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RETIREMENT DECISIONS AND OPTION VALUES: THEIR APPLICATION REGARDING FINLAND, BELGIUM AND GERMANY*

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ABSTRACT: This paper studies determinants of retirement transitions of Europeans and focuses on the impact of social security systems on retirement behaviour. The analysis uses the first 8 waves (1994-2001) of the European Community Household Panel (ECHP). Based on those survey data, option values are constructed for each sampled individual of three countries: Finland, Belgium and Germany. The overall results of the duration and probit models show that the option value, health and well-being at work have a significant impact on retirement decisions. Poor health has an important effect on retirement risk, especially in Germany. In Germany and Belgium we see spikes in retirement at age 60 or 65, whereas the retirement path in Finland is smooth as of age 56. We suggest that a rise in the official retirement age is effective in Germany and Belgium, whereas in Finland the sustainable pension system requires a further cut in the level of pensions if retirement takes place before the official retirement age. The current economic incentives in Germany around the age of 65 or the new ones introduced in Finland with an accrual rate of 4.5% between the ages of 63 and 68 are not effective if workers retire before those ages.

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TIIVISTELMÄ: Tutkimus tarkastelee eläkkeelle siirtymistä Euroopassa keskittyen sosiaaliturvajärjestelmän vaikutuksiin. Aineistona on kahdeksan vuotta (1994-2001) eurooppalaisessa kotitalousaineistossa European Community Household Panel (ECHP). Tarkastelussa käytetään optioarvoja. Nämä ilmaisevat eläkkeelle jäämisen nykyarvon silloin kun tämä on kannattavinta verrattuna siihen, että jäätäisiin heti eläkkeelle. Eläkkeelle siirtymisen optioarvot on laskettu kolmessa maassa: Suomi, Belgia ja Saksa. Duraatio- ja probit-mallien perusteella taloudellisilla kannustimilla, optioarvoilla, ja terveydellä on merkitsevä vaikutus eläkkeelle siirtymiseen. Taloudellisten kannustimien ohella hyvinvointi työssä on tärkeä selittävä tekijä, koska tyytyväisyys työhön tai vapaa-aikaan on tärkeä tekijä eläkepäätöksessä. Maittain tulokset vaihtelevat etenkin terveyden suhteen. Saksassa huono terveys selittää selkeimmin eläkkeelle siirtymistä. Saksassa ja Belgiassa eläkkeelle siirtyminen on keskittynyt ikävuosiin 60 ja 65, kun sen sijaan Suomessa eläkkeelle siirrytään hyvin tasaisesti 56 ikävuodesta alkaen. Eläkkeellesiirtymisiän nostaminen on tehokasta etenkin Saksassa ja Belgiassa, kun sen sijaan Suomessa kustannuksiltaan tehokas eläkejärjestelmä voi edellyttää eläke-etujen karsintaa jo ennen 60 ikävuotta. Nykyiset eläkekannustimet sijoittuvat Saksassa pääosin 65 ikävuoden molemmin puolin ja Suomessa eläkekarttuma on 4.5% ikävuosien 63 ja 68 välillä, mikä ei riitä jos eläkkeelle siirrytään jo pääosin tätä ennen.

1. INTRODUCTION

Sustainability of the European pension systems has been undermined by two main trends. The first fact concerns the population structure and the increasing share of older people. The second trend is the declining or low European labour force participation in general and of the elderly in particular. Both trends result in a rise of the dependency ratio as retirees receive pensions for a longer period and there are fewer workers per retiree to finance the pension systems. A third indicator that shows the problematic participation behaviour of the European elderly is the positive gap between the normal retirement age and the average exit age of the labour force. In addition, it can be noticed that all the above indicators look much brighter in the United States.

This paper uses the international variation in pension provisions across Europe to link incentives and labour force exit decisions; the countries include Finland, Belgium and Germany. The key variable in this approach is the option value to postpone retirement. The option value to postpone retirement expresses, for each retirement age, the trade-off between retiring now and keeping the option open for some later retirement date. The important policy question is whether the labour force participation can be raised by further abolishing early retirement incentives. Has the level of pensions to be cut (the recent German approach) or is it enough to introduce higher marginal incentives to postpone retirement (the Finnish pension reform of 2003)? A further issue is the impact of recent changes towards a more actuarial fair pension system on the labour force participation of the elderly. Two striking illustrative examples in Belgium for the year 2002 are the decline in the importance of the unemployment channel as the legal age to join that channel went up, and the increase in the Belgian female labour force participation rate because of the rise of the normal retirement age of women.

The analysis exploits cross-sectional variation in the social security rules but at this stage does not take into account changes in pension regulations over time. This paper concentrates on social security and does not take into account pension incentives of the second and third pillars of the pension systems, as those data were lacking. Next to pension incentive variables we also consider different health variables. We hereby already state the complex relationship and possible endogeneity problems (Bound, 1991; Kerkhofs et al., 1999).

The literature on social security and pensions encompasses many studies and methods and mainly uses male samples. Early studies estimate reduced-form models of the effect of social security wealth on retirement, reduced-form models incorporating the increase in wealth from working one more year or to a focal age such as 65, and structural models of retirement using a lifetime budget constraint (see Diamond and Gruber (1999) for a more detailed overview). Coile (2003) notes that the early literature suffers from three major problems. The first problem concerns the fact that those studies are often insufficiently forward-looking, focusing on the one-year accrual in retirement wealth rather than the entire future path of accruals. The second problem is connected to the identification of retirement effects in reduced-form models as social security benefits are a function of past earnings, and lifetime earnings are likely to correlate with retirement. The third concern is the fact that many of those papers exclude private pensions and rely on outdated data. In Europe the importance of private pension schemes is still small compared with that in the United States.

A more recent strain of literature has addressed the above problems. Stock and Wise (1990) develop a structural option value model that measures the gain in utility from delaying retirement to the optimal age and find it predicts retirement well in a sample of workers from one firm. Later authors like Gustman and Steinmeier (2002) structurally estimate the option value model, using survey data of the *Health and Retirement Study*. Coile and Gruber (2000) estimate reduced-form versions of the option value model and their peak value model. They control for current and lifetime earnings to avoid the identification problem and find that forward-looking incentive measures have a significant explanatory power for retirement, while one-year accruals do not. Coile (2003) uses the option value in a couple approach and finds that women react similarly to their own incentive measures as men do and that spill-over effects from the wife, in particular, are an important determinant of the husband's retirement.

In general, empirical results based on European data support earlier results from the U.S. and find that dynamic incentive variables have a strong impact on labour force decisions of the elderly. This finding supports the view that the pension systems encourage people to retire early, a phenomenon that is not sustainable in the long run. In Europe the option value model has first been applied in countries that participated in the *Social security and re-*

tirement around the world project of Gruber and Wise (1999)[1]. The first descriptive phase of the project found a striking correlation between labour force participation and social security incentives. The second phase of the project carried out micro-estimations of the impact of social security on retirement and found a causal relationship between social security incentives like the option value and labour force participation (Gruber and Wise, 2002). For Belgium, Dellis et al. (2001) found that social security accruals were negative for over half of the people as early as age 58 and for most people aged 60 and above. A similar pattern was found for forward-looking incentive measures. Most importantly, the dynamic incentives are found to have a strong negative significant impact on the decision to work (see Figure A.5). For Germany, Börsch-Supan and al. (2002) found that the German pension system provided strong incentives to retire early and that the econometric evidence for the strength of incentive effects on old age labour supply is relatively robust (see Figure A.6). For Finland, the option value approach has been applied by Hakola (2002a) and by Laine (2004). Laine concludes that in the Finnish case the economic incentive measure - the option value – has a significant effect on early exit from the labour market (see also Figure A.13).

The structure of the paper is as follows. Section 2 compares age structure and participation trends and age distribution results per country and gender. Section 3 lists different pension incentives. Section 4 describes the data and the empirical strategy. The results are discussed in Section 5 before concluding in Section 6.

2. LABOUR SUPPLY PATTERNS OF THE ELDERLY

2.1. Trends in age structure and participation

In Figure A.1 in Appendix A one can see that the share of the population aged 50 and above has been rising, especially in the last five years. In addition, those shares of the eld-

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[1] The 12 participating countries in the *Social security and retirement around the world* project are Belgium, Canada, Denmark, France, Germany, Italy, Japan, the Netherlands, Spain, Sweden, the United Kingdom and the United States (Gruber and Wise, 1999; 2002).

erly are much higher in Europe than in the United States. The level and the rise in the share of people aged 50 to 64 is especially important in Finland (a level of 20% in 2003) and, to a smaller extent, in Belgium. This evolution of the age structure has been caused by low fertility in European countries, by the rise in life expectancy (in other words fewer people are born and they live longer) and by the ageing of the baby-boom generations. Life expectancy at age 60 – in the age range when retirement transitions are made – has been rising all over Europe but that men and women in Finland, Belgium and Germany still have a lower life expectancy than the European average, a factor that somehow weakens their pension system sustainability problems.

In most European countries, participation of the elderly in working life is very low, and uncertainty about demographical dynamics in the coming decades has a growing influence on the ongoing debate about the sustainability of the pension systems. The activity rates of the elderly (age 55-64) have been around 40% in the EU-15 during the last decade (see Figure A.2). During the same period the increasing participation of European women rose above 30%. During the last ten years, however, a new trend has emerged, and the labour force participation of elderly men has become, somehow, stable and has even increased since the year 2000. Concerns about the impact of ageing on the population structure and about the declining participation rates of men have already culminated in the first big wave of pension reform measures across Europe. Those new measures – like, for example, the transitional rise of the early or normal retirement age – and the changing entry rates into different age categories can explain the recent rise in the participation rates of the elderly.

Figure A.2 reveals that trends are similar across Europe but that there are still considerable differences in the levels of the participation of the elderly. Male participation has been below the European average for Finland and Belgium and above average for Germany. Finnish male participation, however, started to rise as early as 1995 and reached the European average in 2003. The Belgian male participation rate has increased, especially during the last few years, but it almost diverges more from the European average than it did 15 years ago. Also, Belgian women perform very weakly. Germany is close to the European average and Finland performs above the European average. Since 1998 female labour force participation in Finland has risen considerably.

Similar information can be obtained by looking at the average exit rate from the labour force in Figure A3 In 2000 all European countries had average exit ages below the normal

retirement age. There are, however, country differences up to six years. Belgium has almost the lowest exit age at about 58, Germany (a little below 62) and Finland (a little above 62) perform better. Finland and Germany follow the European average in that average exit ages declined from 2000 to 2002, whereas it increased a little in Belgium. European women retire, on average, about one year earlier than men. In Finland average ages across gender are, however, almost the same.

2.2. Participation patterns from the ECHP

A close look at the European Household Panel (ECHP) data provides some useful information about further decisions concerning the model specification. Interestingly, unemployment rises steeply between age 50 and 60 both in Finland and Germany. This can be explained by the existence of a Finnish and German "unemployment pipeline" into retirement. For males the profiles of Finland and Germany are similar, although for Finland 53% of the sample are inactive (unemployed or out of the labour force) at age 60 compared with 44% in Germany (in Finland increasing from 12% at age 55 to 53% at age 60). The female Finnish profile is similar to that of Finnish males. As women and men behave differently overall, they will be analysed separately.

Figure A.4 shows the share of employed people that decide to retire per age. The retirement decision (or transition) dummy has been defined as becoming retired between t and t+1. Those non-cumulative shares are small but they can be compared across each age. For Finland the male-shares show spikes at age 59 (12%), 61 (20%) and 64 (9%), for Germany at age 60 (18%), 63 (26%) and 65 (44%) and for Belgium at age 60 (33%) and 65 (52%). For Finland the female-shares peak at age 59 (15%), 63 (32%) and 65 (43%), for Germany at age 58 (15%), 60 (42%), 63 (21%) and 65 (40%) and for Belgium at age 55 (12%), 60 (40%) and 63 (28%). Spikes are more pronounced in Germany and Belgium, especially at age 60 and 65. Exits are more evenly distributed over age for Finnish males.

The main findings can be summarized as follows: A significant share (5%) of individuals start leaving the labour force when they are 55 years old. For both males and females, exit from the labour force peaks around 59 and 63-65 (Finland) or at 60 and 65 (Belgium, Germany), showing the age of early and normal retirement. The evidence suggests that when analysing exit from the labour force behaviour we do need to look at individuals

younger than 60, too. We therefore select the sample to contain women and men from age 50 to age 64. Because there is little re-entry into employment (on average 2.8%) retirement can be considered as an absorbing state. Compared with employed individuals, unemployed individuals have more than twice as much probability to retire. The broad concept of retirement or non-employment used includes this unemployment channel.

Finally, our empirical approach can be justified by the fact that early retirement has been very much a supply-driven phenomenon. It can be argued, however, that the evolution of the retirement age and labour force participation of the elderly is a demand reaction to the evolution of unemployment rather than a supply response to early retirement incentives. For Germany, Börsch-Supan (2000) found, however, that the retirement age and the unemployment rate have a fairly low or positive time-series correlation between 1960 and 1995. Böckerman and Piekkola (2001) show that the adverse employment prospect of the most experienced employees in the Finnish economy has continued throughout the whole of the 1990s and has not been a phenomenon only of the great depression of the 1990s.

3. THE PENSION INCENTIVES

We present the incentives to stop working this year, relative to retiring at some future optimal age. In many pension schemes, and also in Finland, the accrual rate is much higher in the final years before the legal retirement age. In each period the *replacement rate* (rr) expresses the ratio of pensions to earnings when an individual is employed, all net of taxes. Thus, it tells in percentage terms how high a person's income would be if he retired, compared with his income if he continued to work. The replacement rate is set to zero until the minimum entitlement age, which in this case is defined as the early retirement age minus the period of the relevant years of preceding unemployment:

$$rr = \frac{P(A, Y_{A-1})}{Y_{A-1}} \ , \qquad (1)$$

where A = the period of retirement, Y = the wage income, $P(A, Y_{A-1})$ = the level of pension available at age t when retiring at age A, depending on previous wage income.

The wealth effect operates through the present discounted value of retirement wealth, which is the stream of future social security and pension benefits the person has earned based on his or her work today, discounted for time preference and for mortality risk. This paper uses the following equation for *pension wealth* (PW), based on the replacement rate:

$$PW_{\tau}(A) = Y.\sum_{t=A}^{T}(1+\delta)^{-(t-\tau)}rr \quad , \tag{2}$$

where T = the expected age of death at each age t, τ = the current period, A = the period of retirement, δ = the real discount factor set at 3% (with a discount factor of 6% and a steady annual growth rate w of 3%).

The simplest measure that captures the wealth accrual effect is the *pension accrual* (ΔPW), the change in retirement wealth that results from working one additional year:

$$\Delta PW_{\tau}(A) = PW_{\tau+1}(A) - PW_{\tau}(A) \tag{3}$$

For each retirement age the *option value* (OV) expresses the trade of between retiring immediately and keeping the option open to retire at a later age. In order to obtain an indicator of this variable, one has to choose an explicit utility function, then estimate the option value tied to this utility function on the basis of a set of relevant variables, among which are income from public pension and the wage outlook. The option value function is similar to the above pension wealth accrual function but is more forward-looking. (It takes into account life expectancy.) The major difference is that the option value also incorporates, next to the financial incentives, the utility of consumption and leisure. Let $V_{\tau}(A)$ refer to the expected discounted future utility at age t if the worker retires at age A and let it be specified as (see Stock and Wise, 1990, Coile and Gruber, 2000):

$$V_{\tau}(A) = \sum_{t=\tau}^{A-1}\left[Y_t\right]^{\gamma}(1+\delta)^{-(t-\tau)} + \sum_{t=A}^{T}\left[\alpha\, P_t(A, Y_{A-1})\right]^{\gamma}(1+\delta)^{-(t-\tau)}, \tag{4}$$

where T = the expected age of death at each age t, τ = the current period, A = the period of retirement, δ = the real discount factor set at 6%, Y_t = the wage income at age t (assumed to increase by 1% per year), $P_t(A,Y_{A-1})$ = the level of pension available at age t when

retiring at age A, depending on previous wages; α = the relative utility of the pension benefits to the wages or the marginal utility of leisure; γ = the utility curvature parameter or the risk aversion parameter.

The utility of consumption is represented by an isoelastic utility function, $U(Y)=Y^{\gamma}$ and $U(P)=[\alpha P]^{\gamma}$. The utility parameters and discount rate are based on Coile (2003) so as to be able to compare results. The utility function parameter γ takes the value of 0.75. To capture utility from leisure, utility during retirement is weighted by α >1, where $1/\alpha$ is the marginal disutility of work. This is set to 1.5. Re-estimating the model with other lifetime utility function parameters suggests that the effect of the option value on retirement is robust when we use alternative values for the marginal utility of leisure parameter α and the discount rate δ, but that a change in the utility curvature parameter γ from 1 to 0.75 strengthens the marginal effect. One explanation is the lower weight given to outliers.

Consider now the optimal retirement decision a^* that the marginal incentives for leisure considered above indicate. The individual's option value for a specific age is defined as the difference between the expected lifetime utility if the individual postpones his decisions till the optimal retirement age and the expected value if he retires today. If the individual retires immediately, he loses some years of income and higher pension benefits. If he retires later, he will lose the forgone leisure time. A worker is expected to retire if the optimal utility is not bigger than the utility obtained if he retires today. Retirement probabilities should, therefore, depend negatively on the option value. The option value, giving the opportunity cost of retiring today, is

$$OV(A^*) = E_{\tau}\left[V(A^*)\right] - V_{\tau}(\tau) \quad , \tag{5}$$

where E= the expectation operator and A* = the optimal age of retirement if the individual decides not to retire at time τ. Optimal retirement should occur at an age where the option value is at its maximum. Life-time utility can be calculated like this for each possible retirement period and compared with the life-time utility when retiring today. A higher option value gives an incentive to stay at work longer. Finally, we assume steady annual wage growth w at one per cent.

This approach suggests empirically that we estimate the probability of retirement at a given age by taking the option value as the principle explanatory variable. The international social security project led by Gruber and Wise compiled comparable social security wealth calculations for Belgium, Germany and other countries. Börsch-Supan (2000) used their calculated accrual rates and implicit tax profiles to analyse pension incentives and retirement age distributions, and concludes that in several countries there is a close link between kinks and spikes in both functions (see Table 1).

Table 1: Kinks and spikes in retirement age and pension wealth accrual.

	Finland	Belgium	Germany
Pension wealth accrual	Strong kink at 56, Reverse kink at 65	Very sharp kink at age 65, Reverse kink at 61	Sharp kink at age 58, Reverse kink at age 65
Distribution of retirement age	Spikes at age 57 and 64, opposite spike at age 60	Sharp Spikes at age 60 and age 65	Sharp spike at age 60, and sharp spike at age 65

Based on this evidence, a formal analysis of early retirement incentives is worthwhile.

4. DATA AND EMPIRICAL STRATEGY

4.1. Data

This study uses the *European Community Household Panel* (ECHP). The survey is an annual panel study and consists of a household and a personal file. The same individuals and families are interviewed over time. The panel started in 1994. Currently 8 waves through 2001 are available for most EU countries (6 waves for Finland). The same questionnaire has been adopted by the national data collection units in each participating country[2]. The ad-

[2] In the first wave (in 1994) a sample of some 60,500 nationally representative households – approximately 130,000 adults aged over 16 years and over – were interviewed in the EU Member States. For the fourth wave of the ECHP, in 1997, the original ECHP surveys were stopped in three countries, namely Germany, Luxembourg and the United Kingdom. In these countries, existing national panels were used and comparable data were derived from the GSOEP and BHPS – back from 1994

vantage of these country data is their high comparability level. The survey provides a detailed account of income and employment status. We constructed an unbalanced panel of women and men aged 50 to 64 for three countries: Finland, Belgium and Germany.

The panel is left-censored, as we include only persons who are working. There is right censoring due to missing interviews and due to missing transitions. As noted before, the sample includes men and women between 50 and 64, the age period where early retirement is possible. If people retire at age 65 they use, by definition, the old age retirement path. The final sample has been constructed in different stages. In the first stage we dropped people with unreliable wage observations. In the second stage we dropped individuals with lacking social security incentive variables. In the third stage we excluded the special category of the self-employed, as they may have different pension system rules. Finally, the sample excluded people out of the labour force and with missing transitions. Based on those criteria, the panel includes up to 4,201 individuals (FI: 1315, BE: 681, DE: 2205) with 15,862 (FI: 4414, BE: 2436, DE: 9012) observations. The average observation time is 3.8 years.

Of the individuals 27.54% (FI: 15.92%, BE: 27.03%, DE: 32.94%) make a transition from employment to retirement. More complex histories with at least one reverse transition have been excluded from the sample. Reverse transitions accounted for a minor share of a maximum of 2% of the individuals. More complex transitions are most common in Germany. About 56% of our sample persons are males (FI: 43%, BE: 62%, DE: 60%) and the most frequent retirement age is age 60.

A quick glance at the data reveals some interesting characteristics per country and gender. Table A.11 and A.12 depict results for employed males and females from age 50 till age 64. The average age is 54.9. If we turn to figures on transitions out of employment we note that numbers vary from 7.95% to 10.98% of the total observations. Transitions are slightly more frequent for men than for women. The average pension wealth in the sample amounts to around 25,000 Euros and is highest in Finland and lowest in Belgium. (For age distribution, see Figure A.8.) The average replacement rates are around 52% in Finland, 45% in Belgium and remarkably higher (71%) in Germany. The average option value is about 10,000 Euros and is bigger for males than for females. Figure A.9 in Appendix shows that option value decreases steadily with age in Finland and less steeply in Belgium and Germany.

More than 75% of the individuals are married. For obvious reasons, the share of males with children is much higher for men than for women. Part-time work has a typically high share for females (14.2%) compared with the share for males (1.6%). Public sector workers contribute at least 30% to the male sample and as much as 45% to the female sample.

As health is an important determinant of the labour supply behaviour of the elderly, it is of interest to compare, at this stage, different health variables between our sub-samples. The sample share of people with bad health varies between countries. Women report to be in bad health more often than men. In particular, a high share of German men (17.8%) and women (20.4%) report to be in bad health. Belgium has very small shares, whereas Finland has about 4.6%. The share of people reporting a chronic physical or mental health problem is very high (about 38%) both in Finland and Germany but remarkably lower in Belgium (about 12%). Many Finns (about 26%) and Germans (about 37%) are also hampered in their daily activities by health problems although the problem is now clearly worse for Germans and again the weakest for Belgians (about 11%). The share of men and women as in-patients at a hospital during the last 12 months is the biggest for Finland but generally varies around 10% in all sub-samples. On average, Germans stay the longest in hospital (more than one night), whereas Finns and Belgians only stay about half a night. It should be noted that all results have to be interpreted conditional on each country's age structure. The age means are, however, very similar and are only about one year higher for Germany. There is, however, a concern that the differences in health reports across countries may be both due to real health differences and also due to differences in reporting behaviour (Lindeboom and Van Doorslaer, 2003).

4.2. Empirical strategy

This approach estimates reduced-form models of retirement by country and gender and aims at capturing effects on retirement of movements in variables. At the first stage the duration model approach is used[3]. Retirement is treated as a dynamic discrete choice. The

[3] The hazard model approach is based on Diamond and Hausman (1984) and Hausman and Wise (1985). The hazard model that treats the retirement decision as a dynamic discrete choice has been used in other empirical studies such as Miniacci (1998) for Italy, Antolin and Scarpetta (1998) for Germany, Mastrogiacomo et al. (2002) for the Netherlands and Bütler et al. (2004) for Switzerland.

variable to explain is the duration of employment and the failure is defined as retiring in the next period. This includes, besides self-reported retirement, self-reported unemployment as well, but it excludes individuals that report to take care of the household. This latter category is included in the definition as unemployment of the elderly (in almost all cases, an absorbing state before retirement) and can, in that sense, be seen as a channel towards retirement. Finally, the results of the probit model are compared with those of the duration model to check for robustness. Both models allow for consideration of not only pure economic variables like wages but also non-pecuniary variables like health status.

Legal disability status is not used here, since it is, by definition, more endogenous to the retirement system. We have assumed that all early retired people have started receiving their disability pension if in bad health this or next year and retired. The age limit for the unemployment pension pipeline (55 years in Finland and 55 years in Germany) is not assumed to be binding if the individual is retired before this age and not in bad health (due to the inclusion of all 50+ individuals in the study). The public system pension rules are considered separately in Finland. (The highest replacement rate is 0.66 instead of 0.60 as in the private sector.) We use crude measures for labour market experience that depends on the age and the education level (in Finland, 12 years deducted for primary, 15 years for secondary and 18 years for tertiary education). This gives an average work experience of around 33 years in all the countries. The pension system and pension rules for 2000 in the three countries considered are described in Appendix B. Pension and tax rules for the rest of the years are adapted from these.

4.2.1. Duration Model

The variable of interest is the length of duration T, which elapses from the beginning of some event until its end or until the measurement is taken, which may precede termination. In this case T is the time span of employment before retirement and the end or "failure" is defined as being retired in the next period. One advantage of the duration analysis is that censored spells can be taken into account. Assume T is a random variable having a continuous probability distribution f(t). The probability of the spell length being smaller or equal to a particular value t or the cumulative distribution function is as follows:

$$F(t) = P(T \leq t) = \int_0^t f(s)ds \qquad (6)$$

The survival function S or the probability that the spell of the working period is of length of at least t is given by:

$$S(t) = P(T > t) = 1 - F(t) = \exp\left(- \int_0^t \lambda(s) ds \right) \tag{7}$$

The hazard rate h is the rate at which spells are completed at time t, given that they have lasted until t. In this case the hazard function is the probability of entering retirement at a certain age t, conditional on the fact that the agent has not retired before that age. It can be interpreted as the age-specific failure rate and is given by

$$h(t) = \lim_{\Delta t \to 0} \frac{P(t \le T < t + \Delta t \,|\, T \ge t)}{\Delta t} = \frac{f(t)}{S(t)} = \frac{f(t)}{1 - F(t)} \tag{8}$$

So far, the distribution of the stochastic dependent variable duration has not been specified; thus the duration can follow any known distribution. Based on the underlying assumptions of that distribution, the three groups of duration models are non-parametric, semi-parametric and parametric models. An example of a non-parametric duration model – estimated without covariates - is the Kaplan-Meier or product-limit estimator. This estimator can be applied to subgroups of the population to summarize differences across groups. For the latter purpose selected Kaplan-Meier estimates will be presented.

In this study duration model estimates are, however, based on a semi-parametric distribution. The advantage is that no parametric assumption has to be made. The estimation approach is based on a partial likelihood function. The approach is a way of eliminating the baseline hazard from the equation to be maximized in the estimation procedure. No functional form therefore needs to be specified for the baseline hazard. Here, the Cox proportional hazard model is chosen. Its hazard rate can be written as

$$h(t_i) = h_0(t_i) e^{\beta' x_i} \quad with \; h_0(t_i) > 0 \tag{9}$$

where x_i is a vector of explanatory variables and h_0 is the time-dependent baseline hazard, constant for all individuals. The partial likelihood function PL is the likelihood that all n spells in the sample are observed. In t_i, all spells that have not ended previously are at risk of ending, with the risk given by the hazard rate. These spells can be combined into the risk set R_i. L_i is then the probability that out of the risk set R_i spell i is terminated:

$$PL = \prod_{i=1}^{n} L_i = \prod_{i=1}^{n} \frac{h_0(t_i)e^{\beta' x_i}}{\sum_{t_j \in R_i} h_0(t_i)e^{\beta' x_j}} = \prod_{i=1}^{n} \frac{e^{\beta' x_i}}{\sum_{t_j \in R_i} e^{\beta' x_j}} \quad (10)$$

This is the proportional hazard, in which the quotient depends on time. This partial likelihood, which is independent of a distributional assumption, can now be derived. The disadvantage of this model is that the baseline hazard is identical across individuals at every point in time during the spell.

We also report the marginal effects using probit models (see Wooldridge, 2002). The marginal effects are to be interpreted as the change in the probability of flowing out of employment given a unit change in an explanatory variable X_{it}. We allow the covariates to have various impacts on the flow out of employment for the two genders by carrying out the analysis separately for males and females.

5. ESTIMATION RESULTS

Results are first reported for the total sample (see Table 2) and the country-specific duration model results are discussed (see Table 3 for men and Table 4 for women). Table 2 compares the results of the duration and probit models by gender for Finland and Germany. Belgium income data turned out to be unreliable. This alone can explain the unreliable results in Belgium. The duration model estimates the hazard out of employment and reports the hazard ratios, whereas the probit model estimates the probability of leaving employment and reports the marginal effects. The Cox regression estimates this hazard non-parametrically and obtains maximum-likelihood estimates of the β parameters. To interpret the coefficient estimates it is simpler to calculate the so-called risk ratio, which is e^{β}. In Table 2 -- for example -- $e^{-0.37}=0.68$ means that the hazard is about 32 per cent lower for men with children, so their probability of retiring is indeed considerably lower.

Table 2: Duration versus Probit models, All Countries

	Men		Women	
	Duration	Probit	Duration	Probit
Option value	0.3728***	-0.1076***	0.4019***	-0.0893***
	[6.775]	[5.766]	[5.506]	[4.521]
Pension wealth	1.0115*	0.00	0.9909	-0.0017**
	[1.776]	[0.232]	[1.373]	[2.160]
Capital income	1.0676***	0.0073**	0.9934	-0.001
	[5.392]	[2.401]	[0.122]	[0.149]
Owner occupied	0.9417	-0.001	0.9904	0.0240*
	[0.825]	[0.089]	[0.109]	[1.659]
Bad health	1.8296***	0.0829***	1.6945***	0.0994***
	[7.430]	[3.793]	[5.584]	[5.111]
Inpatient at hospital	1.2751***	0.0452***	1.3376***	0.0430**
	[2.839]	[2.958]	[3.021]	[2.320]
Married	0.8814	-0.0280**	0.8665	-0.0234*
	[1.361]	[2.207]	[1.540]	[1.649]
Third level education	0.9396	0.005	1.0461	-0.0148
	[0.695]	[0.372]	[0.376]	[0.944]
Number of children 0-14	0.6814***	-0.0364**	0.9765	-0.001
	[2.876]	[2.111]	[0.151]	[0.029]
Work satisfaction	0.8217***	-0.0251***	0.8403***	-0.0175***
	[5.371]	[5.360]	[4.241]	[3.090]
Leisure satisfaction	1.1481***	0.0160***	1.0823*	0.0082
	[3.882]	[3.531]	[1.919]	[1.404]
Supervisory job status	0.6810***	-0.0445***	0.7925	-0.0324
	[2.631]	[3.251]	[0.949]	[1.302]
Part time	1.283	0.0451	0.7196***	-0.0444***
	[1.519]	[1.472]	[2.954]	[2.941]
Public employment	0.9308	-0.0117	1.0323	0.0041
	[0.875]	[1.025]	[0.381]	[0.322]
Firm size < 20	1.0039	0.0049	1.0649	-0.002
	[0.046]	[0.367]	[0.698]	[0.128]
Managers, professionals	0.7923**	-0.0276*	0.9049	0.0187
	[2.077]	[1.761]	[0.617]	[0.749]
Technicians	0.8316*	-0.0147	1.0474	0.0173
	[1.697]	[1.080]	[0.383]	[0.873]
Clerks, service workers	0.8852	-0.0104	1.0262	0.0105
	[1.137]	[0.704]	[0.273]	[0.583]
Year 1994	3.2160***	0.0477*	1.7190*	0.0149
	[3.452]	[1.886]	[1.775]	[0.433]
Year 1995	3.1469***	0.0503**	1.1721	-0.005
	[3.526]	[2.045]	[0.559]	[0.144]
Year 1996	3.2723***	0.0422*	1.4123	0.014
	[4.200]	[1.825]	[1.450]	[0.448]
Year 1997	2.6441***	0.0447*	1.2472	-0.0003
	[3.439]	[1.712]	[0.948]	[0.009]
Year 1998	2.4332***	0.0607**	1.0914	-0.0058
	[3.801]	[2.405]	[0.451]	[0.207]
Year 1999	2.3952***	0.0389	0.956	-0.0304
	[3.248]	[1.578]	[0.195]	[0.979]
Observations	6170	6269	4516	4590
Log pseudo-likelihood	-4949.4	-2013.6	-3513.4	-1529.5
Wald chi2	688.2	504.7	621.8	292.4
Pseudo R-squared	0.051	0.169	0.054	0.143

Robust z statistics in brackets * significant at 10%; ** significant at 5%; *** significant at 1%
Specification includes age dummies age 50 to age 64, reference category age 55.

In the above table it is seen that as expected the option value has a negative impact on the propensity to leave employment. The duration model gives more pronounced results than

the probit model. The Cox regression finds that the option value decreases the hazard out of the labour force. The interpretation of the hazard ratio can be done with reference to two men whose option values are OV and OV+10,000 (option values are expressed in 10,000). The man (or woman) with the higher option value has a hazard that is 63% (60%) lower, so the probability of retirement over a short period of time is considerably high (that is, the ratio of their respective hazards is 0.37 (0.40)). This ratio differs significantly from 1.

In the probit model the marginal effects of the option value are also strong and are also in this model somewhat higher for women than for men. As the main component of the option value indicator is income, this gender difference can be explained by the fact that the income elasticity has been found to be higher for women. Note that option values are measured in utility units. The marginal effect for the option value shows that a ten thousand increase in the option value lowers retirement propensity by around 10%-point. These effects are about twice of those based on a U.S. model with the same utility parameters in Coile (2003). Table A. compares the Finnish results with those of Laine (2004) based on an alternative utility function specification of Börsch-Supan (2002). The obtained effect of 0.34 %-point is a little higher than the 0.23 %-point in Laine (2004) and also the average option values are much lower in his paper. Age dummies show that older workers have a higher probability to retire than younger ones. The omission of the age dummies raises the estimated absolute coefficient of the option value up to two times (not reported). Option values capture an essential part of the spikes in early retirement and particularly so for Finland.

Looking at the option value hazard rates of separated country samples produces mixed results. Hazard rates for men vary from 0.023 in Finland to 1.08 in Germany. For women they vary from 0.013 in Finland to 0.94 in Belgium. Finland delivers significant and consistent negative effects. In Belgium and Germany the effects are close to zero. As discussed, the income data for Belgium is unreliable, which can explain the relatively mild effects. In Germany, the option value is important but insignificant for women. An explanation for the insignificant effect for men can also be that the information to compute the German benefits on a lifetime-contribution basis is not available and that the calculation of the pension wealth and option value therefore becomes more difficult. It is also customary for large firms in Belgium and Germany to offer additional support during early retirement.

Table 3: Duration model for the employment of males

	Finland	Belgium	Germany
Option value	0.0227***	0.5014	1.083
	[6.862]	[0.903]	[0.207]
Pension wealth	1.0383***	0.9596	0.9553**
	[4.867]	[1.200]	[2.237]
Capital income	1.1829***	1.0891	1.0488***
	[6.095]	[1.384]	[3.933]
Owner occupied	0.9359	1.1929	0.91
	[0.379]	[0.775]	[1.106]
Bad health	1.3497	0.9405	1.8399***
	[1.281]	[0.084]	[6.923]
Inpatient at hospital	1.3044	1.0933	1.2120*
	[1.400]	[0.384]	[1.807]
Married	0.803	0.6922	0.9978
	[1.322]	[1.558]	[0.018]
Third level education	1.3829	0.8132	0.7443***
	[1.435]	[0.819]	[2.661]
Number of children 0-14	0.9554	0.6153	0.5479***
	[0.282]	[1.295]	[3.151]
Work satisfaction	0.8317***	0.8271***	
	[2.912]	[3.259]	
Leisure satisfaction	1.2865***	1.1541**	
	[4.079]	[2.382]	
Supervisory job status	0.4697***	0.9954	
	[3.313]	[0.019]	
Part time	0.8642	1.6147	
	[0.536]	[1.440]	
Public employment	1.2497	0.6337**	0.909
	[1.419]	[2.103]	[0.924]
Firm size < 20	1.3630*	0.4902**	0.9804
	[1.954]	[2.213]	[0.171]
Managers, professionals	1.2991	0.5228**	
	[0.952]	[2.274]	
Technicians	1.3002	0.5416**	
	[1.281]	[2.157]	
Clerks, service workers	1.1712	0.4735**	
	[0.770]	[2.530]	
Year 1994		11.1111***	0.7283
		[2.970]	[0.298]
Year 1995		6.3803**	0.9263
		[2.460]	[0.072]
Year 1996	0.3922	7.5898***	0.8909
	[1.542]	[2.855]	[0.112]
Year 1997	1.0375	5.9076**	0.7463
	[0.081]	[2.447]	[0.292]
Year 1998	1.8284	6.1723***	1.9099
	[1.495]	[2.860]	[0.663]
Year 1999	1.5987	2.6972	2.7535
	[1.184]	[1.527]	[0.929]
Observations	1587	1464	3119
Log pseudo-likelihood	-796.5	-655.6	-2750.9
Wald chi2	256	307.4	354.3
Pseudo R-squared	0.138	0.103	0.039

Robust z statistics in brackets * significant at 10%; ** significant at 5%; *** significant at 1%
Specification includes age dummies age 50 to age 64, reference category age 55.

Table 4: Duration model of the employment of females

	Finland	Belgium	Germany
Option value	0.0132***	0.937	0.7693
	[7.367]	[0.094]	[0.638]
Pension wealth	1.0158*	0.9901	0.9642*
	[1.659]	[0.365]	[1.803]
Capital income	0.5021	1.0531	1.1782*
	[1.417]	[0.637]	[1.759]
Owner occupied	1.2717	0.9261	1.0469
	[1.253]	[0.247]	[0.449]
Bad health	1.4263*	1.5274	1.5489***
	[1.784]	[0.917]	[4.020]
Inpatient at hospital	0.9221	1.6038	1.3751**
	[0.432]	[1.583]	[2.544]
Married	0.9574	0.8828	0.8548
	[0.251]	[0.502]	[1.246]
Third level education	0.8875	1.7862*	1.0036
	[0.500]	[1.904]	[0.022]
Number of children 0-14	0.8865		1.0506
	[0.522]		[0.218]
Work satisfaction	0.9605	0.8327**	
	[0.630]	[2.302]	
Leisure satisfaction	1.0499	1.1729*	
	[0.798]	[1.772]	
Supervisory job status	0.8666	1.0367	
	[0.447]	[0.070]	
Part time	0.7559	1.089	0.5124***
	[1.637]	[0.323]	[3.895]
Public employment	1.3195**	0.7554	1.1013
	[2.021]	[1.046]	[0.860]
Firm size < 20	1.2224	1.2176	0.8705
	[1.551]	[0.562]	[1.003]
Managers, professionals	1.8492**	0.7184	
	[2.064]	[0.835]	
Technicians	1.3453	0.4423	
	[1.438]	[1.458]	
Clerks, service workers	1.012	0.873	
	[0.073]	[0.452]	
Year 1994			1.4325
			[0.478]
Year 1995		2.0422	0.6088
		[1.201]	[0.756]
Year 1996	0.8699	1.5343	0.5406
	[0.281]	[0.864]	[0.976]
Year 1997	0.962	0.256	1.1651
	[0.096]	[1.641]	[0.268]
Year 1998	1.0898	2.1187	0.8069
	[0.248]	[1.364]	[0.422]
Year 1999	0.8517	1.7053	0.9161
	[0.461]	[0.961]	[0.153]
Observations	1866	820	1833
Log pseudo-likelihood	-972.3	-344.7	-1582.8
Wald chi2	242.8	213.7	368.7
Pseudo R-squared	0.123	0.103	0.055

Robust z statistics in brackets * significant at 10%; ** significant at 5%; *** significant at 1%
Specification includes age dummies age 50 to age 64, reference category age 55.

Here in the model we include only pension wealth and not permanent income, as the panel comprises only average information on incomes from three years. The pension wealth vari-

able does not produce very strong results. The hazard rate is bigger than 1 only in Finland, so that the wealthier have the tendency to retire earlier. In Germany the effect of pension wealth turns out to have the opposite sign and is significant. This may be explained by the fact that the option value already captures the pension wealth effect, as it is an important component.

We included both satisfaction and status measures and non-reported age dummies in order to clean the estimated coefficient of the option value from all non-economic effects. Option values are a non-linear function of the income level that, in itself, affects the valuation of leisure/work. High-income earners may exhibit greater job satisfaction. Thus the option value may partly capture the job satisfaction effects of higher incomes. Controls for satisfaction measures are important and are available for Belgium and Finland. They capture aspects of happiness and well-being, factors that cannot be fully captured by financial incentives. Work satisfaction indeed has a negative effect on the hazard out of employment, whereas leisure satisfaction has the opposite effect and is significant for men. Satisfaction measures are especially crucial to men. In Belgium satisfaction measures are important for both men and women and have stronger absolute effects with work satisfaction hazard rates of 0.82 for men to 0.83 for women, and leisure satisfaction hazard rates of 1.15 for men to 1.17 for women. The effects are rather small but have to be interpreted on a scale from 1 to 6. Exclusion of these variables raises the hazard rates of option values with up to 1%-point.

Most other socio-demographical variables are not significant. Being married or in a consensual union has a positive effect on flowing out of employment for Finnish women but the effects are mostly insignificant and not in line with the probit model results (postponing retirement for Belgian and Finnish men). We find that the education dummy of third-level education does not explain retirement transitions. This may be due to the mixed country effects. The highly educated in Finland and Belgium tend to retire earlier but the opposite is true for German men. Third-level education has a large significant negative effect for German men and shows a hazard rate of 0.74. Another explanation may be that different education levels face different incentives to retire and that the overall distribution of incentives is evenly spread. The higher educated may, for example, leave because of burn-out, whereas the lower educated may leave employment because of physical health problems or unemployment.

Health variables are found to play a more significant role in the pooled data for the countries. The health effects for men are stronger than those for women. Having bad health produces a hazard rate of about 1.83 for men and 1.69 for women. The in-patient at a hospital variable is introduced in the specification to capture more specific health problems that require hospital visits and, unlike the previous health variable, most probably exclude mental health problems. The significant effect for men and women is less than that of the bad health variable. One reason is that a fairly large share (10%) has received hospital care. This may also show the importance of mental health problems in retirement decisions. The results of health variables have to be interpreted carefully, however, as they are prone to endogeneity problems (Bound, 1991, Kerkhofs et al., 1999). Börsch-Supan (2000) stresses that health effects can decrease and financial incentives increase if factors that account for unobserved individual heterogeneity and intertemporal linkages are added to a pooled regression model.

Legal disability status is not used here, since it is, by definition, to be more endogenous to the retirement system. The calculation analysis treats disability pension receivers separately, as these are indirectly recorded in the data. The most significant distinction about the unemployment pension is that there is no age limit for the disability pension. We have assumed that all who retire early before the age limit for the unemployment pension pipeline (55 years in Finland and 55 years in Germany) start receiving disability pension (which may not be realistic).

Focusing now on the hazard rates of the country samples reveals that the results for health variables are mixed. Both bad health and in-patient treatment at a hospital have a robust positive effect on the propensity to flow out of employment only in the case of Germany. Overall average health in Germany is also reported to be much worse than in Belgium and Germany (see Table A. and Table A.). In Finland the self-reported health status explains the retirement behaviour of women, and hospital care explains the retirement behaviour of men. Belgium has very few bad health observations and returns the weakest results for health variables. Disability pensioners in Belgium form a low but now growing share of all the retired, which may explain the weak influence of the health variable.

It is seen that part-time work plays an important role in the total sample. Part-time females are roughly 30%-point less likely to retire. In the country sample we see that part time is especially important for Germany. In Germany the negative part-time effect is only impor-

tant for women, but it is very strong. Germany introduced the option of reducing work to a half of the regular weekly hours at the age of 58 in 1998 and at the age of 55 in 1996 (but this will be rescinded by 2010). The ´blocked´ model of partial retirement included a higher income for older workers than in the case of pre-retirement and more generous reimbursements from the Federal Employment Office to the company, provided the vacancy has been filled by a formerly unemployed person. Part-time work encourages retirement in Belgium but turns out to be insignificant.

Civil servants are modelled to be part of the standard social security system, although the higher maximal replacement rates in Finland are accounted for in the model. Civil servants in Belgium have to work longer, with a retirement age of 65, although disability channels are frequent. Excluding the civil servants increases the estimated effect of the option value insignificantly. Working in the public sector is insignificant in the total sample and in Germany. For Belgian men public employment has a negative but insignificant effect on the propensity to retire. The negative impact for Belgian men signals that Belgian civil servants have more job security and do not use (collectively or individually) the unemployment channel as often as private sector workers. Besides, the pension system for civil servants differs from the private sector system in that the official retirement age of 65 for women is still higher than in the private sector and equal to men's retirement rate.

From the total sample it is seen that the withdrawal from jobs in small firms is not significantly different to that from jobs in other firms. Looking at the country samples we see that the size of the firm does, however, seem to matter for Belgian and Finnish men. Large firms have often provided additional support for the early retired. In the large firms a relatively lower share withdraws and directly starts receiving a pension and a relatively greater share of withdrawals passes via the unemployment pipeline. Finally, looking at occupational information in Finland, retirement propensities effects turn out to be higher for managers, professionals and technicians in comparison with the reference category of blue-collar workers. The opposite is true in Belgium. The highly educated and individuals in good professions seem to be more encouraged to retire in Finland. Year dummies are included to disentangle time effects like macro-economic effects and policy changes in the pooled data. The reference year is 2000. They are positive and significant in Belgium in 1998. They play a more important role in the duration model than in the probit model.

6. CONCLUSIONS

Modelling the pension system for different countries is a difficult task, as each country has its very many rules about and exceptions. A robust modelling of the system per country has, however, been possible although further fine-tuning is appropriate. Our model is concerned about dynamics in that it explains transitions out of employment; it focuses thereby on the early retirement decisions in a sample of people between 50 and 65.

It is shown that forward-looking measures that capture the institutional characteristics of the pension system are important determinants of individual retirement transitions. As it represents the opportunity cost of retirement, the option value turned out to have a significant negative impact on the exit from employment. This is most evident in a duration model that coherently captures the pension wealth accumulation. The forward-looking incentive effects are highest for women. The mild effects for German men appear to contrast with those for a sample of both genders obtained in an earlier paper (see Börsch Supan, 2000). These results and the insignificance of firm size or manual work in manufacturing indicate that many push factors in the firm level remain to be explained.

The analysis shows that policies to raise marginal incentives and, hence, option values are effective in Finland and for women in Germany. The income data in Belgium is too distorted to generate any conclusive results. The incentives hold especially for the early retirement stage. Thus, the current economic incentives in Germany around the age of 65 or the new ones introduced in Finland with a 4.5% accrual rate between the ages of 63 and 68 may continue to be ineffective. We suggest that a sustainable pension system also requires a further cut in the level of pensions if retirement takes place before the age of 60. This is the only way to introduce high-power incentives in early retirement. In Germany and Belgium the spikes in retirement at the ages of 60 or 65 are remarkable, whereas in Finland retirement is smooth as of age 56. We suggest that raising the official retirement age can be also effective in Germany and Belgium, including the Belgium reform to raise the legal age for the unemployment channel. The sustainable pension system requires a further cut in the level of pensions, especially in Finland if retirement takes place before the official retirement age (the age of 60).

We find some country variation, especially in the health effects. Poor health has an important effect on the retirement risk, especially for Germany. Bad health and hospitalisation also play an important role in the early retirement decision. The satisfaction measures also form an important category. They are important in Finland and very important in Belgium. Thus well-being at work remains a crucial factor in all the countries, especially for men. Well-being at work and the fine-tuning of combining family and work life remain very important issues.

Our data covers only eight waves with labour force participation information. The construction of option values could be made optimal by incorporating administrative data into the analysis. Future retirement research could use dynamic programming modelling to study specific issues. Although the latter models can turn out to be rather complex, they have the advantage that the estimates of structural parameters can be used for simulating the effect of policy measures.

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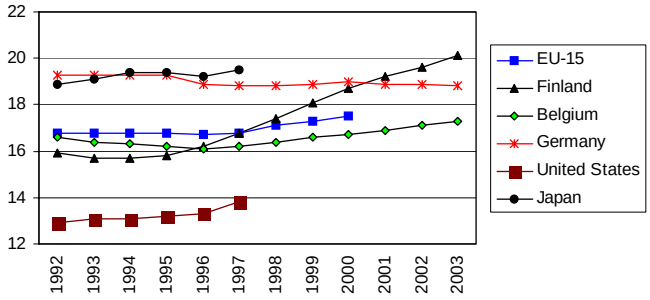
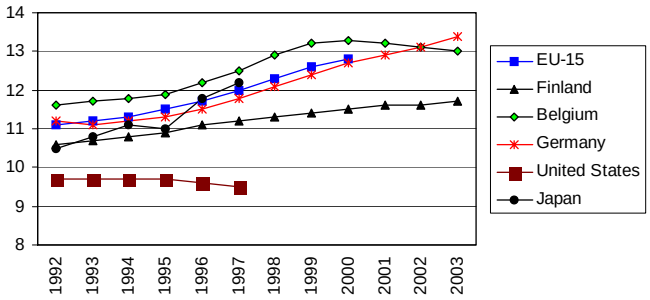
Appendix A: Figures and tables

Figure A.1 Recent evolution of the age structure of the population (EUROSTAT)

Proportion of the population aged 50-64 years (%)



Proportion of the population aged 65-79 years (%)



Proportion of the population aged 80 years and more (%)

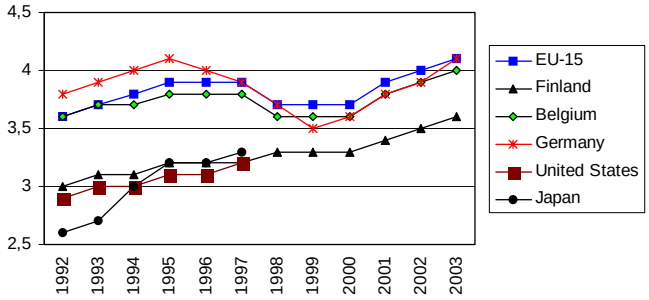


Figure A.2 Activity rate of workers aged 55 to 64 (source: Eurostat)

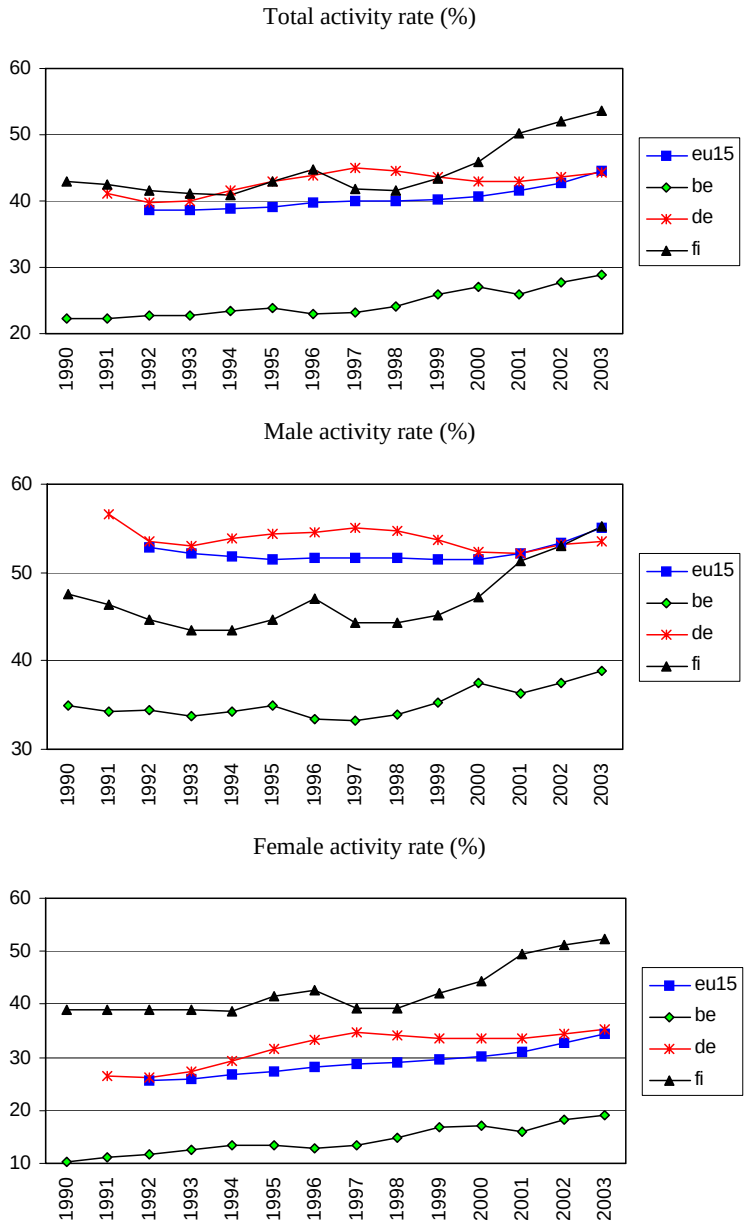
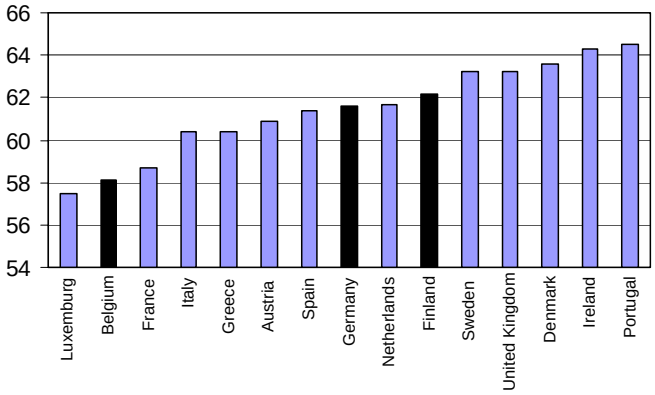
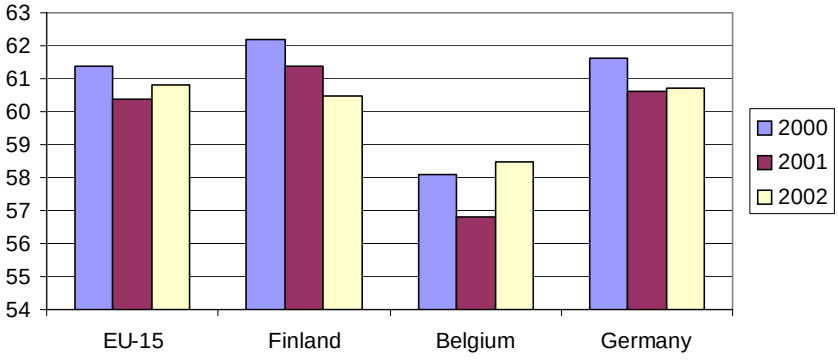


Figure A.3 Average exit age from the labour force (source: Eurostat)

Total for all EU-15 countries: year 2000



Total for selected countries: year 2000 to 2002



By gender for selected countries: year 2001 to 2002

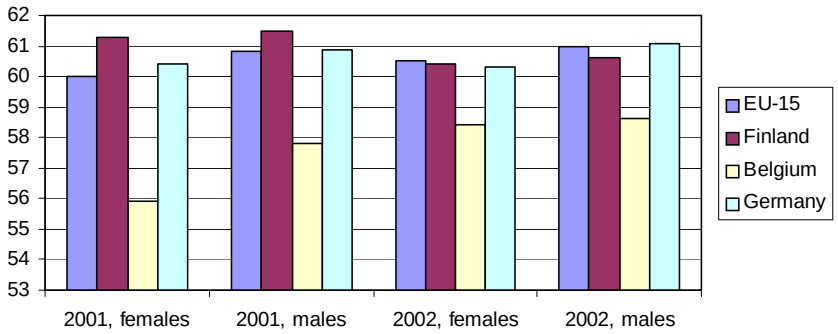


Figure A.4 Age profiles of retirement transitions by country and gender

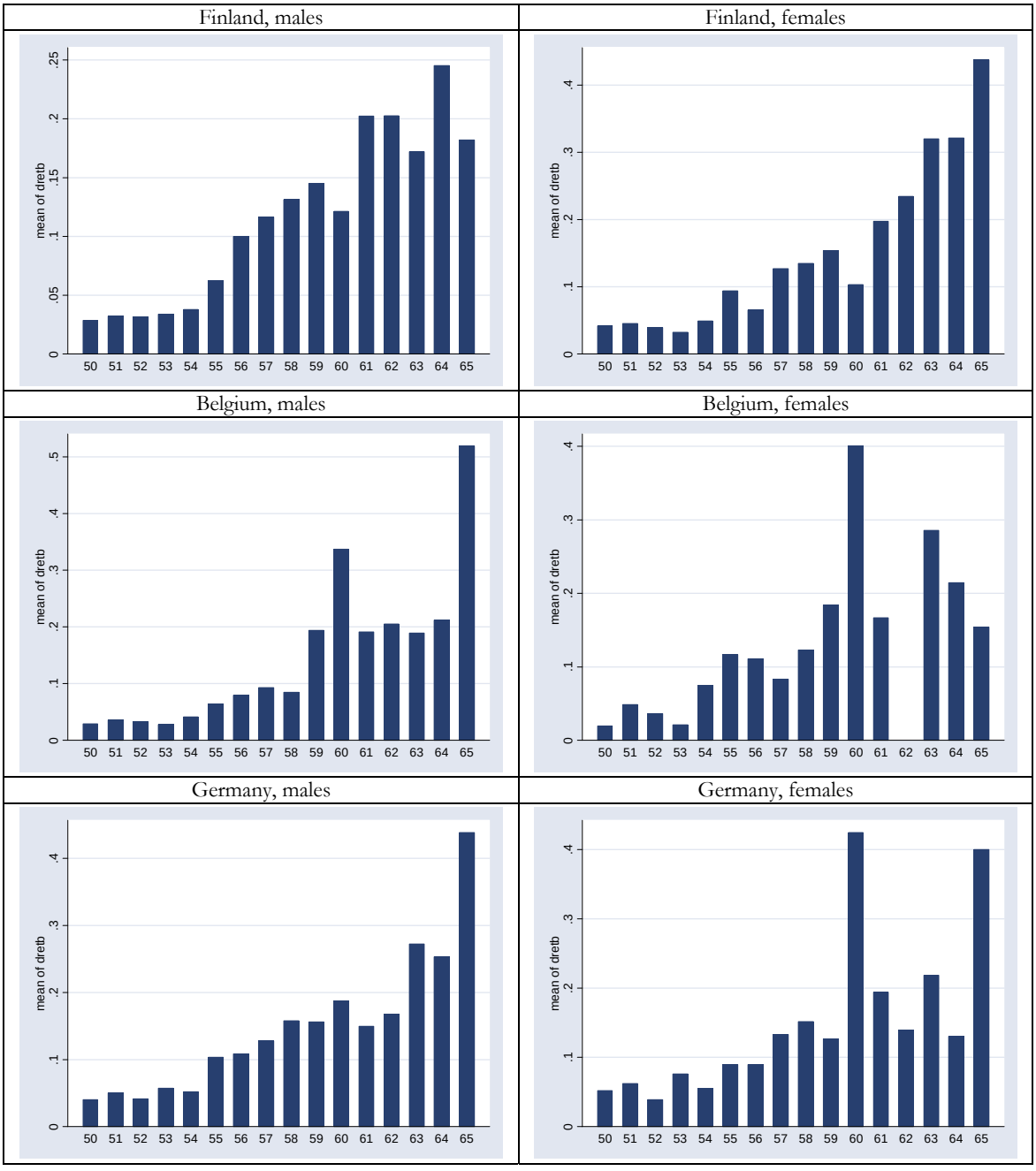
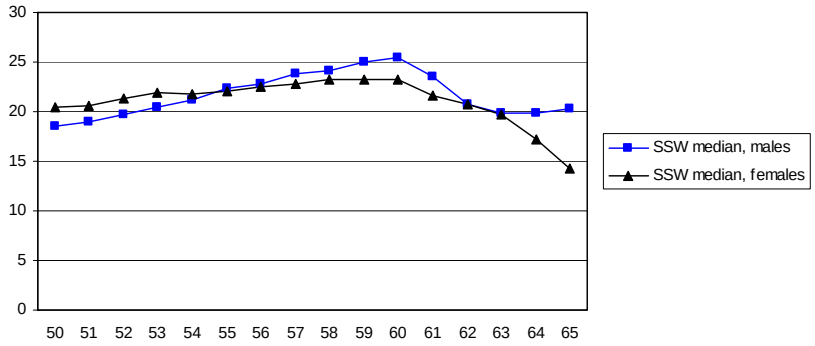
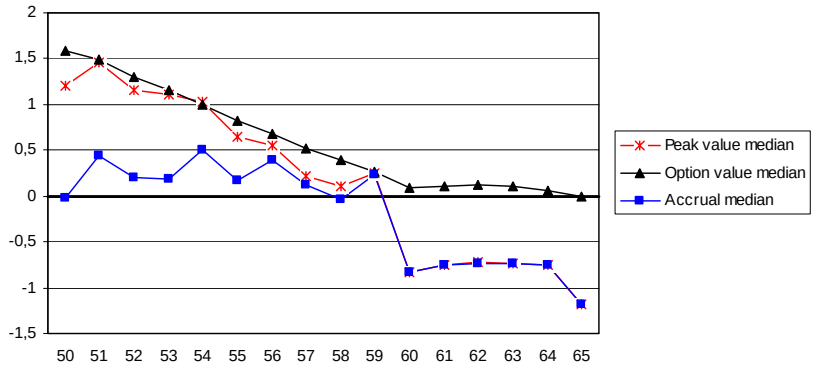


Figure A.5 Age distribution of pension incentives in Belgium based on Dellis et al., (2001)

Social security wealth, median (in 10000 Euro's) per age and gender



Peak value, option value and accrual of men, median (in 10000 Euro's) per age



Peak value, option value and accrual of women, median (in 10000 Euro's) per age

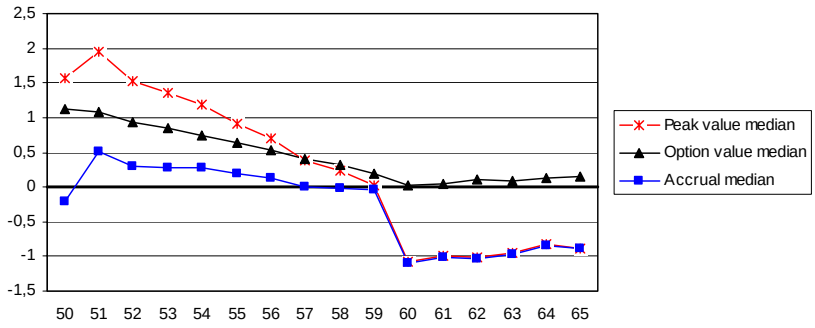
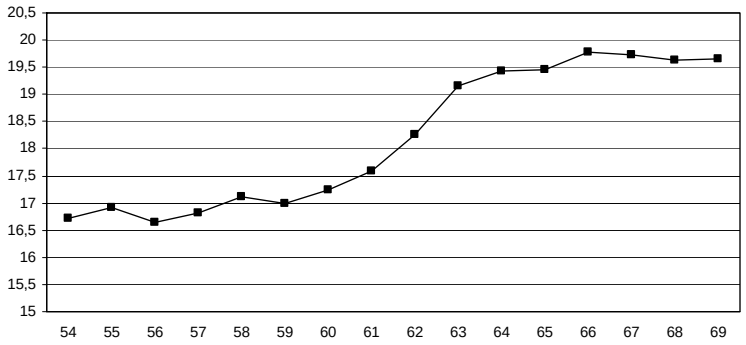
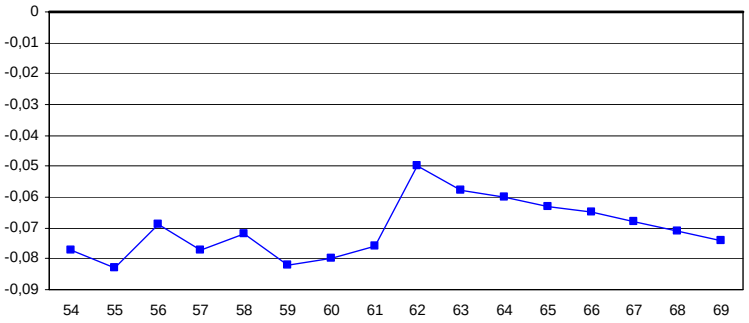


Figure A.6 Age distribution of pension incentives in Germany based on Börsch-Supan et al. (2002)

Social security wealth, mean (in 10000 Euro's) per age



Accrual rate, mean per age



Accrual (down) and option value (up), mean (in 10000 Euro's) per age

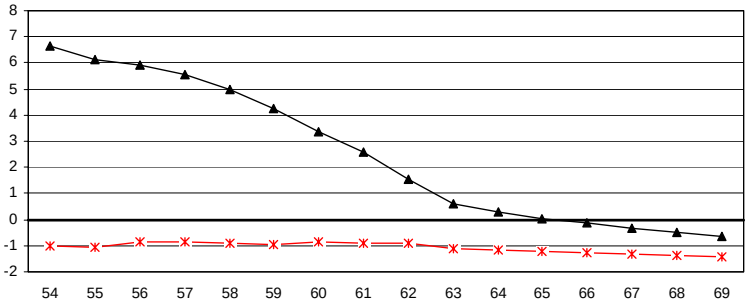
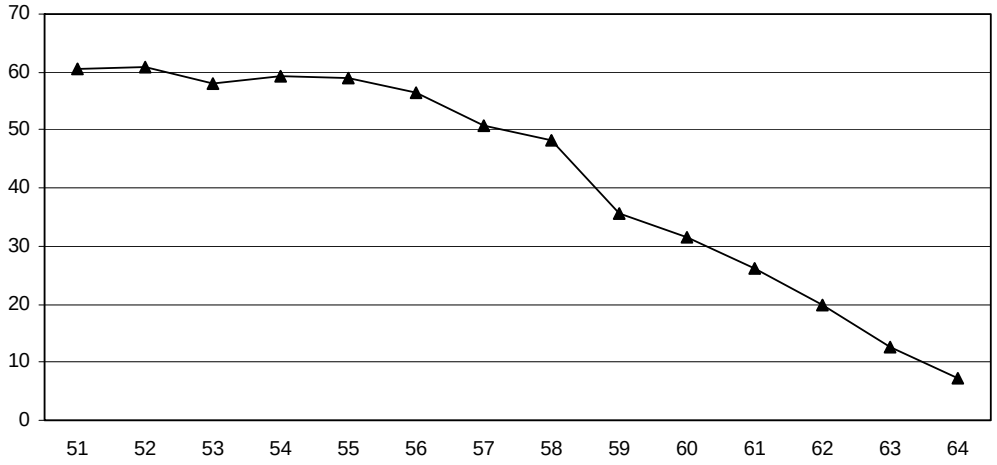


Figure A.7 Age distribution of pension incentives in Finland based on Veli (2004)

Option value (mean in 10000) per age for Finland (analysis results)



Option value (mean in 10000) per age for Finland (Laine, 2004)

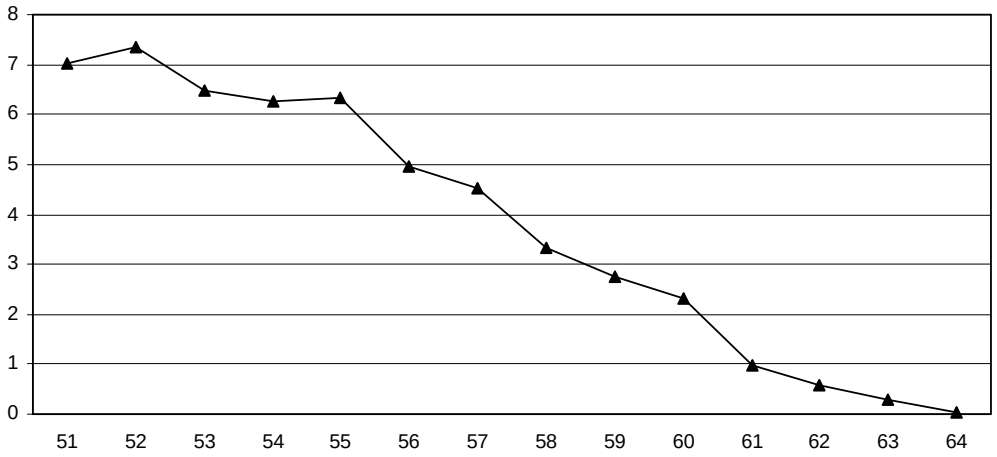


Figure A.8 Age profile of pension wealth (mean, in 10000 Euros) by country and gender

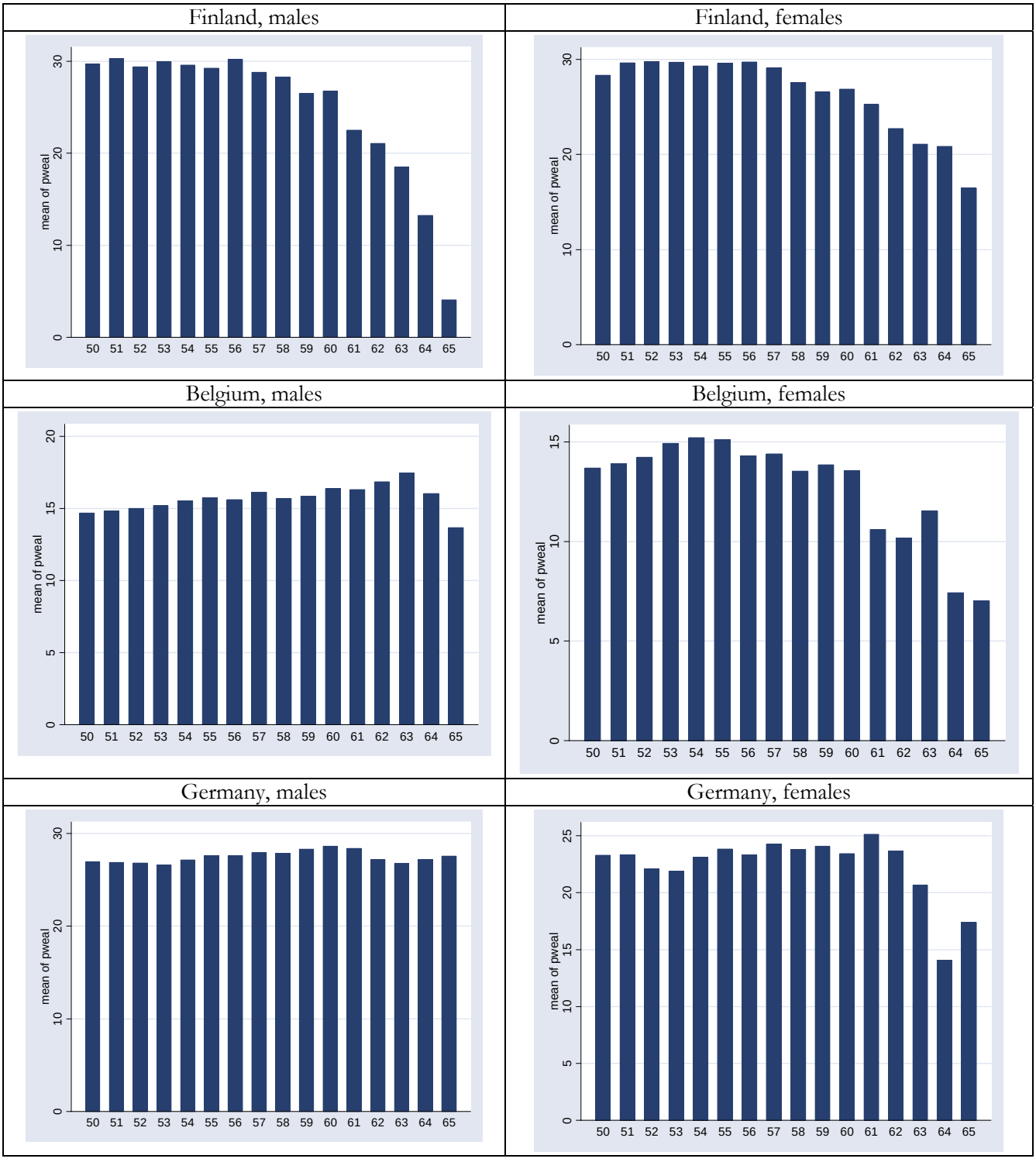


Figure A.9 Age distribution of the option value (mean, in 10000) by country and gender

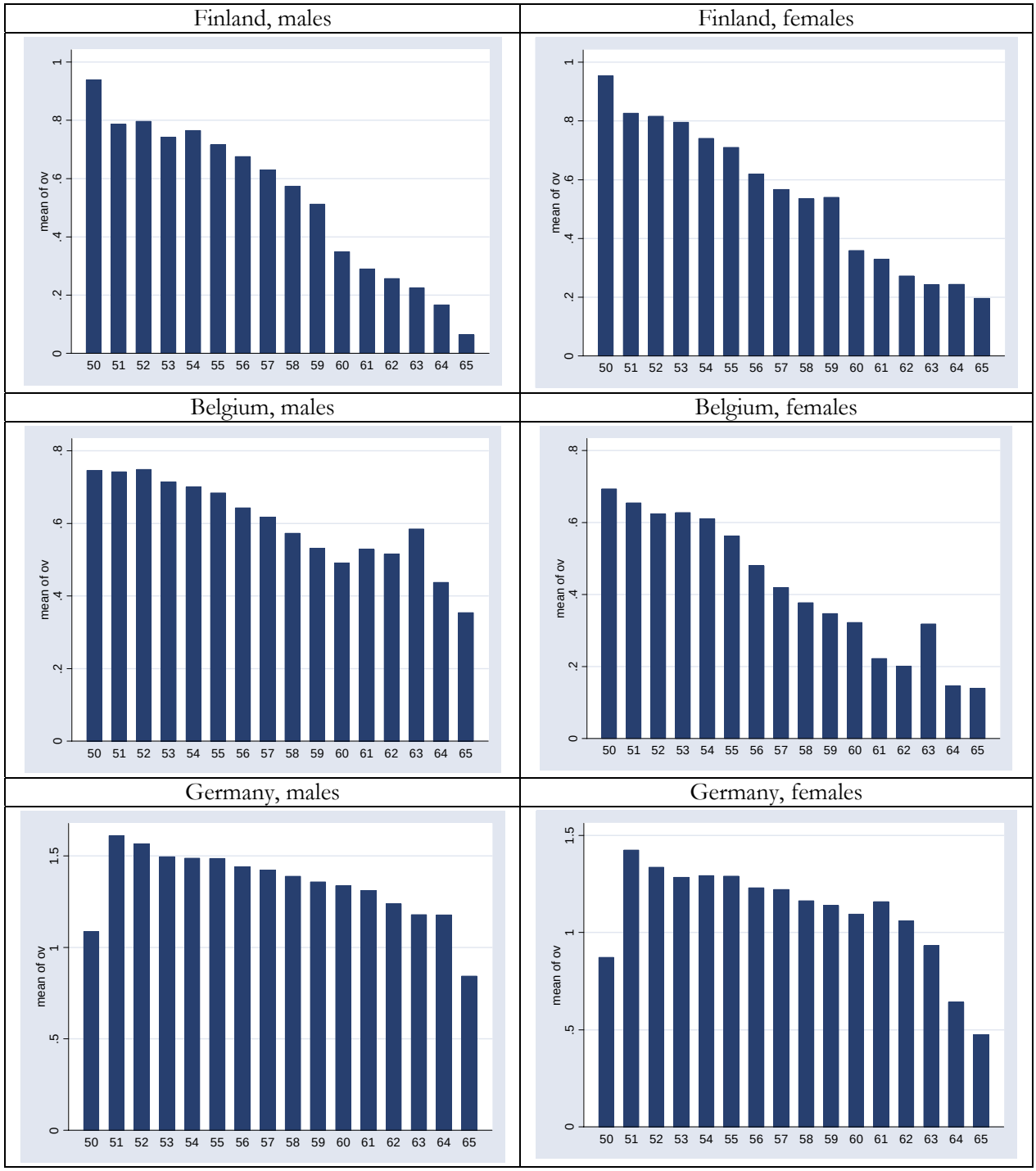
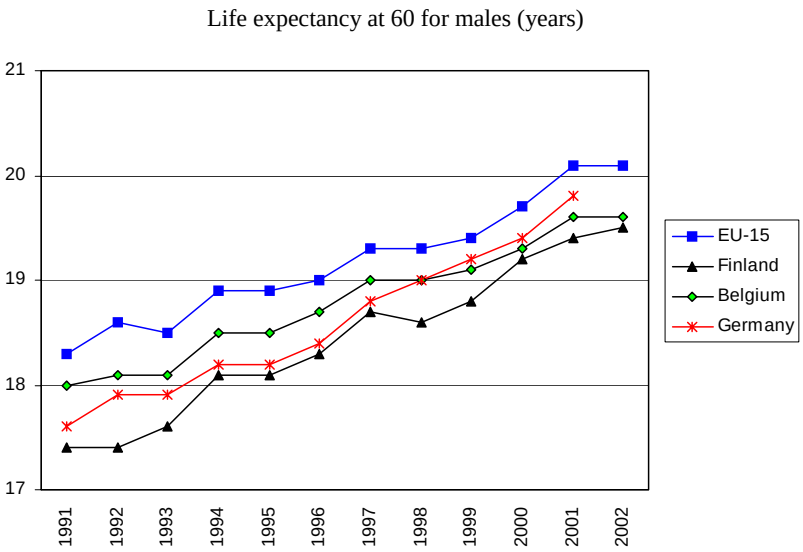


Figure A.10 Life expectancy at 60 for males and females (Eurostat)



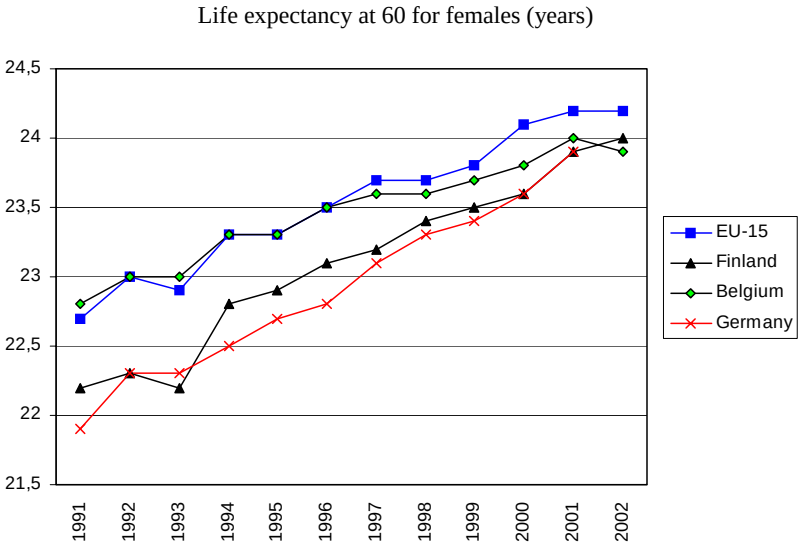


Table A.11 Summary statistics of the male sample

Male sample (age 50- age 64)	Finland		Belgium		Germany		All Countries	
	1686	obs,	1632	obs,	5049	obs,	8367	obs,
	Mean	st-dev,	Mean	st-dev,	Mean	st-dev,	Mean	st-dev,
Transition to retirement	8.46 %	0.01	9.68 %	0.01	10.98 %	0.01	10.20 %	0.00
Option value	0.69	0.01	0.67	0.01	1.49	0.01	1.07	0.01
Pension wealth	28.73	0.31	15.30	0.09	29.12	0.21	25.82	0.16
Replacement rate	51.5 %	0.0019	41.3 %	0.0029	96.1 %	0.0038	71.5 %	0.0046
Replacement rate at age 60	55.6 %	0.0020	45.7 %	0.0029	91.1 %	0.0030	74.6 %	0.0035
Replacement rate at age 65	61.1 %	0.0018	49.0 %	0.0034	85.9 %	0.0048	74.9 %	0.0040
Age	53.9	0.08	54.1	0.09	55.5	0.07	54.9	0.05
Primary education	34.6 %	0.0142	28.2 %	0.0130	12.3 %	0.0060	20.0 %	0.0056
Secondary education	37.7 %	0.0138	33.3 %	0.0140	53.2 %	0.0098	46.3 %	0.0072
Tertiary education	27.6 %	0.0116	34.6 %	0.0134	34.5 %	0.0093	33.0 %	0.0066
Married	77.3 %	0.0128	85.9 %	0.0098	84.0 %	0.0079	82.9 %	0.0058
Cohabitation	84.8 %	0.0110	88.9 %	0.0092	86.4 %	0.0077	86.5 %	0.0055
Separation/divorce /widowhood	14.2 %	0.0108	10.3 %	0.0087	8.9 %	0.0054	10.3 %	0.0043
Children 0-13	11.9 %	0.0248	8.4 %	0.0089	11.2 %	0.0071	10.8 %	0.0071
Children 0-15	25.6 %	0.0370	14.4 %	0.0119	19.1 %	0.0093	19.7 %	0.0102
Household size	2.5	0.05	3.0	0.03	2.7	0.03	2.7	0.02
Non-national	1.08 %	0.0025	4.37 %	0.0051	10.69 %	0.0060	7.45 %	0.0038
Net annual salary/wage (10000 Euro's)	2.9	0.05	2.3	0.03	2.4	0.04	2.5	0.03
Firm size < 20	34.3 %	0.0135	11.2 %	0.0092	13.1 %	0.0066	17.4 %	0.0054
Managers, professionals	23.9 %	0.0109	24.4 %	0.0119	26.5 %	0.0087	25.5 %	0.0061
Technicians	20.4 %	0.0107	12.1 %	0.0094	16.9 %	0.0075	16.8 %	0.0053
Clerks, service workers	8.6 %	0.0079	15.2 %	0.0102	10.0 %	0.0053	10.6 %	0.0041
Blue-collar worker	41.8 %	0.0146	19.3 %	0.0118	40.7 %	0.0097	37.2 %	0.0071
Health (declining scale: 1 to 5)	1.3	0.10	1.8	0.04	2.7	0.02	2.3	0.03
Bad health	4.3 %	0.0058	0.8 %	0.0022	17.8 %	0.0085	11.8 %	0.0055
Good health	50.4 %	0.0142	81.2 %	0.0106	40.6 %	0.0096	50.0 %	0.0072
Chronic physical/mental health problem	38.3 %	0.0134	12.5 %	0.0091	38.5 %	0.0098	33.8 %	0.0070
Limitation	23.9 %	0.0116	11.0 %	0.0084	36.0 %	0.0098	28.9 %	0.0068
Inpatient at a hospital	10.0 %	0.0075	9.6 %	0.0080	9.7 %	0.0057	9.8 %	0.0041
Hospital nights	0.62	0.12	0.62	0.12	0.62	0.12	0.62	0.12
1-5 visits to the doctor	59.7 %	0.0138	53.6 %	0.0144	0.0 %	0.0000	22.6 %	0.0057
6+ visits to the doctor	27.2 %	0.0122	35.7 %	0.0137	0.0 %	0.0000	12.3 %	0.0041

Table A.12 Summary statistics of the female sample

Female sample (age 50- age 64)	Finland		Belgium		Germany		All Countries	
	1014	obs,	2181	obs,	3434	obs,	6629	obs,
	Mean	st-dev,	Mean	st-dev,	Mean	st-dev,	Mean	st-dev,
Transition to retirement	7.95 %	0.01	9.85 %	0.01	10.75 %	0.01	9.68 %	0.01
Option value	0.68	0.01	0.57	0.01	1.20	0.02	0.88	0.01
Pension wealth	28.52	0.26	14.24	0.20	23.31	0.34	24.32	0.19
Replacement rate	52.2 %	0.0018	46.4 %	0.0033	99.7 %	0.0113	71.2 %	0.0072
Replacement rate at age 60	57.6 %	0.0019	51.5 %	0.0028	93.8 %	0.0073	76.3 %	0.0053
Replacement rate at age 65	62.3 %	0.0017	53.3 %	0.0031	87.5 %	0.0104	75.5 %	0.0067
Age	54.5	0.09	53.5	0.12	55.1	0.10	54.7	0.06
Primary education	34.8 %	0.0121	21.4 %	0.0149	27.8 %	0.0114	29.5 %	0.0077
Secondary education	32.2 %	0.0119	34.8 %	0.0186	53.5 %	0.0130	44.0 %	0.0086
Tertiary education	32.9 %	0.0114	39.6 %	0.0190	18.7 %	0.0099	26.0 %	0.0071
Married	67.3 %	0.0125	68.4 %	0.0175	70.5 %	0.0118	69.2 %	0.0080
Cohabitation	73.4 %	0.0120	72.7 %	0.0166	73.9 %	0.0114	73.6 %	0.0077
Separation/divorce /widowhood	24.3 %	0.0115	25.6 %	0.0164	21.9 %	0.0100	23.2 %	0.0070
Children 0-13	3.7 %	0.0049	0.2 %	0.0015	3.3 %	0.0052	3.1 %	0.0033
Children 0-15	7.8 %	0.0067	2.1 %	0.0047	4.6 %	0.0056	5.4 %	0.0039
Household size	2.1	0.02	2.4	0.04	2.2	0.04	2.2	0.02
Non-national	0.62 %	0.0017	3.83 %	0.0068	5.63 %	0.0042	3.69 %	0.0025
Net annual salary/wage (10000 Euro's)	2.1	0.03	1.5	0.03	1.3	0.03	1.6	0.02
Firm size < 20	37.8 %	0.0123	11.3 %	0.0121	22.8 %	0.0112	26.7 %	0.0076
Managers, professionals	23.5 %	0.0100	26.8 %	0.0177	12.1 %	0.0077	17.7 %	0.0059
Technicians	17.1 %	0.0096	10.3 %	0.0109	24.8 %	0.0111	20.5 %	0.0070
Clerks, service workers	39.0 %	0.0123	25.1 %	0.0165	35.6 %	0.0130	35.6 %	0.0084
Blue-collar worker	15.0 %	0.0094	11.9 %	0.0119	20.3 %	0.0102	17.5 %	0.0065
Health (declining scale: 1 to 5)	2.1	0.05	1.9	0.08	2.8	0.03	2.4	0.02
Bad health	4.9 %	0.0052	2.4 %	0.0058	20.4 %	0.0099	12.9 %	0.0058
Good health	54.0 %	0.0125	73.7 %	0.0166	38.0 %	0.0132	47.6 %	0.0086
Chronic physical/mental health problem	41.8 %	0.0124	10.5 %	0.0122	38.9 %	0.0122	36.6 %	0.0080
Limitation	27.4 %	0.0112	10.9 %	0.0123	37.6 %	0.0121	31.0 %	0.0077
Inpatient at a hospital	11.6 %	0.0081	10.5 %	0.0122	11.0 %	0.0075	11.1 %	0.0051
Hospital nights	0.62	0.12	0.62	0.12	0.62	0.12	0.62	0.12
1-5 visits to the doctor	54.2 %	0.0125	43.7 %	0.0191	0.0 %	0.0000	23.7 %	0.0064
6+ visits to the doctor	39.0 %	0.0123	49.4 %	0.0193	0.0 %	0.0000	19.1 %	0.0059

Table A.13 Probit model for retirement transitions in Finland, analysis results (specification 1A and 2A) versus Laine (2000)(specification 1B and 2B)

	(1A)	(1B)	(2A)	(2B)
Option value	-0.0034	-0.0023***	-0.0033***	-0.0025***
	[6.1]	[6.120]	[5.9]	[6.000]
Age	0.0064***	0.0039***	0.0064***	0.0038***
	[6.1]	[3.810]	[4.9]	[4.120]
Health			0.085***	0.0016***
			[4.0]	[4.460]
Observations	3087	4071	3087	4071
Log pseudo-likelihood	-791.7		-782.8	
Wald chi2	122.7		132.6	
Pseudo R-squared	0.185		0.194	

Robust z statistics in brackets * significant at 10%; ** significant at 5%; *** significant at 1%; Specification includes year dummies, reference year 2000. In our sample the mean option value is 22 versus 3,6 in Laine's sample (in 10000).

Appendix B: Pension Rules and Tax Treatments

This appendix describes pension rules within the first pillar. The focus is on regulations during the sample period years 1994 to 2001. The CPI deflated data have the reference year 2000.

Belgium

The conditions for obtaining a full pension for men is being a minimum of 65 years of age and having a working career of at least 45 years. Women can obtain a full pension after a career of 42 years from the age of 62. Men and women can go on pension from age 60 if their career reached a minimum of 20 years in 1997. It may be informative to know that the gross replacement rate of the average worker in the private sector amounted to 29.9% in 2000.

The calculation of the pension benefits is based on the following formula:

Benefit = r*average wage*min[d/(42 or 45),1].

This consequently depends on (1) replacement rate r depending on the reported type of household: 0.6 for singles and 0.75 for a one-earner couple, (2) average earnings based on periods of affiliation, and (3) the share of years completed of the full career (42 years for women and 45 years for men). This corresponds to an annual accrual rate of 2.38 for women and 2.22 for men. The average wage corresponds to the price-indexed average wages over the period of affiliation. An important characteristic of this scheme is that periods spent in unemployment, inactivity due to sickness and disability and early retirement also count as affiliation years in the computation of the average wage and hence of the pension benefit. All benefits in this scheme are consumer-price indexed.

In this system, pension benefits are limited at both ends: for a complete career the minimum annual pension was 11 794 Euros for a one-earner couple or 9 438 Euros for individuals in February 2002 (about 56% of the average net wages). The earnings entering the above pension formula had a ceiling of 38 678 Euros (120% of the average gross wage) in

2001. If the ceiling is adapted for the whole career, the maximum annual pension amounted to 20 894 Euros for a one-earner couple and 16 715 Euros for an individual in 2001.

Men may retire at the age of 60 if replaced by unemployed persons. Women may retire if unemployed or disabled between the ages of 61 and 65. People can retire as of the age of 60 with a 26-year career for retirement in 2000. (A 20-year career in 1998, a 22-year career in 1998, a 24-year career in 1999, a 30-year career in 2002, a 32-year career in 2003, a 34-year career in 2004, and a 35-year career in 2005).

Wage-earner and self-employed pensions follow the evolution of the consumer price index, that is, the health consumer price index, corrected for cigarettes, etc. These pensions are also irregularly adapted to the living standards.

Unemployment pension: Next to the official wage earner scheme, several forms of early retirement programmes have recently developed, some being official early retirement schemes, others (unemployment, disability, sickness) being unofficial. Those schemes can be broadly divided into two groups, mandatory collective retirement and individual retirement. Individual early retirement differentiates itself from its collective counterpart by the fact that it is based on an individual's decisions to retire from work. The most prevalent way is to pass through the unemployment system in which people aged 50 or more are considered "aged unemployed", not being required to actively seek work.

Disability pension: The normal allowance is 65% of the lost earnings (subject to a ceiling) for individuals with dependants, 45% for singles without dependants, 40% for cohabiting individuals without dependants. The recipient, isolated or co-habitant without dependants, is entitled to a rate of 65% when it is acknowledged that he or she requires the assistance of a third party in order to perform the basic activities of daily living.

Finland

The earnings-related pension depends on accrued pension rights during (self) employment: benefits are based on (1) the number of years in employment, and (2) the accrual rate: the pension starts growing from the age of 23. For the years before 1.7.1962 an employee acquires a pension rate of 0.5% per year. For the years following 1.7.1962 the pension rate is

1.5% per year. From the age of 60 on an employee acquires a pension rate of 2.5%. The maximum pension is 60% of the highest wage. (3) The pensionable salary is the gross income net of the employee's pension contributions and corresponds to the average salary of the last 10 years of occupation. Although the maximum pension is 60% of the highest income during the career, there is no upper limit for the amount of pension received. Pension rights are indexed-based on the evolution of wages (50% before age 65, 80% from age 65 on) and prices (50% before age 65, 20% from age 65 on). No pension rights can be accrued on the income earned after age 65 but this does increase the pension entitlements by 0.6% per month. It is however possible to retire from the age of 60 on. This actuarially reduces the level of pension payments by 0.4% for every month below age 65.

Benefit= pensionable salary*years of employment*accrual rate

The government pension is FIM 2547 FIM a month, FIM 2272 for a married person, depending on the municipality of residence. This is reduced by one-half of the amount exceeding FIM 245 a month of the pension based on employment contracts. It is not paid if the earnings-related pension exceeds FIM 5090-5311 a month, depending on municipality. A married person receives no pension if his earnings-related pension exceeds FIM 4484-4672 a month. (1998 figures). The pension income is taxable. Additional sickness insurance for pensioners is 2.7 (in addition to 1.5).

Unemployment pension is equal to the disability pension at the time the person is entitled to a disability pension (if disabled). Those born later than 1945 (younger than age 58 in 2002) are not entitled to the pension supplement until age 65. For those born before 1945 the pension supplement is also earned during a period of unemployment. This is equal to 0.8 times the number of months of unemployment times the pension divided by the remaining months until age 65.

Unemployment pension consists of (a) Pension entitlement at the time of unemployment, (b) Upcoming pension until age 60 = unemployment months until age 60 * pension wage / 1000 after 500 days of unemployment (approx. 2 years), (c) Upcoming pension since age 60 = unemployment pension months until age 65 (60 or less) * pension wage / 1500 after 500 days of unemployment (approx. 2 years), and (d) Pension supplement after 500 days of unemployment: coefficient = 0.8 * unemployment months / (504 – unemployment months)

where unemployment months = unemployment days until age 60 / 22 and 504 shows months between age 23 and 65. Unemployment pension can than be defined as

Unemployment pension = min [(a+b+c)*(1+coefficient), 0.6*pension wage]

Disability pension consists of (a) Pension entitlement at the time of disability, (b) Upcoming pension until age 50 = Disability months until age 50 * pension wage / 800, (c) Upcoming pension at age 50-59 = Disability months at age 50-59 (120 or less) * pension wage / 1000, and (d) Upcoming pension at age 60-65 = Disability months at age 60-64 (60 or less) / 1500 where unemployment period = unemployment days / 22. The Disability pension can than be defined as

Disability pension = min [(a+b+c+d), 0.6*pension wage]

Germany

In 1972 Germany underwent a major pension reform that created different incentives to retire earlier than 65. This had an effect on the cross-sectional distribution of retirement ages. Instead of a single retirement spike at age 65 the reform resulted in different spikes at ages 60, 63 and 65 (Börsch-Supan, 2000). Individuals are entitled to the old-age pension at 63 with 35 years of contributions, at 65 with 5 years. The retirement age has been 60 for women, but is being gradually shifted to 65 (assumed for both genders). The maximum of pensions is 75% of the average earnings of all the insured.

Old-age pension benefits are defined as

Pension=earnings points*pension factor*pension value.

Earnings points are annual or reference earnings divided by the average earnings of all contributors. The employee's relative contribution position (EP) is computed by averaging her or his annual relative contribution positions over the entire earnings history. In each year, the relative contribution position is expressed as a multiple (minimum 75%) of the average annual contribution (roughly speaking, the relative income position). The reference earnings are insured employment income (up to the contribution ceiling) during the entire duration of the insurance period. The monthly contribution ceiling for 2000 is EUR 4,397

(West) and EUR 3,630 (East). For contributions before 1973 the multiple cannot fall below 75%. For contributions between 1973 and 1992, multiples below 75% are multiplied up to a maximum of 75%, effectively reducing the distribution for workers with income positions below 50%. The pension factor is usually 1 but increases if retirement is postponed. For delayed retirement after age 65, an added factor of 1.0 plus 0.5% for each month is used to increase the benefit (pension factor). The pension value refers to the monthly benefit amount for one year's average covered earnings. This determines the income distribution between workers and pensioners.

The average gross earnings of all contributors was 53508€ in 1999. The average net earnings of all contributors was 33517€ in 1999, and 34143€ in 2000. Contributions are levied on earnings between a floor of 1% and a ceiling of 170% of average earnings, thus equalling about DEM 272.58 for the floor and DEM 46338.6 for the top in 1999. Benefits are adjusted annually for changes in the real value of pensions compared with changes in earnings.

Unemployment pension: Unemployment compensation has been used as pre-retirement income in an unofficial scheme that induced very early retirement from age 56 onwards, as unemployment compensation is paid up to three years for elderly workers and is followed by the lower unemployment aid before an unemployment pension could start at age 60. (Before 1997 the unemployment pipeline started at age 54.) In addition, early retirement at age 58 was made possible in an official (less popular) pre-retirement scheme, in which the employer received a subsidy if a younger employee was hired.

Thus, according to the "59 rules" and "57 rules" companies which release older workers in a "socially acceptable manner", meaning, in a way that they can bridge the gap to the take-up of an old-age pension with unemployment benefit, are allowed to shift part of the expenses onto the Federal Employment Office. The Act of the Consolidation of Job Promotion from 1982 obliged companies to pay the earnings-related unemployment benefit plus related social security contributions for up to one year when firing an older worker who had been employed at the company for at least 10 years.

There is no special tax relief for older people. Income up to a statutory line is exempt from tax. This was around DEM 13 000 per person in 1999. This provision applies equally to citizens of pensionable age and those of working age. A part of the income reflecting the

(notional) repayment of capital is not taxable, while a part relating to the (notional) interest on capital is taxable. This covers the public pension, privately purchased annuities and two particular types of occupational pension plan. The proportion of the income subject to tax varies with the age at which the individual retired. For retirement at age 62, only 27% of the pension is taxable. The share at other illustrative retirement ages is as follows: 38% at age 55, 32% at age 60 and 21% at age 70. There is an additional deduction of DEM 200.

Two other forms of occupational pension income and civil service income are, in principle, taxed as wage income as assumed here (and thus are eligible for the allowance for work-related expenses, even though such expenses are not usually incurred). In addition, 40% of the benefit is exempt from tax up to a ceiling of DEM 6 000. This rule is applied here for all pensions.

Social security contributions are paid based on the total amount of the pension, but are not the same as for employed people. Retired wage earners pay 3.55% social security contributions for sickness and invalidity, provided that (in 2001) this contribution does not mean that the pension paid to single people is less than 1117 €, or 1396 € for married people. On top of that, another contribution ranging between 0.5% and 2% is paid for pension financing, according to the pension level and only for people receiving pensions higher than 1975 € (single) or 2257 € (married). This is called the 'solidarity contribution'. Civil servants pay the same contributions + 0.5% to finance funeral benefits.

Self-employed people do not pay contributions from their pensions. Their pensions are financed by the contributions paid during their career and an annual federal amount. As for taxes, the normal tax rates apply to pensions. Since pensions are replacement income, a reduction is allowed of 1478,76 € (per year) for single people and 1726,65 € (per year) for families. Wage-earner pensions and self-employed pensions follow the evolution of the consumer price index, that is, the health consumer price index, corrected for cigarettes, etc. These pensions are also irregularly adapted to the living standards.

Disability pension: Disability pension benefits can be received if one passes a strict earnings test (full benefits) or a weaker earnings test (before age 60: 60% of the applicable old-age pension). Survivor pensions are 60% of the husband's applicable pension for spouses that are 45 and over or if children are in the household, otherwise 25%. Survivor benefits are a large part of the public pension budget and of the total pension wealth. In addition to the

above benefits, transfer payments enable one to what is referred to as "pre-retirement". Labour force exit before age 60 is frequent: about 45% of all men call themselves retired at age 59. Only about half of them retire because of disability; the other half make use of the many official and unofficial pre-retirement schemes.

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