THE EFFECT OF THE PENSION REFORM ON RETIREMENT AGE AND INCOME DISTRIBUTION
- ESTIMATES FROM A DYNAMIC PROGRAMMING MODEL

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Abstract

Pension reforms can be aimed to increase the labour force participation. While doing this, however, they can also change the benefit distribution among the individuals. Here we evaluate these two effects in a dynamic programming model with detailed pension, unemployment benefit and taxation rules.

We find that the 2005 Finnish pension reform increases the average labour market withdrawal age by about eight months, but the distribution of the pension benefits changes relatively little with an exception of an increase in the lowest benefits. So the evaluated reform succeeds in increasing the retirement age without an adverse impact on the benefit distribution.

JEL classification: J14, J26
Keywords: Early retirement, dynamic programming, pension benefit distribution

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1 Introduction

Ageing population has recently induced many countries to undertake or contemplate pension reforms. Many of these reforms attempt to increase employment rates of the people in their 50s and 60s. Policies that increase incentives to continue working longer have also potential effects on benefit distribution. An incentive improvement generally means a cut of the benefits at a certain age and/or an increase in the benefits at another age. This may affect the benefit distribution.

Pension reforms tend to be hard to evaluate. Reforms are rarely fully effective from the day they are legislated, but there is usually a long gestation period. It is therefore hard to get suitable data for the reform evaluation. Furthermore, it would naturally be ideal to evaluate a reform before it is even implemented.

Before-hand evaluations can be done by pension rule changes that are combined with regressions on historical data (see, for example, Gruber and Wise, forthcoming) or by dynamic programming models. In this paper we follow the latter approach as it can deal better with uncertainty. We construct a dynamic programming model with wage uncertainty and use the model to evaluate a major pension reform.

The pension reform that we evaluate was done to the Employment Pension scheme in Finland in 2005. The reform aimed to increase older workers' employment rates without producing undesirable changes in equity. The pension reform abolished some early retirement schemes, changed the retirement ages in some other schemes, and tried to increase the incentives to work longer. The reform also changed fundamentally the way the benefits are calculated. All in all, even if the basic DB-PAYG – structure of the pension system was maintained, the 2005 reform has been described as the biggest change in the Finnish Employment Pension system since its initiation in the 1960s.

Pension reforms have been evaluated with dynamic programming models before. (See, for example, Rust, 1990, Knaus, 2002, Heyma, 2004, Karlström et al., 2004.) Our model adds two new aspects to this growing literature. First, we model highly complicated pension and unemployment benefit rules in great detail. Earlier papers concentrate only on the old age pension

system[1] and/or overlook many details in the benefit calculation. The great detail of the model, however, has the cost of having to do resort to aggregate matching rather than maximum likelihood as done by our predecessors. Our second contribution to the existing literature is a greater emphasis on equity. None of the earlier papers looks at how the benefit distribution was changed in the reform.

Our main results are that the evaluated pension reform increases the withdrawal age by about eight months and evens the benefit distribution. Changes in the benefit distribution are small, but the most significant ones concentrate on the lower end of the benefit distribution.

Our paper follows the familiar structure. After this introduction, we first describe the pension reform that we are about to evaluate. In the third chapter, we lay out the means of this evaluation – hence we describe our version of the dynamic programming model. In the fourth chapter we present the results. First we look at the impact of the reform on the labour market withdrawals and then on the benefit distribution. The final chapter - chapter five – concludes.

2 Finnish Pension Reform

The Finnish pension system was thoroughly reformed in 2005. This reform had four major aims (Börsch-Supan, 2005): 1) It tried to increase the labour force participation among the older workers; 2) It tried to make the pension system more equitable; 3) It tried to make the earnings-related pension scheme more sustainable; and 4) It tried to simplify the pension calculation. In this paper, we try to assess whether the reform was successful in achieving the first two goals.

The first goal, the increase of the labour force participation, was meant to be achieved by: 1) Changing the retirement age for the old age pension scheme; 2) Increasing the pension accrual rate in the older ages; 3) Increasing the actuarial adjustment for early withdrawal; 4) Removing the cap on the replacement rate; and 5) Restricting the access to early retirement options.

Prior the reform, the full retirement age for the old age pension scheme was 65, and the minimum early withdrawal age with actuarially reduced benefits was 60. The 2005 pension reform changed both of these. For the full retirement age, the reform introduced a flexible retirement window. Benefits can now be taken up in full at the age of 63, but if one continues to work, benefits accrue until the age of 68. So the old age pension scheme has a flexible retirement age

[1] With the notable exception of Heyma, 2004, who models all the major early retirement schemes.

between 63 and 68. For the early old age retirement, benefits can now be taken out early at the age of 62, that is, the early retirement age was increased by two years.

Pension accrual rates were changed to favour work at older ages. Prior the reform, pensions accrued at the rate of 1.5 per cent per year until the age 60, after which the accrual was 2.5 per cent until the age of 65. After the reform, benefits accrue with the same 1.5 per cent per year until the age of 53, and after this the accrual rate is 1.9 per cent. During the retirement window of 63 to 68, there is a significantly higher accrual rate – 4.5 per cent per year.

If the old age pension benefits are withdrawn early or late, the yearly benefits are adjusted down or up. The adjustment rate for early withdrawal prior the reform was 0.4 per cent per month. After the reform, the adjustment rate is higher – 0.6 per cent per month. Early withdrawal is therefore more heavily penalized after the reform. The late withdrawal has, in contrast, a smaller adjustment percentage after the reform. Before the reform, the late withdrawal adjustment was 0.6 per cent per delayed month and after the reform, 0.4 per cent.

The Finnish employment pension system covers virtually all earnings – also the very high salaries. Yet before the reform there was a relative cap on the pension benefits. Benefits could not exceed sixty per cent of the highest wage used in the individual's total benefit calculation. If the benefits exceeded this percentage cap, they were adjusted down. In the reform, even the relative cap was removed, and the benefits are never adjusted down.

Finally, curtailing early retirement options plays a very important part in the attempt to raise labour force participation. In the reform, two early retirement schemes were abolished: unemployment pension and disability pension with less stringent health criteria. Yet even if the unemployment pension was abolished, the long-term aged unemployed maintain a right to extended unemployment benefits.

While curtailing the early retirement options, also the unemployment benefit legislation was changed. Because the true labour market withdrawal of the older unemployed happens before the unemployment pension, also the age when continued earnings-related unemployment benefits can be obtained was increased. Prior the 2005 reform, the earliest age for this was age 55, whereas post-reform it is 57.

The second aim of the reform was to increase equity in the earnings-related pension scheme. The biggest change here was the decision to base the benefits on the life-time earnings. Prior the reform, the pension rights were calculated for each employment contract separately, indexed, and added up at retirement. In the calculation, an accrual percentage, months in the specific job and last wages in that job were all multiplied together. The wage that was used was an average wage of the past ten years in the job. After the reform, the pension rights are, instead, calculated yearly, indexed, and then added up at retirement. Henceforth, after the reform, each year's wage matters in determining the size of the final pension benefit, whereas, previously, only the final wages in each job counted.

In the labour force and equity considerations, we will also consider a reform component that mainly aimed to increase the sustainability of the pension system. Namely, the reform introduced a life expectancy coefficient that tries to maintain the capital value of the benefits constant even when the life expectancy is rising. Yearly pension benefits will be cut by a share that corresponds to the expected increase in years when the benefits are received. To do this, the life expectancy of each cohort is compared to the life expectancy of a reference cohort at the age of 62. It is expected that in the long-run the life expectancy coefficient will cut the pension benefits by more than ten per cent. (Lassila and Valkonen, 2005)

3 The dynamic programming model

In this section, we describe our dynamic programming model. Because of the complexity of all of the various transfer systems involved we do not describe the model in full detail, but rather aim to explain the main elements of the individual optimization problem.

Each period individuals decide whether to work or not. Those who decide to work receive wages, and those who decide not to work receive unemployment benefits. Individuals who are age-eligible also make a retirement decision. The decision to retire is irreversible: once the individual has retired, she cannot return to work. We do not model savings decisions: consumption is constrained to equal net income in each period. This is of course a major simplification which we are forced in order to capture the rules of the pension system in detail. Savings in private pension schemes are still almost negligible in Finland.

When making her labour supply decision, each individual compares her net wage to an alternative compensation – to the unemployment benefit, and, if she is age-eligible, also to the pension benefit. Of course, individuals don't only consider the current values of their benefits but they

also take into account intertemporal linkages between their current decisions and future benefits. One such linkage is the effect of the labour supply decision on the future pension benefits. Another important linkage is the dependence of the unemployment benefits on the length of the unemployment spell.

Individual's wage level is stochastic and follows an AR(1) process with age terms. This process is:

$$\log(w_j) = a_0 + a_1 \log w_{j\text{-}1} + a_2 j + a_3 j^2 + a_4 j^3 + a_5 j^4 + \varepsilon_j, \quad (1)$$

where w_j is the annual wage level at age *j* and ε_j has a normal distribution with mean zero and variance δ_ε^2. We also scale down the wage offers after unemploymnent, as unemployment spells are expected to reduce wages (Kyyra, 1999).

Parameters for the wage process were estimated from individual-level data on earnings from 1962 to 1999. This panel data was collected for pension policy planning, and it contains a sample of individuals with all of their employment dates and yearly earnings. The coefficients of the regression were estimated as if the data were a cross-section with a full set of yearly dummies. Also all zero wages were excluded. The estimated coefficient on the lagged wage was 0.835. After one year in unemployment we multiplied the wage offer by 0.85, and after two years in unemployment by a further 0.95.

We incorporated three of the biggest pension schemes to the model.[2] First we modelled the old age pension scheme. As described in the previous chapter, pre-reform this scheme was available from the age 60 onwards.

The second scheme is the unemployment route out of the labour force. Prior the reform, this route opened up at the age of 55. The unemployment route is financially quite attractive. However, in the real life, an individual can only take it in accordance with her employer who has to pay part of the costs related to the unemployment route. We simply assume that each period, individuals face a 10 per cent probability of being able to take the unemployment route. We chose this probability so as to roughly match the share of individuals taking it. Following the

[2] The only major scheme that we left out is the part-time pension scheme. In recent years, the part-time pension scheme has been about 10 per cent of some age groups.

actual pension rules, individuals also have to have been employed in the previous period. The choice between the old-age pension and the unemployment route is still effectively endogenous because only a fraction of the individuals that could follow the unemployment route choose to do so.

In addition to the old-age and unemployment pensions, we also model the disability pension scheme. Entry to the disability pension scheme is exogeneous, however. Individuals have an age-dependent probability to become disabled. When an individual is hit with disability, she is forced to retire. Disability benefits depend on the former career the same way as the other pension benefits do.

Prior the reform, we need to keep track on the following *state variables* in order to model the relation between labour supply decisions and various benefits: 1) pension benefits earned from previous employment contracts, 2) a proxy for the average wage level of the last 10 years in the current job, 3) number of periods spent in the current job, and 4) number of past unemployment periods. In order to model the unemployment insurance, we also needed to keep track on 5) whether the individual has been unemployed zero, 1, or at least two periods in a row. Finally, we obviously need to know 6) the current wage level. We denote the vector of all state variables in age *j* by x_j.

When the individual becomes unemployed, her pension benefits earned from the previous job is computed and added to the pension benefits from all previous employment contracts. When the individual retires, her benefit is determined according to a formula which takes into account the pension rights from unemployment spells as well. Unemployment spells increase benefits proportionally to pension benefits that are from employment contracts.

The post-reform pension system is substantially simpler to model. In particular, it is no longer necessary to keep track on the number of periods spent in the current job or the number of unemployment periods. This is because each period's wages and unemployment benefits contribute similarly to the pension benefit.

We assume the following commonly used periodic utility function:

$$u(c,l) = \log(c) + \kappa I(l),$$

where *c* denotes consumption, $l \in \{0,1\}$ the time spent working, $I(l)$ is an index function that equals to one if $l = 1$ and zero if $l = 0$, and $\kappa < 0$ is the utility cost of working.

Individual's optimization problem can be written recursively in the following rather general form:

$$
\begin{aligned}
& V^{w}{}_{j}(x_j) = \max\{\max_{l_j \in \{0,1\}}[u(c_j, l_j) + \beta E V^{w}{}_{j}(x_{j+1})], V_j^{r}(x_j)\} \\
& s.t. \\
& c_j = w_j l_j + UI(x_j, l_j) - T(w_j l_j + UI(x_j, l_j)) \\
& x_{j+1} = S(x_j, l_j, \varepsilon_{j+1})
\end{aligned}
\tag{2}
$$

$V^{w}{}_{j}(x_j)$ is the *value function* of an individual that has not yet retired. It gives the expected remaining life-time utility from age *j* onwards given the current state variables. The individual first decides whether she retires or not (assuming that she is eligible to retire). This decision is the first max-operator.[3] The remaining lifetime utility following from retirement is denoted by $V_j^{r}(x_j)$. The value of non-retirement in this period is the sum of this period's utility and discounted expected value from next period onwards. Parameter β is the subjective discount factor.

The first of the constraints above sets consumption equal to net income each period. Net income equals wages income unemployment benefits (UI) less income taxes T. The tax function follows close the actual progressive income taxation. The second constraint is *the law of motion* for the state variables. Function *S* determines how the next period's state variables depend on the current state variables, current decisions and the next period's wage shock.

The post-reform pension system is substantially simpler to model. In particular, it is no longer necessary to keep track on the number of periods spent in the current job or the number of unemployment periods. Hence, the number of the state variables post-reform is reduced from 6 to 4.

[3] If the individual is hit with disability, r is forced to one.

Parameters for the wage process were estimated from a data on earnings from 1962 to 1999. This panel data was collected for pension policy planning, and it contains a sample of individuals with all of their employment dates and yearly earnings. The coefficients of the regression were estimated as if the data were a cross-section with a full set of yearly dummies. Also all zero wages were excluded. The estimated coefficient on the lagged wage was 0.835. After one year in unemployment we multiplied the wage offer by 0.85, and after two years in unemployment by a further 0.95.

We choose the discount factor, β, and the disutility of work, κ, so as to obtain a reasonable match on the age-wise average labour market statuses in real data. Experimenting with different values, we found that a relatively low discount factor of $\beta = 0.90$ works best.

Figures 1 and 2 show this matching of the model to the data from the Employment Statistics of Statistics Finland.

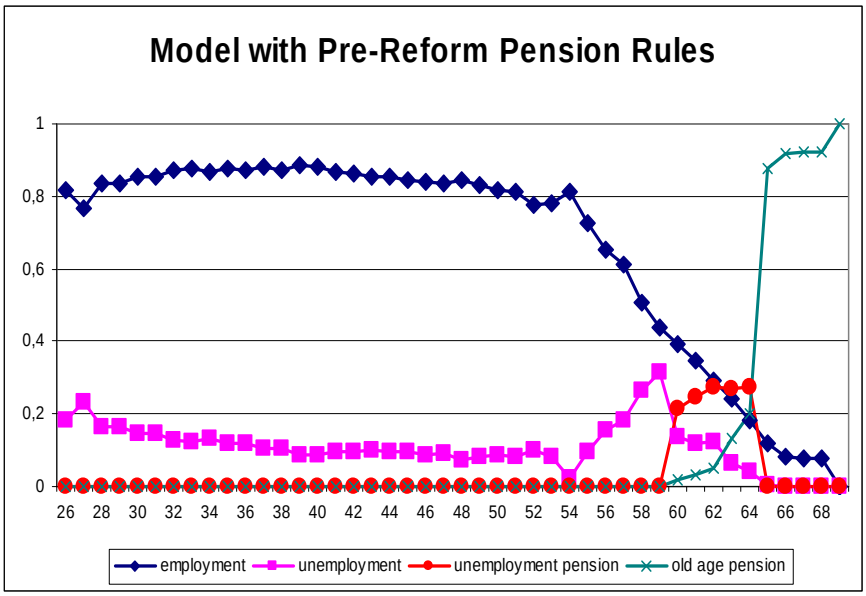

Figure 1: Labour Market States in the Model prior the Reform

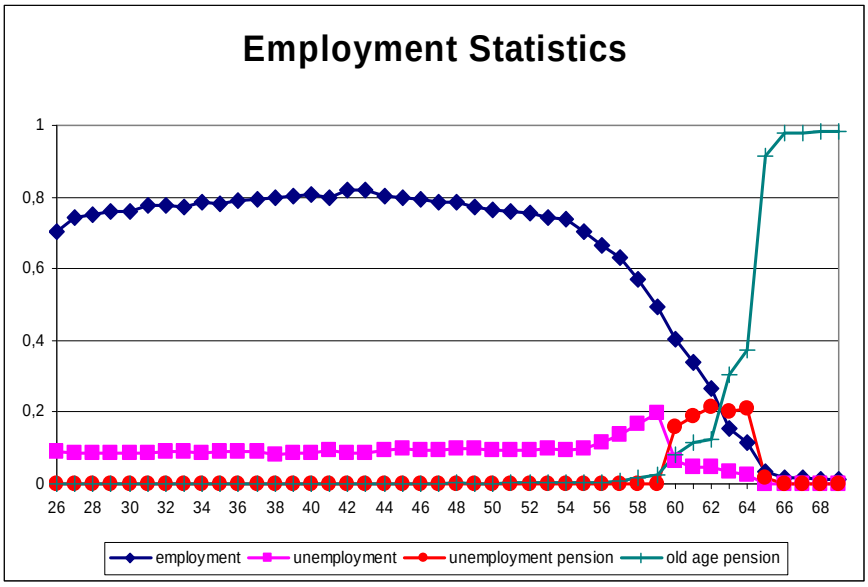

Figure 2: Labour Market States in the Employment Statistics in 2002

Employment rate starts to fall around the mid-50s, at the time when the unemployment rate starts to rise. Old-age pensions start to increase a bit later, after the age 60. Disability share is not shown in the figures as these functions match by definition.

After solving the model for 2,000 individuals and matching the above average shares, we used the calibrated preference parameters and the post-reform pension rules to simulate the behaviour of further 2,000 individuals. The following results are obtained by maintaining the same realizations of the wage process under both pension rules.

4 Results

In this chapter, we first show how the reform affected the withdrawals from the labour market. Thereafter, we focus on the distributional aspects of the pension reform.

4.1 Labour market withdrawal

First we look at the age distribution of the labour market withdrawals. Withdrawal ages from the model prior and post reform are presented in Figure 3.

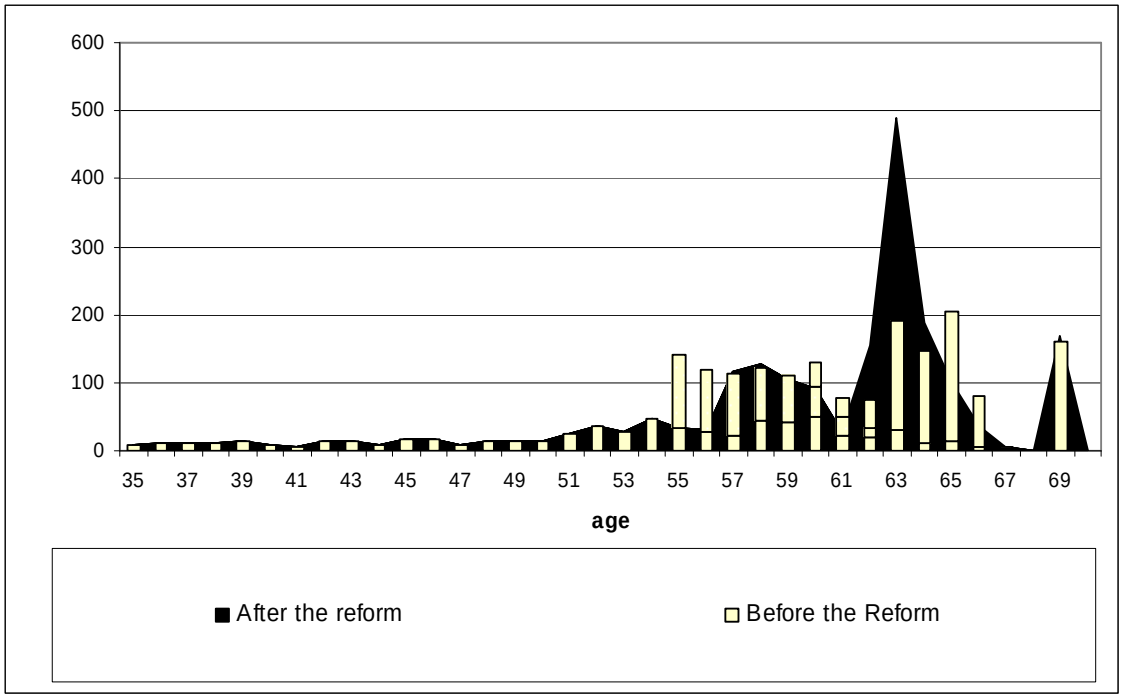

Figure 3: Labour Market Withdrawal prior and post Reform

The reform makes the withdrawal age distribution more concentrated. After the reform there is a high peak at the age of 63 (first full old-age pension age). The number of the retirees at this age is over double the number of retirements at any single age before the reform. The average withdrawal age for the whole distribution increases from 59.1 to 59.8 years. So the changes in the unemployment and the old age retirement rules delay the average labour market withdrawal by 8.5 months.

These changes can be further analyzed if we break the distribution down by the withdrawal type. This is in Figure 4 where we show the same distribution by disability, unemployment and old-age pensions.

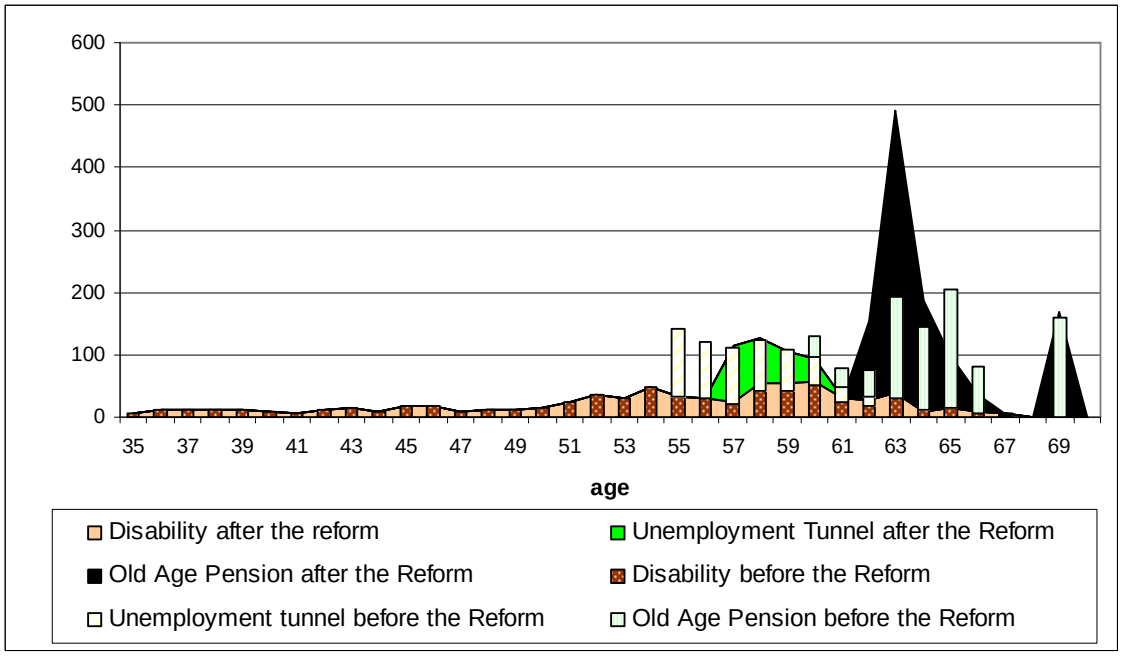

Figure 4: Labour Market Withdrawals by Withdrawal Type

The unemployment withdrawals increase at the minimum age for the unemployment labour market withdrawals. Before the reform this was 55 years, whereas after the reform it is 57 years. These unemployment withdrawals are restricted per year, so the total number of unemployment retirees is reduced by the fact that there are two fewer years to retire through this channel. Similarly the reform increased the minimum age for the early old age pension – from 60 to 62 years of age. This shows up as an increase in the ages when people take up the early old age pension. Prior the reform, most early old age pensions were withdrawn close to the official retirement age. After the reform, first early old age pensions are withdrawn at the post-reform minimum age – age 62. The early old age pension is, however, not very popular as many people seem to find it worthwhile to postpone their retirement until the lower bound of the old age retirement window - the age of 63.

In order to summarize the changes in the labour market behaviour we also looked at the labour market states for each individual each year pre- and post-reform. Hence, in Table 1, we cross-tabulate the individual's labour market states each year before the reform and after the reform. The total number of individual-years we observe is 88 000 (2 000 individuals for 44 years).

Table 1: Labour Market States prior and after the Reform

	labour	**market**	**state with**	**New rules**	
labour market state with old rules	*employed*	*unemployed*	*disabled*	*retired with old age*	*total*
employed	58 521	1 386	0	560	60 467
unemployed	2 013	6 964	55	419	9 451

	labour	**market**	**state with**	**New rules**	
labour market state with old rules	*employed*	*unemployed*	*disabled*	*retired with old age*	*total*
unemployment pension	530	487	122	1 176	2 315
disabled	0	3	6 364	1 250	7 617
retired with old age	290	52	4	7 804	8 150
total	61 354	8 892	6 545	11 209	88 000

Out of the 88,000 person-year labour market states, 58,521 were employment years under both pension regimes (pre- and post-reform). Similarly, 6,964 were unemployment years, 6,364 disability years, and 7,804 old age retirement years under both regimes. All in all, more than 90 per cent of the labour market state observations remained the same despite the change in the pension rules.

So there is a change in about 10 per cent of all labour market states. The greatest change is in the old age retirement years. These increase by almost 40 per cent. Yet a large share of this is technical.[4] Total employment years increase a little, but unemployment and disability years fall somewhat.

The largest number of changes is from unemployment to employment (2,013 observations). This is mainly caused by shortening the unemployment pathway. Removing the right to use the unemployment pathway from one cohort for two years leaves 4,000 labour market states to be replaced for. About a half of this goes into an increased employment and the rest shows up in unemployment without a right to the final withdrawal. Similarly, abolishing the unemployment pension increases the years in old age retirement but also in employment and unemployment. The latter two increases are almost equal by size.

A significant number of the previous employment periods are also turned into unemployment. Agewise this happens more often at the age of 54 which before the reform was an age just before when the unemployment withdrawal channel opens up. With the old rules it was worthwhile staying at work even with a lower salary because this gave the individual an opportunity to withdraw through unemployment with generous benefits a year after. With the new rules this not the same age anymore.

4.2 Benefit Distribution

[4] Disability pensions and unemployment benefits are converted to old age pension benefits earlier than before and this shows up in the unemployment pension to old age and disability to old age cells.

The pension reform changed the accrual rules and curtailed early retirement options. As we saw above, individuals will therefore alter their retirement behaviour. Because benefit calculation was changed and behaviour is expected to change the pension benefit distribution is also likely change after the reform. We will next focus on these distributional changes.

In Figure 5, we present the pension benefit distributions as they are in our model. The figure does not include disability pension benefits that are so far not fully modelled.

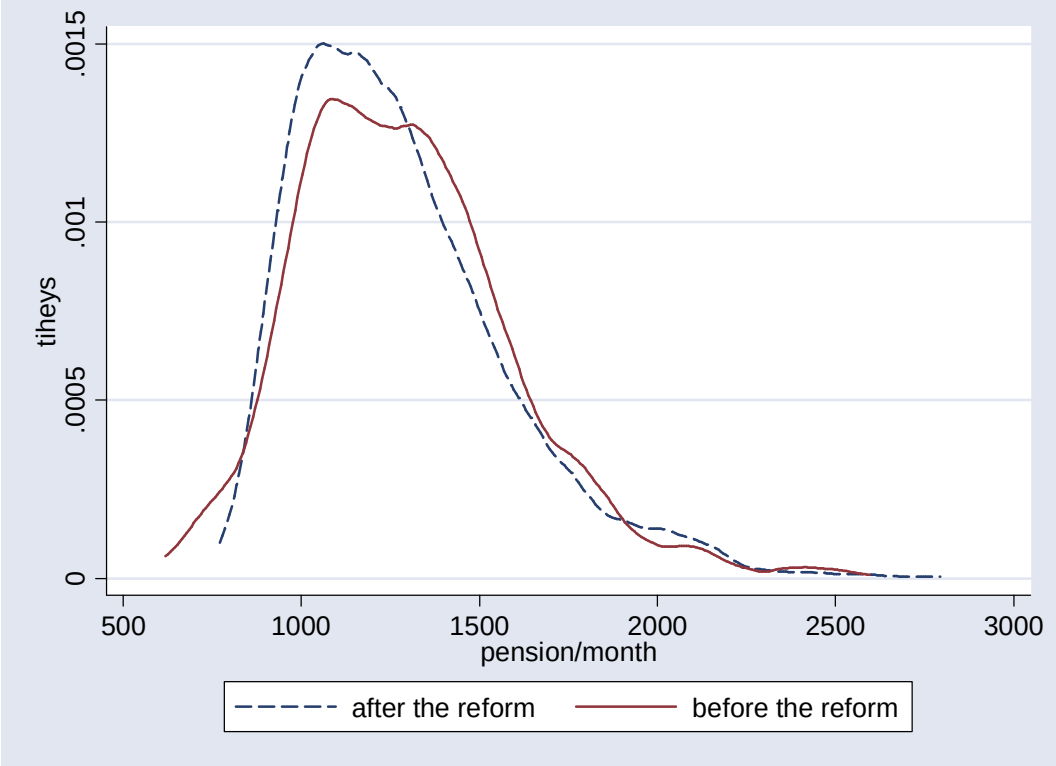

Figure 5: Benefit Distribution before and after the Reform

The distributions of the pre- and post-reform pension benefits look fairly similar. The mean of the monthly pension benefits is virtually the same – it is reduced only by 8 euros a month. The variance of the distribution shrinks by 3 per cent. The lowest benefit increases by 25 per cent and the lowest post-reform benefit is higher than 2 per cent of the pre-reform benefits. So the reform seems to increase equity slightly by shifting the left tail of the distribution rightwards.

Next we compare the benefit levels for the same individual before and after the reform. This is done in Figure 6. Dots that are on the 45 degree line are equal under the both rules, and dots that are below the line gain in the reform, and dots that are above lose.

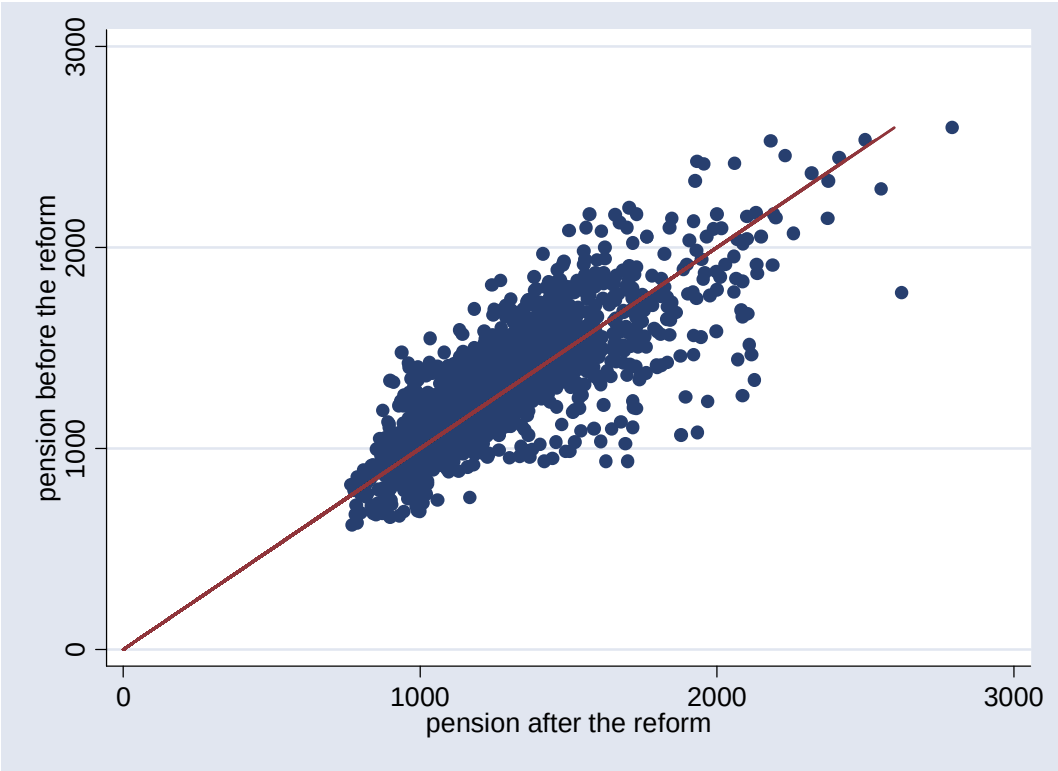

Figure 6: Benefits before and after the Reform

None of the individuals in our model have equal benefits under the both regimes. 702 individuals lose in the reform and 617 individuals gain.[5] So in many cases individuals with exactly the same exogenous shocks receive very different benefits under the two systems. The gain in the lower benefits shows up as a high concentration of dots below the line at low benefit levels. There are not a lot of observations with more than 2,000 euro pensions, but majority of them seem to lose from the reform. The greatest number of "losers", however, is in the middle of the pension distribution. Out of those whose pensions are between 1,000 and 2,000 euros a month, more people lose than gain from the reform.

As it is to be expected, those who gain from the reform have higher life-cycle wages than those who lose. So the system with the life-cycle wages raises the benefit levels for some people. Those who gain from the life-cycle principle also change jobs more frequently so they gain from the fact that job changes are no more penalized under the new rules. Moreover, the retirement (or withdrawal) age is higher for those who gain in the reform, so they are the ones who gain more from high accruals at the end of the career. They actually alter their retirement age more to take advantage of the new rules. (Those who gain increase their average withdrawal age

[5] We removed all individuals that were hit by disability in either of the regimes. Hence, the number of individuals is less than the total of 2,000 in our model.

by 1.6 years whereas those who lose in the reform increase the average withdrawal age merely by 0.3 years.)

Finally, we look how the pre-reform final wage principle affected the benefit levels. In Table 2 we regress the yearly benefits pre- and post-reform on the same lifetime wages and report the R squared for the regression.

Table 2: Share of pension variation explained by life-cycle wages

Dependent variable	**R2 of the regression with constant and life-cycle wages**
Pre-reform benefits	0.433
Post-reform benefits	0.501

In both systems, individuals with the same lifetime wages can receive very different benefits depending on their work decisions and life cycle wage profiles. However, conditional on the wage level the variance of the benefits is smaller under the new rules. For example, the variance of the pension benefits of 100 individuals in the middle of our lifetime wage distribution was 20 per cent lower under the new regime than under the old system. In a sense, the pension reform increased equity by removing the subsidy to those with a long tenure.

5 Conclusion

Population ageing has forced most industrialized countries to re-evaluate their public PAYG pension systems. Pension reforms that curb benefits have been either undertaken or at least discussed. Politically it is easier to market a reform where retirement age is increased rather than where benefits are directly cut. The problem with the reform that attempts to increase the retirement age is that it is not clear whether the individuals react and/or how much they will react to the reform. Moreover, a cut in benefits (despite it being marketed as an increase in the retirement age) and the resulting changes in behaviour may also affect the distribution of the final pension benefits. These are naturally of interest to the policy maker.

In this paper we used a dynamic programming model to evaluate a pension reform that was undertaken in Finland in 2005. The reform abolished a few early retirement options, increased the minimum retirement age in some schemes, and changed the incentive structure to favour

work at older ages. Equity considerations were mostly affected by calculating the pension benefits from the lifetime wages rather than final wages of each job. The reforms that were undertaken are policy reforms that have been under consideration also in many other countries.

With the simulations in the dynamic programming model we find that the Finnish pension reform increased the age of the labour market withdrawal by about 8.5 months. Most of this increase was due to the increases in the minimum ages of the early retirement options. Labour market withdrawal through unemployment and early old age pension was delayed by raising the minimum age of these schemes.

Benefit distribution changed surprisingly little. Average benefits are virtually the same after the reform even if the smallest benefits increase. Therefore the reform seems to have succeeded in raising the retirement age without adverse effects on the benefit distribution. The reform also removed the subsidy that was given for those who had long careers.

All in all, we conclude that the Finnish pension reform is likely to succeed in the two aims that were set to it: it looks to have increased the employment rates of the older workers and it increased equity within the pension system. Whether these changes are enough to contain the still high and increasing contributions will be a subject of another discussion.

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