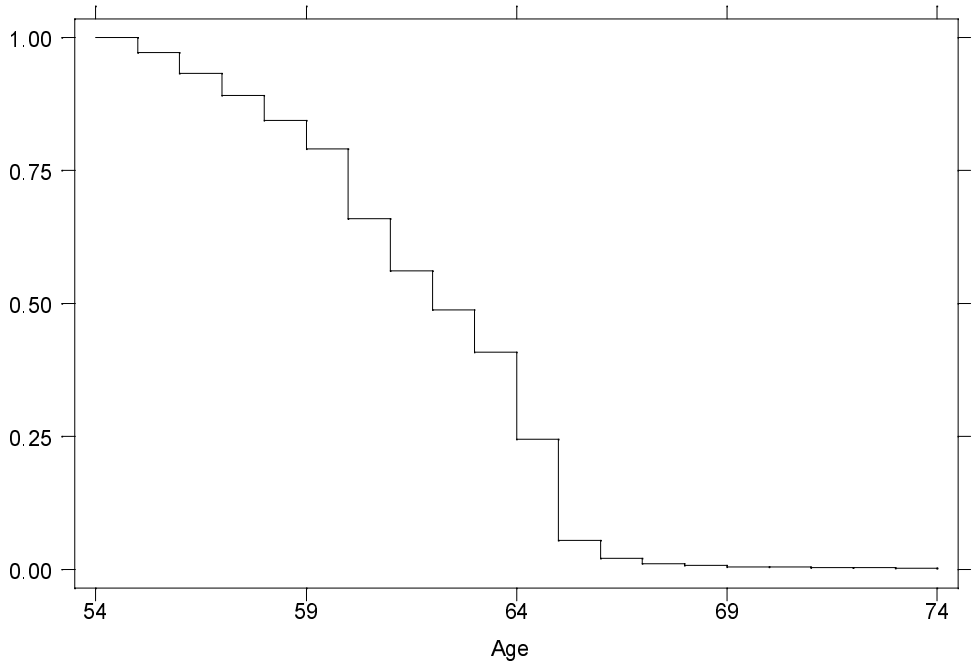

Figure A1: Kaplan Meier Survival Function for All Retirement Channels

Big jump in the retirement with the unemployment pension takes place at the age of 60 as is shown in figure A2. The fall of the survival curve at this

[55]The base sample consists only of those individuals who were more than 43 years old. Often the mean or median retirement age takes into account also those who have retired with a disability at even younger ages.

age is natural, as the unemployment pension becomes available at the age of 60, during most of the years in the sample period. In 1988 and 1989, there are some individuals who retire at the age of 58 and 59, respectively, as these years were still years of transition of raising the age limit of unemployment pension to the age of 60. For the age groups other than 60, falls in the survival rates are not as big.

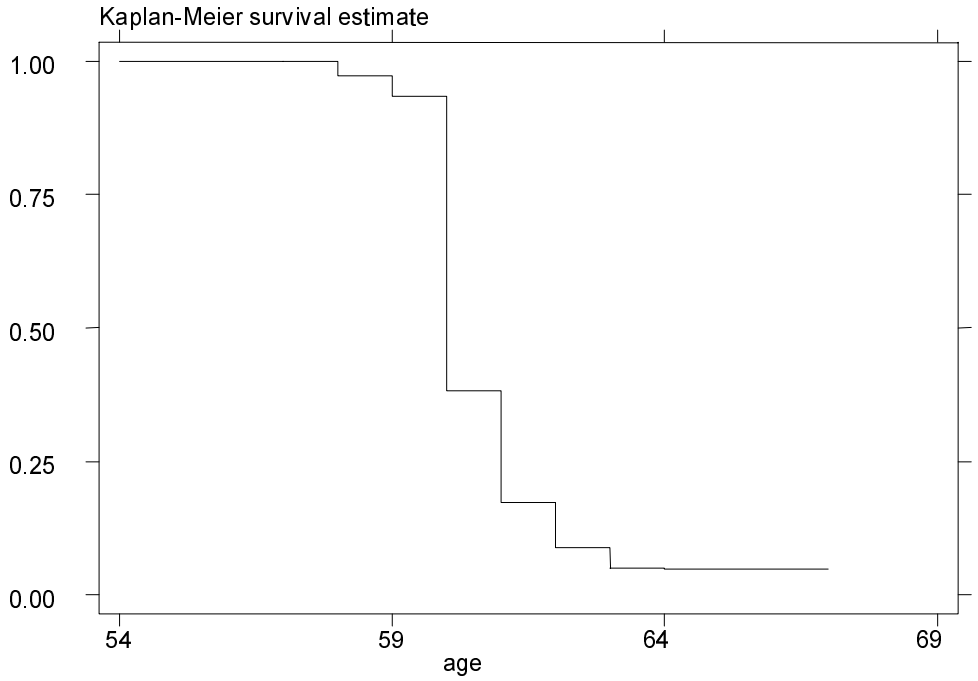

Figure A2: Kaplan Meier Survival Function for the Unemployment Pension for those who were Unemployed in the Previous Period

Most early retirees actually go through a disability pension system. Figure A3 shows that the failure rate for this type of pension is distributed rather evenly. The disability pension here covers both normal disability pension and individual early retirement. Separating[56] the survivor functions for the two disability pension systems, however, did not change this picture radically[57]. Failure rate in both systems is rather even, without significant kinks.

[56] This separation was possible only for years 1988-1994, and therefore, is not presented in the table.

[57] Most disability retirements at this age are probably individual early retirements.

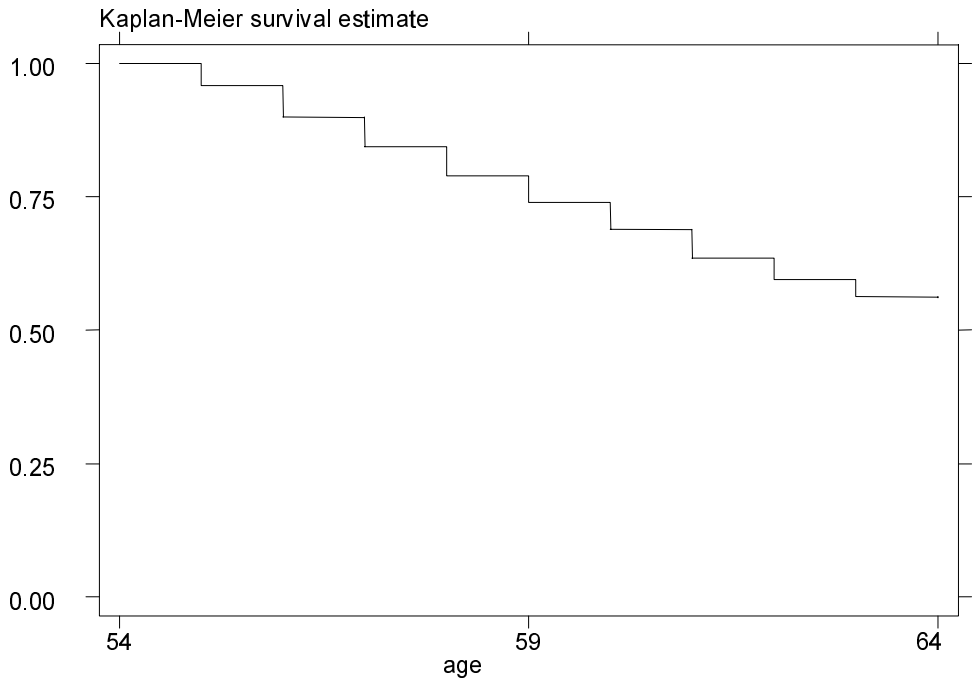

Figure A3: Kaplan Meier Survivor Function for Disability Pension (Disability and Individual Early Retirement)

Old age retirement is obviously concentrated at the legal age of the old age retirement (65). This is shown in figure A4. The second most significant fall is at the age of 63. This is the official old-age retirement age for the public sector. Moreover, there are some smaller specific groups of employees, enabling people to retire as early as 55. Since 1986, there has also been an early old-age pension possibility which actually involves an actuarial reduction in the pension benefits. Some individuals postpone their retirement - the eldest retiree in the sample is as old as 74.

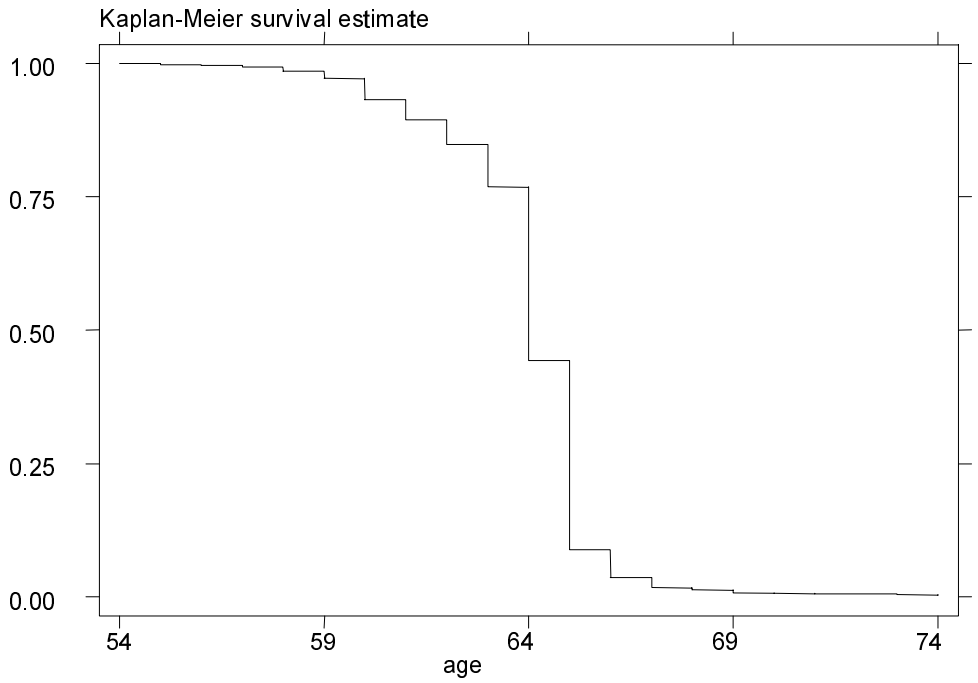

Figure A4: Kaplan Meier Survival Function for the Old Age Retirement

Extra variables in the Competing Risks Model Some specification in the competing risks models included more explanatory variables than are given in the main text. This section contains analysis of the coefficient results for some of the remaining individual-specific and job-related factors that are not given in the main body of the text. Some of these results can be found in the appendix of Hakola (2000).

Dummy variables on the geographical location tried to capture differences in the labour market conditions and health status in different parts of Finland. Both the Northern and the Eastern part of Finland were worst hit by the recession of the 1990s. The Southern region of Uusimaa (including the capital area), in contrast, tends to have more job opportunities than the other parts of Finland. These conjectures were confirmed by the results. There were more early retirements (both due to disability and unemployment) both in the East and the North than elsewhere. In contrast, there were less early retirements in the South.

Differences between the coefficients for the Eastern and the Northern

region were also tested. Interestingly, the difference between the regional coefficients seemed to be significant, even if only marginally (10 per cent significance rate), for the disability pension channel, but not for the unemployment pension channel.

The variable on the rate of unemployment in the home community is a combination of regional differences (cross-section) and cyclical variance (time series). In essence, it could be therefore thought of as a cross-term of the regional and the yearly dummies. The highly negative coefficient (or the low hazard ratio) would, in this case, get an interpretation of a regional difference that varied with the economic cycle. The propensity to retire in the areas with already a high propensity to retire were least affected in a cyclical downturn.

Most of the wealth of the aged is in their own dwellings. Ownership of one's own home was included for control of the wealth effects. Traditionally a positive wealth effect would increase the demand for free time. This is indeed the case for the old-age retirement channel. The reverse sign with the two early retirement channels, was more difficult to explain. Ownership of one's own home could also increase the unwillingness to move for a job. This should also increase the probability of retirement, and yet, the results for the disability and unemployment channels are negative. Most likely, therefore, the housing variable was actually proxying something else than the wealth effect. For example, ownership of one's own home might reflect "better control of one's own life".

Higher wealth, as well as higher debt, seemed to reduce the probability of retirement. The former runs in contrast against the traditional wealth effect, whereas the latter supports this. The debt effect dominates the wealth effect with the conventional significance levels.

Spouse's labour market status has some relevance for the transition into some of the retirement channels. The reference group for the table is those who are single. The results show that those whose spouse is still working, are more likely to continue work than those who have no spouse. Retired spouse encourages retirement through disability or old-age pension. This would seem to support the hypothesis that there is value for the joint leisure time.

The way the previous job was terminated had also some explanatory power. For the probability to end up to the unemployment pension channel there seemed to be no difference between those who had been fired and those who had had a temporary job. For the old-age pension (and for all pensions

taken together), someone who had been fired, had a bigger probability to retire than those whose employment was self-terminated or those who had a temporary job to start with. Those who got fired were more likely to end up with a disability than those who had a temporary job.