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Disability pension motivated income adjustment

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MEMORANDUM

No 17/2008

Disability Pension Motivated Income Adjustment

The seal of the University of Oslo is a circular emblem. It features a central figure of a woman in classical attire, holding a lyre. The text 'UNIVERSITAS OSLOENSIS' is inscribed around the top inner edge of the circle, and 'MDCCCXXXIII' is at the bottom. The seal is rendered in a light gray tone.

Dag S. Holen

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No 15/08	Karine Nyborg <i>I don't Want to Hear About it: Rational Ignorance among Duty-Oriented Consumers</i>
No 14/08	Fedor Iskhakov <i>Pension reform in Norway: evidence from a structural dynamic model</i>
No 13/08	Eileen Fumagalli and Tore Nilssen <i>Waiting to Merge</i>
No 12/08	Pedro P. Barros, Steffen Hoernig and Tore Nilssen <i>Keeping both eyes wide open: The life of a competitive authority among sectoral regulators</i>
No 11/08	Kari Furu, Dag Morten Dalen, Marilena Locatelli and Steinar Strøm <i>Generic substitution</i>
No 10/08	Reyer Gerlagh, Snorre Kverndokk and Knut Einar Rosendahl <i>Linking Environmental and Innovation Policy</i>
No 9/08	Steinar Strøm and Jon Vislie <i>A Discrete-Choice Model Approach to Optimal Congestion Charge</i>
No 8/08	M. I. Di Tomasso, Steinar Strøm and Erik Magnus Sæther <i>Nurses wanted. Is the job too harsh or is the wage too low?</i>
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Disability Pension Motivated Income Adjustment*

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28.03.2007

Abstract

One element of the Norwegian disability pension system makes the extent to which pension responds to changes in income in the last three years before disablement vary over different income profiles. This special feature is explored in order to identify an individual specific pension incentive for income adjustment. If disability is foreseen, this feature implies that there is a motive for increasing income in the years before disablement and through this increase pensions. Analysis on register data for all persons receiving disability pension 1992-2001 shows that the possibility to affect pensions increases income, indicating that disability to some extent is foreseen and that individuals strategically adjust their income in order to increase their pensions.

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1 Introduction

Persons receiving disability pensions in Norway add up to more than 10 per cent of the population between 18 and 67 years. The share of the population in working age that receives pensions is a potential strain on the welfare state, and may be crucial for its viability. In order to understand the roots of the large number of people receiving disability pensions, there is a need to examine the disability pension program. In particular, it is important to examine whether the design of the system contributes to the large number of disability pensioners.

The main focus of this paper is the rules of the public pension system and what kind of incentives the system creates for individual behavior in the period before disablement. Disability pension depends on past labor income. Increasing one's labor supply thus can increase the pension level. This makes labor supply not only a source for generating income while working, but also generating pension rights and thus generating income while retired. In light of a probable retirement, this mechanism can dominate other means of financing consumption while retired, since pension is granted every period while savings have to be spread out across the remaining years of life.

Persons with uncertain health may want to work less in order to avoid becoming permanently disabled. Working less, and thus earning less, may reduce the pension level if he nevertheless should become disabled. This paper shows that a feature of the Norwegian disability pension system makes pension respond more to changes in income for some income profiles than others. Further, income before disablement is shown to fall for persons where this does not reduce the pension level and increase for persons where pension depends strongly on the income level before disablement.

If disablement is seen as a probable outcome in the near future, the pension one will receive if one actually becomes disabled is a natural worry, as the economic consequences of disablement may be dramatic. A person facing possible disablement has two major concerns: to try to avoid disablement, and to try to avoid a low pension if he nevertheless becomes disabled. These two concerns may very well be in conflict with each other. Taking care of one's health may mean to work less. However, working less may reduce pension. The design of the Norwegian disability pension system is such that working less do not reduce pension for all individuals. Pension responds differently to changes in income for

different persons depending on their income profile, and so, the cost of reducing labor effort varies between individuals.

Holen (2007b) analyzes the incentive effects between different pension systems. Assuming that pension is determined by last period income only, I find that being covered by a more generous pension system creates stronger work incentives and leads to higher income before disablement. In contrast to Holen (2007b), this paper abstracts from other income sources while disabled than the public pension system, but models the complicated rules of the public pension system which creates a pension response to last period income that varies across different income profiles.

This paper focuses on the behavior before the time of disablement, given the transition into the disability pension system, and not on the transition in itself. The paper is related to the literature of endogenous disability retirement, but only indirectly.¹ While the pension level usually is given at the retirement decision in this literature, it is the outcome of the model in my paper. This may influence the interpretation of the results in the endogenous retirement literature. On the other hand, the insights from this literature, which focuses on the effects of the pension level on retirement decisions, may shed light of the results of this paper. If the pension level increases the probability of a person ending up on disability pension, my results may follow from selection mechanisms in retirement behavior. Persons who act upon the incentives formulated in this paper receive a higher pension than otherwise and this may affect the probability of becoming disabled.

I present a model of pension motivated labor supply that includes the response of public disability pension of income before disablement to the factors that affect labor market decisions. I present how the optimal allocation for a person who knows that he will become disabled in the near future depends on how the income in the following years will affect his disability pension.

I study register data on disability pensioners in Norway 1992-2001, with individual income history back to 1967. In order to compare income of the disabled to income paths without the presence of pension motivated income adjustment, I construct a control group out of the population who has not been registered as recipients of disability pension.

¹See Diamond and Mirrlees (1978) and Golosov and Tsyvinski (2006) for some theoretical studies, Gruber (2000) for a Canadian study and Bratberg (1999) for a Norwegian study.

Each individual in the control group is randomly assigned with a contra factual time of disablement, which from the randomization and the fact that these individuals are not disabled, should not capture the pension incentives I model here. Since income is strongly related to age, I construct the control group in such a way that the age distribution as well as the total number of individuals in the control group is the same in the disabled group for each year of disablement. I find that, compared to the control group, income falls in the years before disablement. However, this income reduction is negatively correlated with the extent to which the pension responds to changes in income: income falls in the years before disablement, but less so for persons who have the most to lose from a decreasing income. My results indicate that the incentives created by the pension system are acted upon, thereby increasing the pension level.

The rest of this paper is organized as follows: Section 2 presents a simple model identifying the incentives for pension motivated income adjustment; Section 3 describes the procedure for obtaining values for the response in pensions to changes in income; Section 4 describes the data; Section 5 presents the empirical strategy with some extensions; Section 6 presents the results; Section 7 presents some sensitivity analysis; Section 8 concludes.

2 A model of pension motivated labor supply

The model in this section is a standard lifecycle model of consumption and labor. There is a positive probability of becoming disabled. If so, one will receive a disability pension each period. I assume that individuals have a lifetime utility function

$$V = \sum_{t=1}^N \sum_j P_t(j) \beta^{t-1} U(I_t^j, L_t^j) \quad , \quad (1)$$

where I denotes income and L is labor, which both depend on labor force status, $j \in \{A, R\}$, at time t , where A is active in the labor force and R is retired, either from disablement or from old age. The maximum periods of active working life is 51, representing the years from turning 17 until turning 67.² The first period of retirement is denoted $T \in \{1, \dots, 52\}$. If the person becomes disabled, $T < 52$, and T is called the time of disablement. If the person retires from old age, $T = 52$. The number of periods receiving

²I abstract from early retirement

pensions is $N - T + 1$, where N is the number of periods, which is assumed fixed with $N > 52$. $P_t(j)$ denotes the probability of being in state j at time t . Everyone is retired after age 67, implying that $P_t(R) = 1$ for $t > 51$. Retirement is assumed to be an absorbing state, hence $P_t(R) = 1$ if $j = R$ at $t - 1$.

I want to keep things simple and in the following I assume a separable utility function of the form

$$U(I_t^j, L_t^j) = \ln I_t^j - \lambda L_t^j \quad ,$$

where $\lambda > 0$. Making the utility linear in labor allows me to highlight the effects of the pension system. For simplicity, I also abstract from sources of income other than labor income and pensions.

Income is described as

$$\begin{aligned} I_t^A &= w_t L_t^A \\ I_t^R &= f(\mathbf{H}_T) \quad , \end{aligned}$$

where $w_t L_t^A$ is labor income, $\mathbf{H}_T = \{I_1^A, \dots, I_{T-1}^A\}$ is the income history up until the time of retirement and $f(\cdot)$ is the pension function. This function is described in brief in the next section and in more detail in the appendix. It follows from the fact that only income before retirement affect the pension level and the assumption that retirement is absorbing that income is constant after retirement, $I_t^R = I_T^R$ for all $t \geq T$.

Labor is assumed to be freely chosen by the individual. After retirement, no labor is supplied, $L_t^R = 0$.

Maximizing utility with respect to labor at time t , given $j = A$, gives us the following first order condition

$$\frac{\partial U}{\partial L_t^A} + w_t \frac{\partial U}{\partial I_t^A} + \sum_{s=t+1}^N P_s(R) \beta^{s-t} \frac{\partial U}{\partial I_s^R} \frac{\partial I_s^R}{\partial I_t^A} w_t = 0.$$

The first two terms are the normal intratemporal trade off between leisure and income. The last term is the expected marginal utility of the response in pensions from labor at time t . For any $s > t + 1$, \mathbf{H}_s contains future income. The response in pensions can thus generally not be found without solving all first order conditions simultaneously.³

³If, for example, the time of retirement is known for sure to be more than 20 periods ahead and the income path is strictly increasing, there is no response in pensions, since present income in this case is not included in the 20 best years, relevant for the pension level (see appendix for details).

Inserting for the utility function and rearranging, the first order condition can be expressed as

$$L_t^A = \frac{1}{\lambda} \left(1 + \sum_{s=t+1}^N P_s(R) \beta^{s-t} \varepsilon_t^s \right) , \quad (2)$$

where

$$\varepsilon_t^s = \frac{\partial I_s^R I_t^A}{\partial I_t^A I_s^R} \quad (3)$$

is the elasticity of pensions with respect to income at time t , given that the individual retires at time s .

If the pension level does not respond to changes in income, i.e. $\varepsilon_t^s = 0$, labor supply is only a function of λ . This follows from the specific form of the utility function, where the income effect cancels the substitution effect. In this model the only motive for varying labor supply is thus the pension incentive. Taking (2) for t and $t' < T$, with $t < t'$, and inserting for income we get

$$\frac{I_{t'}^A}{I_t^A} = \frac{w_{t'}}{w_t} \left[\frac{1 + \sum_{s=t'+1}^N P_s(R) \beta^{s-t'} \varepsilon_{t'}^s}{1 + \sum_{s=t+1}^N P_s(R) \beta^{s-t} \varepsilon_t^s} \right] \quad (4)$$

Define (4) as the equation for income adjustment. Income adjustment has two potential sources. First, wages may be different, affecting income directly. Second, there may be pension motivated income adjustment, following from a difference in the elasticities of pensions with respect to income. If pensions respond more to income at time t' than at time t , there are incentives for having higher income at time t' . The intuition is simple: work harder in periods where increased income means that future pension will increase.

The model has two crucial assumptions relevant for this prediction. First, the model assumes that labor is freely chosen by the individual, which one may argue is no realistic assumption. However, assuming that there is some possibility of adjusting labor, e.g. by reducing one's position from full to part time or vice versa, at least partly justifies this assumption. Second, the model abstracts from all other motives for adjusting labor. In particular, one can argue that age is an important factor to labor supply decisions. In order to analyze the effect of the pension incentives on the income adjustment, one needs to compare the income paths to paths without the presence of the pension incentives.

The elasticity of pension with respect to income is the interesting variable in this

model. The value of this variable is not straightforward to obtain though. The pension function in the Norwegian pension system is a complicated function of income history, with all income years having a potential effect. Even the age profile of income matters for the pension level. The procedure for obtaining values for the elasticity of pension with respect to income is described in the next section.

3 The response in pensions

Consider the following example shown in Figure 1. Person B has been working since the age of 17, earning an income shown by the thin solid line. At age 45 he becomes disabled. In calculating his pension level, he is compensated for his loss of future earnings by being awarded pension rights from future income from the time of disablement until the age of 67, based on his income the last three years. The pension rights of future income are shown by the thin dotted line. Of his 51 years of earning income, past and future, his pension is based on the best 20. Person A has been working since the age of 17 as well, earning an income shown by the thick solid line. She also becomes disabled at the age of 45, but since her income the last three years are lower than most of her past income, pension rights from future income are based on an average of the best half of her past income years. Pension rights of future income are shown by the thick dotted line. Her pension level is then based on the best 20 years of past and future income years. We see that the last three years of income do not affect the pension level of person A at all, but is the only income that matters for person B. This example illustrates how the last years of active working life influences the pension level to different extents, depending on the income history.

The Norwegian disability pension program is explained in some detail in Appendix A. The mechanism of interest for this paper is a feature that causes income in the last three years to have a potentially large effect on pension incentives relative to income in earlier years. This feature has a larger effect for some income histories than for others, creating an individual specific incentive for pension motivated income adjustment. Thus, for some income histories, the incentives for pension motivated income adjustment between the fourth last year and the last three years may be strong. For a given change in the income

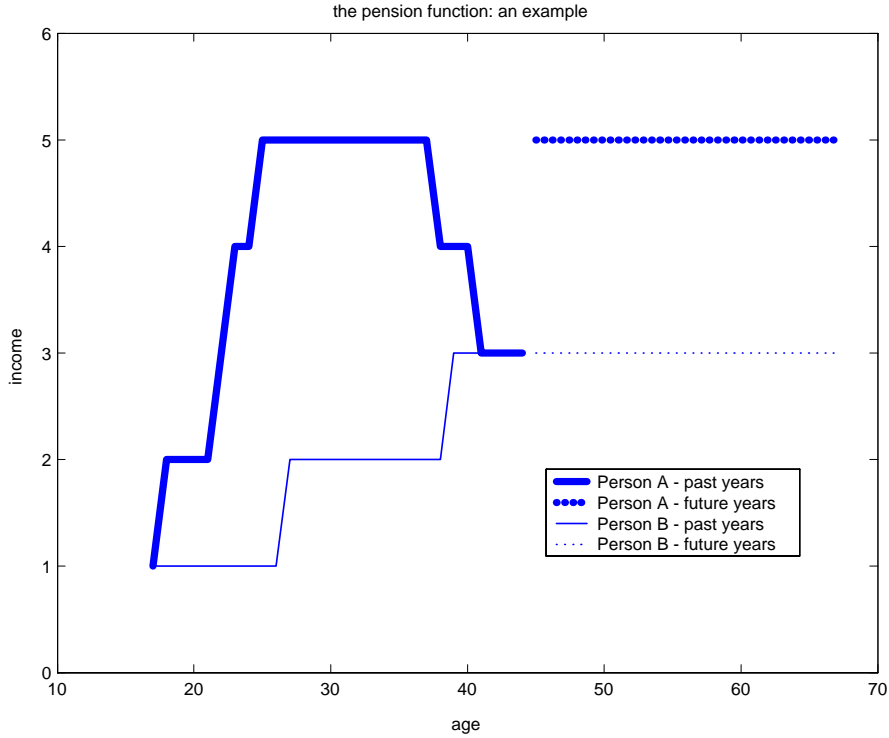


Figure 1: An example of the public disability pension function

level, the response in the pension level varies from no response to nearly one third of the change in income, depending on the income history. Two persons at the same age, earning the same initial income and changing the income in the same manner, will have their pension level respond to the changes in income to a different extent, on account of having different income history. However, the difference in the response is not independent of the magnitude of the income variation. Given a particular income history, the pension level may not respond at all to a ten percent increase in income, but respond substantially to a 50 percent increase in income.

The pension function is complicated and only piecewise differentiable. There is need for some simplifications in order to get values for the elasticity of pensions with respect to income at time t , ε_t^T , defined in equation (3). The procedure for approximating these values is described in Appendix B. In short, I assume that disability is perfectly foreseen by the individual, i.e. that $P_t(R) = 0$, for $t < T$ and that $P_T(R) = 1$. Given the time of disablement and the income history up to five years before disablement, I then calculate what disability pensions would be if income in the remaining four years was stable at the

income level at $T - 5$. The elasticity of pensions with respect to income in the remaining four years is then approximated by calculating how the pension level is affected by income variations around this level.

Let $\hat{\varepsilon}_{T-4}^T$ and $\hat{\varepsilon}_{T-3}^T$ be the approximated values for the elasticity of pension with respect to income at time $T - 4$ and $T - 3$, respectively. Further, let

$$\Pi_{T-t', T-t} \equiv \ln \left(1 + \hat{\varepsilon}_{T-t'}^T \beta^{T-t'} \phi_T \right) - \ln \left(1 + \hat{\varepsilon}_{T-t}^T \beta^{T-t} \phi_T \right) \quad , \quad (5)$$

by the be the pension incentive for income adjustment, where $\phi_T \equiv \sum_{s=0}^{N-T} \beta^s$ is the value of receiving a pension of 1 for all $N - T + 1$ periods of retirement seen from time T . Equation (4) can the be expressed as

$$DI_{T-3, T-4} = \ln \left(\frac{w_{T-3}}{w_{T-4}} \right) + \Pi_{T-3, T-4} \quad , \quad (6)$$

where

$$DI_{T-t', T-t} \equiv \ln I_{T-t'}^A - \ln I_{T-t}^A. \quad (7)$$

For a given wage growth, income growth should be higher at time t' , the higher the increase in elasticity of pensions to income from time t to time t' . For income histories where $\hat{\varepsilon}_t^T = \hat{\varepsilon}_{t'}^T = 0$, growth in income should equal growth in wages.

What makes pensions more sensitive to variation in income at $T - 3$ than at $T - 4$ ($\hat{\varepsilon}_{T-3}^T - \hat{\varepsilon}_{T-4}^T > 0$) is the fact that future income is based on the three last years for certain income histories. We thus have $\hat{\varepsilon}_{T-3}^T = \hat{\varepsilon}_{T-2}^T = \hat{\varepsilon}_{T-1}^T$.⁴ Any $\Pi_{T-3, T-4} \neq 0$ will then correspond to a $\Pi_{T-j, T-4} \neq 0$, for $j = 1, 2$ as well. As a consequence the variable $\Pi_{T-3, T-4}$ captures the pension incentive for income adjustment between income in $T - j$ and $T - 4$ also for $j = 1, 2$.

In order to obtain numerical values for the approximation of the elasticities, I assumed that disablement was perfectly foreseen. Uncertainty about disablement and the timing of this event, reduces the incentive for disability pension motivated income adjustment. My specification of the pension incentive variable can thus be interpreted as an upper limit.

⁴As long as the condition for being awarded future pension points is not affected. See the appendix for details.

4 Data

The analysis is based on data from Statistic Norway’s database FD-Trygd. The database covers the entire Norwegian population and is based on information provided from several administrative registers. This analysis will mainly use the information on social security obtained from the National Insurance Administration. FD-Trygd also provides information on demographics, education, employment, income and wealth. The data set runs from 1992, and a particular feature of the data set that one may trace each individual’s movements in and out of different welfare states.

4.1 Disabled group

There was a reform in Norway’s pension system in 1992. In order to avoid the effects of this reform, I restrict the sample to persons with a time of disablement after 1991. In addition, I only include persons with an age at the time of disablement from 18 to 67 and persons who have not re-entered the disability pension system, causing them to have more than one value for the time of disablement. The remaining sample consists of 177,405 individuals receiving disability pension at least one month during 1992-2001. When constructing the pension incentive variable, I need at least five years of economic active life. In this set-up economic active life starts at 17 and so the minimum age in the sample is 22.

I use income back to $T - 7$ as control variables in the analysis, increasing the minimum age in the sample to 24. Excluding individuals with missing observations in other control variables further reduces the sample, to a remaining 127,964 individuals.⁵

All disabled individuals are registered with International Classification of Diseases (ICD) codes. Disability pension entries prior to December 1998 are coded with ICD9. Entries in December 1998 and thereafter are coded with ICD10. This variable has been used among others by Rege et al (2005) and Bratberg (1999) as explanatory variables for

⁵As pointed out in Holen (2007b), public disability pension is only one part of disability pension. About 50 percent of Norwegian population is covered by an occupational pension system as well. This might very well alter the economic incentives regarding retirement behavior, but exact information about individual coverage of additional pension plans are not accessible. I have preformed some preliminary estimation only including disability pensioners, and the results are qualitatively the same.

the probability of becoming a disability pensioner. Information on diagnosis is not used in this paper. One assumption of the model is that disablement is foreseen. Clearly, in some cases this assumption is not realistic: some cases of disablement are unpredictable and sudden. It would be interesting to check whether there are significant differences between cases where disablement is possible to foresee and where it is not. However, the distinction between the two from the ICD-variable is not clear and I do not use information about diagnosis at all.

4.2 Control group

I want to estimate the effects of the pension incentive variable on the income path. In addition, I want to control for the possibility that my specification of the pension incentive variable does not capture any effects of the income process that are unrelated to the pension incentives. An individual with large variations in income over the working life, will typically have variations in the value of the pension incentive variable for different periods. Further, the pension system makes the pension level respond more to income variation at peaks in the income process than in dips and this may cause a negative correlation between pension incentives and income growth that is unrelated to pension incentives.

In order to compare the income path to a case without pension incentives and control for any pension unrelated correlation between the pension incentive variable and income growth, I construct a control group of non-disabled individuals. The control group is randomly selected from the part of the population who has not been registered as recipients of disability pension in the period 1992-2001. They are each assigned a hypothetical time of disablement in this period in such a way that the number of hypothetical and actual disabled persons are the same and that the age distribution in each group is the same for every year. There is no reason for this time of disablement was foreseen, since it is assigned randomly and the individuals in this group in fact never became disabled during the period. Any income adjustment in this group can thus not follow from the fact that disablement is foreseen and adjusted to. From their assigned times of disablement, disability pension is calculated and the variable for the pension incentive for income adjustment is constructed. The total number in the group with hypothetical time of disablement is

176,403. Excluding the persons with missing observations in control variables reduces the number to 127,850 individuals.

Alternatively, the control group could be constructed by matching more than age. Income and gender are two natural extensions to the matching criteria. Another possible variable to match is the pension incentive variable. This could be done by assigning every non-disabled individual with a time of disablement for each of the ten years in the period 1992-2001. Given these times of disablement, I could construct the five hypothetical income paths and then construct the pension incentive variable for each of the ten years. I would then have several million individuals with one value for the pension incentive variable for ten different years. It could then be possible to construct a control group that matched the disabled group in age, gender, income and the pension incentive variable. Given the data available, other variables, like education and country background could be included in the match criteria as well. I have chosen to match age only for each year of disablement and instead add other possible match criteria as control variables. The descriptive statistics of the different parts of the sample are described in Appendix C.

5 Empirical specification

The question of interest here is whether the pension incentive leads to more income adjustment as predicted by the model in equation (6). There are three major problems in estimating (6). First, I have no data on wage growth. In order to estimate (6), the $\ln(w_{T-j}/w_{T-4})$ -term has to be handled by the controls. However, the incentive effect is close to zero for two years either within or outside the last three years:

$$\ln I_{t'}^A - \ln I_t^A \approx \ln w_{t'} - \ln w_t \quad ,$$

for $t, t' \in \{T-1, T-2, T-3\}$ or $\in \{T-4, T-5, \dots, 1\}$. Lagged income can thus be used as controls for lagged wage growth.

Second, the pension incentive variable, $\Pi_{T-3, T-4}$, may capture some dynamics other than the pension motivated income adjustment. According to my model, $\Pi_{T-3, T-4}$ should have no explanatory power for income growth for the control group, but we need to control for the possibility of it capturing some non-observed variables affecting income growth.

The question is whether there is an additional effect of the pension incentive variable for individuals in the disabled group.

Third, the only motives for income adjustment included in the model are the wage incentive and the pension incentive. There may be a variety of different motives for the income adjustment observed in the data. In particular, there may be health reasons for decreasing labor supply and thereby income. However, as long as this effect is not correlated with the pension incentive variable, this should not affect the results too much.

Equation (6) is estimated with a regression of the form

$$DI_{T-3,T-4}^i = \alpha_0 + \alpha_1 D_i + \alpha_2 \Pi_{T-3,T-4}^i + \alpha_3 D_i * \Pi_{T-3,T-4}^i + \alpha_4 \text{CONTROLS}_i + \epsilon_i \quad , \quad (8)$$

where ϵ_i is assumed to be iid and $\sim N(0, \sigma^2)$, $DI_{T-3,T-4}^i$ is income adjustment from time $T-4$ to time $T-3$ for individual i , D_i is a dummy for *actually* becoming disabled in the period 1992-2001, $\Pi_{T-3,T-4}^i$ is the pension incentive for income adjustment from $T-4$ to $T-3$ and CONTROLS_i is a vector of control variables including lagged income, age, year of disablement, sex, marital status, country background and education. Interactions between age, income, income growth and education, in various forms, are controlled for as well. Lagged income is included in levels, logs and squared for possible non-linear relationships.

α_1 different from zero implies that being in the disabled group has an effect on the income growth. If, for example, there are negative health effects on one's productivity that eventually leads to disablement, α_1 should be negative.

Remember that the individuals in the control group ($D_i = 0$) never have been registered as recipients of disability pensions and have been assigned with a hypothetical, randomly given time of disablement, T . It is the time of disablement that creates the driving force behind the pension incentive for income adjustment. The pension incentive variable is for this reason not a relevant variable for the control group. α_2 should thus be zero according to my model. α_2 different from zero implies that the pension incentive variable captures some income dynamics that are not handled by the controls. As mentioned in section 4.2, persons with large variations in income over time, may cause a negative correlation between the pension incentive variable and income adjustment, since the pension level responds more to changes in income at an income peak than in a dip.

If income is volatile for parts of the control group, we should expect α_2 to be zero.

The coefficient of interest is α_3 , which measures the effect the pension incentive for income adjustment. A positive α_3 implies that for the part of the sample who actually becomes disabled at time T , there is more income adjustment the higher the pension incentives for such adjustment, relative to the general effect for the whole sample. If there is no pension motivated income adjustment, α_3 should not be positive. According to my model, α_3 should equal unity. This follows from the assumption that disability is perfectly foreseen. Uncertainty about the time of disablement and whether one actually will become disabled should yield an α_3 less than one.

The model is estimated with income adjustment between $T-4$ and all three later years ($DI_{T-4,T-3}$, $DI_{T-4,T-2}$ and $DI_{T-4,T-1}$, respectively) as the dependent variable (Models 1a, 1b and 1c respectively).

6 Results

The regression results for Models 1a-1c, with the respective dependent variable being income adjustment from $T-4$ to $T-3$, $T-2$ and $T-1$, are reported in Table 1. The coefficient for the dummy variable, α_1 , is significantly negative for all three specifications. The fact that the individual actually becomes disabled has a negative effect on growth of income. The effect gets stronger when looking at adjustment closer in time to the time of disablement. Disablement reduces income growth with 1.9 percentage points looking at adjustment between the fourth and the third to last year before the time of disablement, with 2.6 percentage points between the fourth and the second to last year before the time of disablement and with 3.3 percentage points between the fourth to last and the last year before the time of disablement. This indicates that individuals ending up receiving disability pensions have an income path that is increasing less than the rest of the population. Reasons for this may be health related, but is also consistent with a hypothesis that disablement is more likely for individuals who have a lower option value of staying in the active work force, as argued by among others Bratberg (1999), who finds a significantly negative effect of expected wages on the probability that an individual on long term sick leave transfers to the disability pension program.

Table 1: Regression results, key variables, Models 1a-1c

Dependent variable	$DI_{T-3,T-4}^*$	$DI_{T-2,T-4}^*$	$DI_{T-1,T-4}^*$
	Model 1a	Model 1b	Model 1c
Variable	Coefficient (Std.err.)	Coefficient (Std.err.)	Coefficient (Std.err.)
Disability			
D	-0.019	-0.026	-0.033
α_1	(0.002)	(0.002)	(0.002)
Pension Incentive (general)			
$\Pi_{T-3,T-4}^{**}$	-0.112	-0.161	-0.188
α_2	(0.003)	(0.004)	(0.004)
Pension Incentive (disable)			
$D * \Pi_{T-3,T-4}$	0.074	0.104	0.114
α_3	(0.003)	(0.004)	(0.004)
N	255,814	253,569	251,322
Adj. R ²	0.182	0.208	0.225

Note: * $DI_{T-j,T-4}$ is income adjustment from $T - 4$ to $T - j$ as defined in equation (7).

** $\Pi_{T-3,T-4}$ is the pension incentive as defined in equation (5), with $N = 64$ and $\beta = .96$.

The pension incentive variable has a negative effect on income adjustment for the whole sample and this effect gets stronger as the time of disablement gets nearer. As mentioned in the discussion in Sections 4.2 and 5, the pension incentive variable may capture some other income dynamics than the pension predicted by the model. The

results show that this is the case. Increased sensitivity of pensions with respect to income as measured by the pension incentive variable negatively affects the income adjustment. High volatility of past income combined with the fact that the pension level responds more to changes at an income peak than in a dip, would explain such a negative correlation. This result highlights the importance of including a control group in order to control for any non-modeled effects of the pension incentive variable on the income dynamics.

The coefficient of interest is α_3 , measuring the effect of the pension incentive variable on the individuals who actually ends up receiving disability pensions, net of the general effect of this variable on the whole sample. This coefficient is significantly positive and increasing as the time of disablement is closer to the year included in the dependent variable.

A positive α_3 implies that incentives for pension motivated income adjustment increases income for individuals who end up receiving disability pensions. There are signs of pension motivated income adjustment. Further, that this adjustment leads to higher income than without the presence of these incentives, and that disability pensions are higher because of this. The fact that the effects gets stronger as the time of disablement gets closer, could be that disablement is easier to foresee closer in time, that more individuals finds disablement as a probable outcome or that disablement gets more probable when this state is closer in time. According to my model, the coefficient of the pension incentive variable should be unity. The results show that the coefficient is well below one, but still significantly greater than zero. Remember that in order to derive numerical values for the response in pensions, I assumed that disablement was perfectly foreseen. An α_3 below one thus indicates that there is some uncertainty about when and whether individuals become disabled, but that this uncertainty is reduced as disablement approaches. Even with the coefficient well below one, the results are still substantive. The average pension incentive implied an income increase of 44 percent for the disabled group. With a coefficient of 0.07 as in Model 1a, this means that the average effect of pension incentives is an income increase of 3 percent. The respective number for model 1c is 4.8 percent. The effect on the pension level can be found by multiplying with the average elasticity, yielding an increase in disability pension of 0.22 percent for Model 1a and 0.36 percent for Model 1c. These numbers may seem small, but remember that the pension is paid out

every year for the rest of one's life. Further, these numbers are given that the increase is transitory, i.e. the increase in income only holds for one of the last three years. If the income stays at the higher level for all three years, the effect on pension would be up to three times larger.

As noted earlier, the model does not explicitly model the transition into the disability pension system. The time of disablement is taken as given. Disablement could in this model either be purely exogenous but not unexpected, or be (at least partly) chosen by the individual some years prior to the time of disablement and that income is adjusted given the choice of T .

The literature on endogenous retirement has a somewhat different focus: that there are some elements of choice with regards to entrance into the disability pension system and that this choice is taken given the income history. Although this paper does not explicitly model the choice of the time of retirement, a model where retirement is optimally chosen with elements of planning ahead, would exhibit similar effects of the pension incentive variable. An alternative model with permanent and transitory shocks to wages and endogenous entrance into disablement could possibly explain the data as well. Consider an individual who has disability pension as an option. A transitory positive shock to income does not affect expected future income. If the elasticity of pensions (and through this the pension incentive variable) is high, the trade off between disability pensions and the value of staying in the work force is affected. The pension incentive variable is thus relevant for the effects of income shocks for the endogenous retirement decision.

Testing the robustness of the results, a variety of alternative specifications of the model and sample selections are estimated as well, as described in the following section.

7 Sensitivity analysis

In the benchmark estimation of (6) all other parameters than the coefficient for the pension incentive variable and the intercept are assumed to be common for the disabled group and the control group. Likewise, sex is only assumed to have an effect on the intercept. In order to check whether these assumptions are driving the results, equation (6) is estimated for men and women separately (Models 2a-2b) and the disabled group and the control

group separately (Models 3a-3b).

In the benchmark case, age is controlled for by including one-year dummy variables, as well as controlling for the interaction of age, education and income (both in levels and growth). However, the effect of the pension incentive variable is assumed to be independent of age. Testing whether the results are sensitive to this assumption, the regression is estimated for nine different age groups separately (Models 4a-4i).

In the benchmark case, the maximum age was set to 80, making $N = 64$. Following this assumption, every individual receives old age pensions, which equals the disability pensions for individuals who are receiving disability pensions when reaching retirement age, for 13 years. In order to check whether this assumption drives the results, N is set to 51 (Model 5a). This specification of the model thus disregards periods after the age of retirement, and thereby old age pensions. Remember that the value of receiving a pension of 1 for every period the individual is retired is measured by $\phi_T = \sum_{s=0}^{N-T} \beta^s$. With $N = 51$, this variable measures the value of receiving a pension of 1 for every period until the age of retirement. This reduces the pension incentive for income adjustment with a stronger effect the closer the time of disablement is to the time of retirement.

The discount factor, β , is of importance when considering incentives for adjusting present income to affect future pensions. In the benchmark case β was set to .96. Decreasing β weakens the incentive for income adjustment. The importance of the value of β is checked by estimating the model using $\beta = .8$ (Model 5b). Both Model 5a and Model 5b can be seen as capturing the effect of uncertain lifetime, decreasing the discounted value of future utility.

The elasticities of pensions with respect to income had to be numerically approximated using a simple two-sided approximation method of the derivative of the pension function and varying the income in the relevant year with half a point each way. This approximation only captures the sensitivity of pensions for small variations in income. The relationship between the sensitivity of pensions and variations of income is not necessarily strictly increasing. Some individuals may have no sensitivity of pensions at low variations of income, but high sensitivity of pensions for high variations. For this reason an alternative approximation of the elasticities is performed. The procedure is exactly the same as in

the benchmark case.⁶ The only difference is that income is varied by 2 G on not 0.5 G.

Let $\tilde{\varepsilon}_{T-4}^T$ and $\tilde{\varepsilon}_{T-3}^T$ by the resulting elasticities of pension with respect to income at time $T - 4$ and $T - 3$, respectively and let

$$\tilde{\Pi}_{T-t',T-t} \equiv \ln \left(1 + \tilde{\varepsilon}_{T-t'}^T \beta^{T-t'} \phi_T \right) - \ln \left(1 + \tilde{\varepsilon}_{T-t}^T \beta^{T-t} \phi_T \right), \quad (9)$$

by the new specification of the pension incentive variable. The model is estimated with this alternative specification of the pension incentive variable, with the benchmark values for N and β (Model 6a), setting $\beta = .8$ and $N = 64$ (Model 6b) and setting $\beta = .96$ and $N = 51$ (Model 6c).

Qualitatively, the effects still holds for all model specifications where the three coefficients are common for all ages. Table 2 present the regression results for men and women separately (Models 2a-2b), Table 3 presents the regression results for the disabled group and the control group separately (Models 3a-3b) and Tables 11 and 12 in the appendix present the regression results for various specifications of the pension incentive variable.

Looking at the adjustment between the fourth to last and third to last year before disablement, the coefficient for the disablement dummy ranges from -.03 (Model 6a) to -.015 (Model 2b). The coefficient for the general effect of the pension incentive ranges from -.376 (Model 5a) to -.075 (Model 6a). The net effect of the pension incentive on the disabled group ranges from .012 (Model 5b) to .247 (Model 5a).

Turning to Models 3a-3b, the importance of including the control group becomes apparent. The pension incentive variable is a complicated function of the income history. Future income may be a function of the income history as well. The pension incentive variable can thus contain information about future income that does not follow from any retirement decision. In order to estimate the effect of pension incentives on income adjustment, the pension incentive variable should be emptied of all information other than the pension incentives. One way of doing this is to include a group with no pension incentives. In Models 3a-3b, the estimation is performed for the two groups separately, and the pension incentive has a significantly negative coefficient for both groups. If the control group was not included in the estimation, one could be led to believe that there was no pension motivated income adjustment. By including the control group and then

⁶Described in detail in Appendix B

Table 2: Regression results, key variables, Models 2a-2b

Dependent variable	$DI_{T-3,T-4}^*$		
		Model 2a	Model 2b
		Men	Women
Variable		Coefficient (Std.err.)	Coefficient (Std.err.)
Disability			
D		-0.018	-0.015
α_1		(0.002)	(0.003)
Pension Incentive (general)			
$\Pi_{T-3,T-4}^{**}$		-0.078	-0.135
α_2		(0.005)	(0.006)
Pension Incentive (disable)			
$D * \Pi_{T-3,T-4}$		0.053	0.086
α_3		(0.005)	(0.005)
N		135,196	120,618
Adj. R ²		0.221	0.162

Note: * $DI_{T-j,T-4}$ is income adjustment from $T - 4$ to $T - j$ as defined in equation (7).

** $\Pi_{T-3,T-4}$ is the pension incentive as defined in equation (5), with $N = 64$ and $\beta = .96$.

looking at the effect of pension incentive for the disabled group, net of the general effect, leads to the opposite conclusion.

The age at the time of disablement is important for the number of years future income is awarded, thereby affecting the elasticity of pensions with respect to income. Further, the number of years receiving pensions has importance for the value of the elasticities of

Table 3: Regression results, key variables, Models 3a-3b

Dependent variable	$DI_{T-3,T-4}^*$	
	Model 3a	Model 3b
	Disability group	Control group
Variable	Coefficient (Std.err.)	Coefficient (Std.err.)
Pension Incentive (general)		
$\Pi_{T-3,T-4}^{**}$	-0.11	-0.029
α_2	(0.004)	(0.004)
N	127,850	127,964
Adj. R ²	0.191	0.179

Note: * $DI_{T-j,T-4}$ is income adjustment from $T - 4$ to $T - j$ as defined in equation (7).

** $\Pi_{T-3,T-4}$ is the pension incentive as defined in equation (5), with $N = 64$ and $\beta = .96$.

pensions. The role of pension incentives may thus not be common for all ages. Whether the age composition is driving the average effect of pension incentives is examined by estimating the model for nine age groups separately (Models 4a-4i), where age is defined as the age in the first year of receiving disability pensions. The sample is split in five year age groups (four years for the youngest group) with one year dummies on age. The results for these regressions are presented in Tables 8, 9 and 10 in Appendix D.

The effect are qualitative more or less the same as above. The sign of the coefficients are the same, except for the coefficient for the disablement dummy variable which is positive for the two youngest and the oldest group. For the control group in the oldest five years, early (not disablement) retirement may affect the estimates. Early retirement has become increasingly important in Norway for the period since 1992, with a increasing share of individuals above 62 retiring for non disablement reasons and a declining share

receiving disability pensions.

The pension incentive variable has a general negative effect in all age groups. The effect is by far strongest in the youngest group (-.629) and roughly around -.01 in all other groups. For the disabled group, there is a positive effect net of the general effect for all age groups. There is a declining, non-monotonic trend over age, with the youngest (.444) and the oldest (.034) at each extreme. For the age groups below 48 years the estimate is above .1 and for age groups above 48 years it below .1.

8 Conclusion

In order to understand why more than ten percent of the Norwegian working population is receiving disability pensions, one has to examine the incentives created by the disability pension system. Previous research has focused on the role of the pension level relative to future income in an endogenous retirement framework. Higher generosity in the disability pension system may increase the probability of ending up as a disability pensioner.

Persons who are likely to become disabled in the near future may want to adjust their income path in order to avoid getting a too low disability pension. A feature of the Norwegian disability pension system makes pension respond more to changes in income for some persons than others. This paper focuses on the variations in the response of disability pension to income in the last years before disablement. I use this variation in order to estimate whether having a pension that is sensitive to changes in income affects the income path of persons soon to be disabled.

The results show that there is pension motivated income adjustment. Pension incentives can explain income growth in the last years before disablement, i.e. individuals with strong pension incentives on average have higher income growth. Compared to a control group of not disabled persons, income falls in the years before disablement, but less so for persons where this will affect the pension level. The results need not necessarily be driven by individuals adjusting income in order to avoid a low pension. An alternative explanation of the results concerns a selection mechanism: persons with income paths that are consistent with pension incentives are over-represented among disability pensioners. Such a selection mechanism may stem from two different facts. First, sharply increasing labor

effort to a higher level for a short period of time, may negatively affect health, increasing the probability of becoming disabled. Second, the pension level may affect the probability of successful rehabilitation. If income in the last years before disablement is inconsistent with acting upon the pension incentives, the pension level is lower than otherwise which reduces the financial incentives of being transferred from rehabilitation to disability pension. Whether the results stem from a selection mechanism or from income adjustment motivated by the effects on the pension level is a question for further research. The main finding of this paper is that the results are consistent with my model of pension motivated income adjustment.

One interpretation is that disablement is planned and that the rules of the system are exploited in order to get the maximal disability pension. Another interpretation is that persons with uncertain health are concerned about their economic conditions if they should become disabled and increase their labor effort in order to avoid a low disability pension. A third interpretation is that the design of the disability pension system is good. If individuals the system design does not affect the income path, but that the income path is rather a result of other factors, a positive correlation between the pension incentive variable and income adjustment means that the system compensates individuals of loss of future earnings in such a way that persons with relatively few years with high income still can receive a decent disability pension.

In any case, it is a cause for concern that the response in the pension level to changes in income explains the income pattern in the years before disablement. Increasing pension by increasing the income before disablement affects the incentives for returning to active working life. Further, improving the economic situation if one should become permanently disabled may be a costly form of insurance, since this behavior possibly increases the probability of becoming disabled.

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Appendix A: The pension system in more detail

The rules of the Norwegian disability pension system are taken from Kjønstad, (2001).

The period of an individual's life that is relevant for the pension system are the years from turning 17 until turning 67, making the maximum periods of active working life 51. Let each year in this period, be denoted by $t \in \{1, 2, \dots, 51\}$. For each year in this period every individual is registered with a non-negative income I_t^A measured in pension points.

Income, I_t , is transformed into pension points by the following formula:

$$I_t^A = \begin{cases} 0 & \text{for } I_t \leq 1 \quad , \\ I_t - 1 & \text{for } 1 \leq I_t \leq 6 \quad , \\ 5 + \frac{1}{3}(I_t - 6) & \text{for } 6 \leq I_t \leq 12 \quad , \\ 7 & \text{for } I_t \geq 12. \end{cases} \quad (10)$$

Income is measured in G , the basic number in the public pension system and is set by the government. G is in principle adjusted each year for inflation and wage increase. In 2005 it is set to 60,699 NOK.

One gets pension points for all income above 1 G . Up to 6 G , an increase in income increases pension points one to one. Income in the interval of 6 G to 12 G , increases pension points by one third. After 12 G , one is not awarded any additional pension points, making the maximum number of pension points 7. Before 1992 the tilt point in the formula was 7 G and the maximum number of pension points was 8.33.

One can either retire from old age, after reaching the age of 67, or from becoming disabled before the age of 67. Let T denote the first period of retirement. If $T < 52$, the individual becomes disabled and T is called the time of disablement.

Let $\mathbf{H}_T = [I_1^A, \dots, I_{T-1}^A]$ be the income history from the age of 17 of an individual who retires in period T . Let $\bar{\mathbf{H}}_T$ be the half of the values in \mathbf{H}_T with the highest income and \bar{I}_T the average of this half. Let $\mathbf{H}_T^3 = \{I_{T-3}^A, I_{T-2}^A, I_{T-1}^A\}$ be the income in the last three years before the time of disablement and I_T^3 be the average of these three years. Future income, \hat{I}_T , is then given by

$$\hat{I}_T = \max \{ \bar{I}_T, I_T^3 \} .$$

Future pension points are awarded for every period left of the individual's working life $t \in \{T, T + 1, \dots, 51\}$. Future pension points are only awarded if

$$I_{T-1}^A > 0 \quad \text{or if} \quad \{I_{T-4}^A, I_{T-3}^A, I_{T-2}^A\} \neq \{0, 0, 0\} . \quad (11)$$

There are special rules for those who were 17 before 1967, when the public pension system was introduced and pension points first were registered. There are also special rules for those who are born disabled or become disabled before the age of 26 and for individuals who been awarded pension points for caring for family members. For simplicity, none of these aspects are taken into consideration in this paper.

Total income history, $\hat{\mathbf{H}}_T$, is defined as the pension points in every year, with regular pension point for $t \in \{1, 2, \dots, T - 1\}$ and future pension point for $t \in \{T, T + 1, \dots, 51\}$:

$$\hat{\mathbf{H}}_T = \left[I_1^A, \dots, I_{T-1}^A, \hat{I}_T, \hat{I}_T, \dots, \hat{I}_T \right]$$

Let \mathbf{H}_T^{20} be the 20 values of total income history, $\hat{\mathbf{H}}_T$, with the highest income and let F_T the average of these 20 years. F_T is called final pension points.

Let Y be the number of years in $\hat{\mathbf{H}}_T$ with strictly positive income and let $X = \min \{Y/40, 1\}$. Disability pensions, I_T^R , is then given by

$$\begin{aligned} I_T^R &= B + \max \{ F_T * 0.42 * X, M \} \\ &= B + S_p(F_T) \quad , \end{aligned} \quad (12)$$

where $S_p(F_T) = \max \{ F_T * 0.42 * X, M \}$.

B is the basic pension in the pension system. It is ordinarily 1G, but set to .75G if one is living with a person receiving pensions or earning an income above 2G. For simplicity, B is set to 1 for all individuals in this paper. $S_p(F_T)$ is called supplemental pension and is the part of the pension which varies with final pension points. M is the minimum supplemental pension factor. The standard minimum supplemental pension factor is 0.7933 in 2005. Depending on the characteristics of one's spouse (most importantly age and pension level) it can either be higher (1.5866) or lower (0.74). These cases are not

considered in this and the standard factor is used for all individuals. Both the basic pension and the minimum supplemental pension are increasing in the number of years living in Norway, up to 40 years (including future years). Persons that have immigrated to Norway as adults, typically receive a lower pension. The number of years living in Norway are not handled in this paper. All calculated pension are based on 40 years of living in Norway.

0.42 is the pension percentage. It was lowered from 0.45 in 1992.

For a given Y , the number of years in H_T relevant for the pension level varies from 3 to 20. If the three last years are the basis for future pension points and the number of future years is strictly greater than 16, none of the other years in H_T matter for the calculation of final pension points. In this case the only relevant question is whether the pension points in the rest of the years are strictly positive or not.

For most cases, the ordering of income in time does not matter for the pension level. If $t < T - 4$ it does not matter. If $t \geq T - 4$, whether $I_t^A > 0$ potentially affects the condition for being awarded future pension points (11). Further, if $t \geq T - 3$, future pension points may be based on I_t^A .

It follows from this set up that as long as the condition for being awarded future pension points is not affected, that for any income history with $I_t^A = I_{t'}^A$, and both years or either within or outside of the last three years, (formally, if $t, t' \in \{1, \dots, T - 4\}$,or $t, t' \in \{T - 3, T - 2, T - 1\}$), pensions respond in the same way to changes in I_t^A and $I_{t'}^A$.

Appendix B: Approximating the elasticities of pensions with respect to income

Let \mathbf{H}_T^{-4} be the individuals' income history four years before the time of disablement:

$$\mathbf{H}_T^{-4} = \{I_1^A, \dots, I_{T-5}^A\}$$

Then define the following hypothetical income histories up until the time of disablement

$$\begin{aligned} \mathbf{H}_T^1 &= \{\{\mathbf{H}_T^{-4}\}, I_{T-5}^A, I_{T-5}^A, I_{T-5}^A, I_{T-5}^A\} \\ \mathbf{H}_T^2 &= \{\{\mathbf{H}_T^{-4}\}, I_{T-5}^A + .5, I_{T-5}^A, I_{T-5}^A, I_{T-5}^A\} \\ \mathbf{H}_T^3 &= \{\{\mathbf{H}_T^{-4}\}, I_{T-5}^A - .5, I_{T-5}^A, I_{T-5}^A, I_{T-5}^A\} \\ \mathbf{H}_T^4 &= \{\{\mathbf{H}_T^{-4}\}, I_{T-5}^A, I_{T-5}^A + .5, I_{T-5}^A, I_{T-5}^A\} \\ \mathbf{H}_T^5 &= \{\{\mathbf{H}_T^{-4}\}, I_{T-5}^A, I_{T-5}^A - .5, I_{T-5}^A, I_{T-5}^A\} \end{aligned}$$

\mathbf{H}_T^1 is the reference path, assuming the same income in the last four years as at $T - 5$. \mathbf{H}_T^2 and \mathbf{H}_T^3 are used to approximate the elasticity of pensions with respect to income at $T - 4$. \mathbf{H}_T^4 and \mathbf{H}_T^5 are used to approximate the elasticity of pensions with respect to income at $T - 3$. I only look at a transitory change in income in order to isolate the effect on pensions of changes in income in one particular year. As explained above, the magnitude of the income variation is of importance for the degree to which pension responds to the variation. In the five income paths above, income is varied by half a basic point either way.⁷ The response is greater for a higher variation in income. In section 7, I approximate the elasticities using a larger variation in income. The reason for choosing a moderate variation level is that people might face constraints regarding the possibility to adjust the income level.

Feeding these hypothetical income histories into the pension function generates hypothetical pension levels, given by

$$I_T^{Ri} = f(\mathbf{H}_T^i), \quad \text{for } i = \{1, \dots, 5\}.$$

⁷Half a basic point is approximately 31,000 NOK or 5,000 USD in 2006.

As an approximation to the elasticity of pensions (defined in (3)) with respect to income at $T - 4$, I then define

$$\hat{\varepsilon}_{T-4}^T = (I_T^{R4} - I_T^{R5}) \frac{I_{T-5}^A}{I_T^{R1}} \quad . \quad (13)$$

Similarly, the elasticity of pension with respect to income at time $T - 3$ is approximated by

$$\hat{\varepsilon}_{T-3}^T = (I_T^{R2} - I_T^{R3}) \frac{I_{T-5}^A}{I_T^{R1}} \quad . \quad (14)$$

It follows from the pension rule and this set up, that varying income at $T - 2$ or $T - 1$ in the same way has identical effect on pensions, such that⁸

$$\hat{\varepsilon}_{T-3}^T = \hat{\varepsilon}_{T-2}^T = \hat{\varepsilon}_{T-1}^T \quad . \quad (15)$$

⁸As long as the condition for being awarded future pension points is not affected. See the appendix for details.

Appendix C: Descriptive statistics

Tables 4 and 5 show descriptive statistics for key variables for persons receiving disability pensions and the control group. In order to get numerical values for the pension incentive variable I need values for the discount factor and the total number of periods. I set $\beta = 0.96$ and the maximum age 80, making $N = 64$. Income is on average higher for the control group than for the disabled group, indicating that disablement is less frequent for high income groups. Average income is decreasing in time for both groups. A stylized fact of income paths is that income follows a hump shaped pattern over age (see Iskhatov (2005) for a recent example). A reason for the decreasing income may thus be the high average age, roughly 55 years and that a large part of the sample has passed the income peak. The fact that income is falling up to the (contra factual) time of disablement for the control group illustrates the importance of matching the age distribution of the disabled group.

As stated in the discussion of the pension function, pensions respond more to changes in income in the third to last year than the fourth to last year. The elasticities of the pension level with respect to income at time $T - 4$ and $T - 3$ are reported in Table 4 and Table 5. The difference between the two elasticities is highest for the disabled group, where the elasticity of pension at time $T - 3$ is 4.1 times higher than at time $T - 4$, compared to a factor of 2.9 for the control group. In the most extreme cases 23 percent of variations in income are passed through to the pension level. The presence of the basic pension that does not vary with past income is the reason for the maximum value being below 33 percent.

Table 4: Descriptive statistics for persons receiving disability pensions

Variable	Mean	Std. Dev	Median	Min.	Max.
Income					
I_{T-3}^A	3.727	1.558	3.810	0.010	8.328
I_{T-4}^A	3.766	1.585	3.810	0.010	8.328
I_{T-5}^A	3.787	1.631	3.810	0.010	8.328
Income adjustment					
$DI_{T-3,T-4}$	-0.014	0.383	-0.003	-6.551	6.328
Elasticities of pensions					
$\hat{\varepsilon}_{T-3}^T$	0.074	0.067	0.059	0	0.232
$\hat{\varepsilon}_{T-4}^T$	0.018	0.013	0.017	0	0.130
Pension incentive					
$\Pi_{T-3,T-4}$	0.441	0.470	0.297	0	1.434
Age of disability					
$T + 17$	54.100	8.504	56	24	67
Pension levels					
I_T^R	2.746	0.651	2.734	1.166	4.498
I_T^{R1}	2.717	0.713	2.717	0.314	4.498
$I_T^R - I_T^{R1}$	0.030	0.233	0.000	-1.754	3.258

Note: Share of men: .48 N: 127,964

The pension incentive of income adjustment variable, $\Pi_{T-3,T-4}$, is on average more than twice as high in the disabled group. According to my model the size of the pension incentive variable should equal the income increase, given constant wages. The pension incentive variable is the increase in the discounted value of consumption when retired, following the response in pensions from income three years before disablement relative to the response in pensions from income four years before disablement. The effect depends on the number of periods when retired, i.e. the age at the time of disablement and the discount factor, but mostly the special importance of income in the last three years before disablement. For constant wages the model predicts an income adjustment of on

Table 5: Descriptive statistics for control group

Variable	Mean	Std. Dev	Median	Min.	Max.
Income					
I_{T-3}^A	4.334	1.746	4.500	0.010	8.328
I_{T-4}^A	4.380	1.790	4.500	0.010	8.328
I_{T-5}^A	4.416	1.850	4.490	0.010	8.328
Income adjustment					
$DI_{T-3,T-4}$	-0.012	0.352	0.000	-6.548	6.592
Elasticities of pensions					
$\hat{\epsilon}_{T-3}^T$	0.038	0.055	0.014	0	0.232
$\hat{\epsilon}_{T-4}^T$	0.013	0.014	0.012	0	0.115
Pension incentive					
$\Pi_{T-3,T-4}$	0.201	0.358	0.008	0	1.437
Age of disability					
$T + 17$	52.964	8.817	54	24	67
Pension levels					
I_T^R	3.021	0.754	3.064	0.224	4.498
I_T^{R1}	3.050	0.769	3.097	0.314	4.498
$I_T^R - I_T^{R1}$	-0.029	0.228	-0.012	-3.243	3.434

Note: Share of men: .58 N: 127,850

average 44 percent for the disabled group and 20 percent for the control group. The most extreme case is a pension incentive predicting an income adjustment of 143 percent for both groups.

Not surprisingly given the income variables, the pension levels for both actual income histories and the hypothetical reference histories are higher in the control group. Interestingly though, the difference between the actual and the reference pension levels is on average positive in the disabled group, but negative in the control group. This indicates a stronger positive correlation between the income adjustment variable and the pension incentive variable in the disabled group than in the control group.

Table 6: Descriptive statistics for men, whole sample

Variable	Mean	Std. Dev	Median	Min.	Max.
Income					
I_{T-3}^A	4.748	1.548	4.939	0.010	8.328
I_{T-4}^A	4.830	1.576	4.960	0.010	8.328
I_{T-5}^A	4.904	1.621	4.980	0.010	8.328
Income adjustment					
$DI_{T-3,T-4}$	-0.022	0.368	-0.004	-6.551	6.592
Elasticities of pensions					
$\hat{\varepsilon}_{T-3}^T$	0.043	0.059	0.017	0	0.232
$\hat{\varepsilon}_{T-4}^T$	0.014	0.014	0.014	0	0.130
Pension incentive					
$\Pi_{T-3,T-4}$	0.231	0.390	0.009	0	1.433
Age of disability					
$T + 17$	53.738	8.735	56	24	67
Pension levels					
I_T^R	3.292	0.571	3.262	0.224	4.498
I_T^{R1}	3.308	0.596	3.294	0.314	4.498
$I_T^R - I_T^{R1}$	-0.017	0.197	-0.004	-3.243	3.434

Note: Share of disable: .46 N: 135,196

The control group was randomly selected from the general population with age as the only matching criterion. The share of men is ten percentage points higher in the control group. Descriptive statistics are therefore presented in Tables 6 and 7 for men and women separately.

Qualitatively, most of the differences between the disabled group and the control group apply for men and women as well. Note that income is higher for men. Income is decreasing over time for men but slightly increasing for women. There is a two percent negative income adjustment on average for men, but basically zero for women. The elasticity of pensions both at time $T - 3$ and $T - 4$ is higher for women. Women have on

Table 7: Descriptive statistics for women, whole sample

Variable	Mean	Std. Dev	Median	Min.	Max.
Income					
I_{T-3}^A	3.226	1.446	3.280	0.010	8.328
I_{T-4}^A	3.224	1.454	3.260	0.010	8.328
I_{T-5}^A	3.202	1.477	3.220	0.010	8.328
Income adjustment					
$DI_{T-3,T-4}$	-0.003	0.368	0.000	-5.989	5.460
Elasticities of pensions					
$\hat{\epsilon}_{T-3}^T$	0.071	0.066	0.054	0	0.232
$\hat{\epsilon}_{T-4}^T$	0.017	0.013	0.016	0	0.120
Pension incentive					
$\Pi_{T-3,T-4}$	0.423	0.459	0.265	0	1.437
Age of disability					
$T + 17$	53.301	8.613	55	24	67
Pension levels					
I_T^R	2.426	0.575	2.422	0.224	4.498
I_T^{R1}	2.407	0.631	2.409	0.314	4.498
$I_T^R - I_T^{R1}$	0.019	0.266	0.000	-2.784	3.394

Note: Share of disable: .55, N: 120,618

average almost twice as high a variable for pension incentive for income adjustment.

The actual pension level is on average lower than the reference path pension level for men, which the opposite applies for women, consistent with the fact that the pension incentive is stronger for females.

Appendix D: Tables

Table 8: Regression results, key variables, Models 4a-4c

Dependent variable	$DI_{T-3,T-4}^*$	Model 4a	Model 4b	Model 4c
		Age of disability 24-27	Age of disability 28-32	Age of disability 33-37
Variable		Coefficient (Std.err.)	Coefficient (Std.err.)	Coefficient (Std.err.)
Disability				
D		0.073	0.076	-0.032
α_1		(0.067)	(0.022)	(0.013)
Pension Incentive (general)				
$\Pi_{T-3,T-4}^{**}$		-0.629	-0.167	-0.133
α_2		(0.444)	(0.040)	(0.021)
Pension Incentive (disable)				
$D * \Pi_{T-3,T-4}$		0.444	0.102	0.124
α_3		(0.403)	(0.038)	(0.018)
N		9,626	4,693	9,781
Adj. R ²		0.324	0.241	0.249

Note: * $DI_{T-j,T-4}$ is income adjustment from $T - 4$ to $T - j$ as defined in equation (7).

** $\Pi_{T-3,T-4}$ is the pension incentive as defined in equation (5), with $N = 64$ and $\beta = .96$.

Table 9: Regression results, key variables, Models 4d-4f

Dependent variable	$DI_{T-3,T-4}^*$			
		Model 4c	Model 4d	Model 4f
		Age of disability	Age of disability	Age of disability
		38-42	43-47	48-52
Variable		Coefficient (Std.err.)	Coefficient (Std.err.)	Coefficient (Std.err.)
Disability				
D		-0.034	-0.059	-0.030
α_1		(0.009)	(0.006)	(0.005)
Pension Incentive (general)				
$\Pi_{T-3,T-4}^{**}$		-0.109	-0.115	-0.075
α_2		(0.015)	(0.011)	(0.008)
Pension Incentive (disable)				
$D * \Pi_{T-3,T-4}$		0.103	0.116	0.071
α_3		(0.012)	(0.009)	(0.007)
N		15,701	26,104	40,619
Adj. R ²		0.276	0.229	0.198

Note: * $DI_{T-j,T-4}$ is income adjustment from $T - 4$ to $T - j$ as defined in equation (7).

** $\Pi_{T-3,T-4}$ is the pension incentive as defined in equation (5), with $N = 64$ and $\beta = .96$.

Table 10: Regression results, key variables, Models 4g-4i

Dependent variable	$DI_{T-3,T-4}^*$			
		Model 4g	Model 4h	Model 4i
		Age of disability	Age of disability	Age of disability
		53-57	58-62	63-67
Variable		Coefficient (Std.err.)	Coefficient (Std.err.)	Coefficient (Std.err.)
Disability				
D		-0.033	-0.014	0.024
α_1		(0.004)	(0.003)	(0.005)
Pension Incentive (general)				
$\Pi_{T-3,T-4}^{**}$		-0.101	-0.103	-0.094
α_2		(0.008)	(0.010)	(0.030)
Pension Incentive (disable)				
$D * \Pi_{T-3,T-4}$		0.093	0.072	0.034
α_3		(0.007)	(0.008)	(0.025)
N		54,731	69,650	33,539
Adj. R ²		0.185	0.155	0.117

Note: * $DI_{T-j,T-4}$ is income adjustment from $T - 4$ to $T - j$ as defined in equation (7).

** $\Pi_{T-3,T-4}$ is the pension incentive as defined in equation (5), with $N = 64$ and $\beta = .96$.

Table 11: Regression results, key variables, Models 5a-5b

Dependent variable	$DI_{T-3,T-4}^*$	
	Model 5a	Model 5b
	$\beta = .8$	$N = 51$
Variable	Coefficient (Std.err.)	Coefficient (Std.err.)
Disability		
D	-0.018	-0.015
α_1	(0.002)	(0.002)
Pension Incentive (general)		
$\Pi_{T-3,T-4}^{**}$	-0.376	-0.133
α_2	(0.013)	(0.004)
Pension Incentive (disable)		
$D * \Pi_{T-3,T-4}$	0.247	0.012
α_3	(0.087)	(0.004)
N	255,814	255,814
Adj. R^2	0.182	0.182

Note: * $DI_{T-j,T-4}$ is income adjustment from $T - 4$ to $T - j$ as defined in equation (7).

** $\Pi_{T-3,T-4}$ is the pension incentive as defined in equation (5), with $N = 64$ and $\beta = .96$.

Table 12: Regression results, key variables, Models 6a-6c

Dependent variable	$DI_{T-3,T-4}^*$		
	Model 6a	Model 6b	Model 6c
	Standard case	$\beta = .8$	$N = 51$
Variable	Coefficient (Std.err.)	Coefficient (Std.err.)	Coefficient (Std.err.)
Disability			
D	-0.030	-0.028	-0.018
α_1	(0.003)	(0.002)	(0.002)
Pension Incentive (general)			
$\tilde{\Pi}_{T-3,T-4}^{**}$	-0.075	-0.197	-0.090
α_2	(0.002)	(0.005)	(0.002)
Pension Incentive (disable)			
$D * \tilde{\Pi}_{T-3,T-4}$	0.030	0.099	0.032
α_3	(0.002)	(0.005)	(0.002)
N	255,814	255,814	255,814
Adj. R ²	0.183	0.184	0.1841

Note: * $DI_{T-j,T-4}$ is income adjustment from $T - 4$ to $T - j$ as defined in equation (7).

** $\tilde{\Pi}_{T-3,T-4}$ is the pension incentive as defined in equation (9), with $N = 64$ and $\beta = .96$ (Model 6a), with $N = 64$ and $\beta = .8$ (Model 6b) and with $N = 51$ and $\beta = .96$ (Model 6a).

Table 13: Summarized Results

Dependent variable	$DI_{T-3,T-4}^*$		
Variable	D	$\Pi_{T-3,T-4}$	$D * \Pi_{T-3,T-4}$
Coefficient	α_1	α_2	α_3
Model			
1a	-0.019	-0.112	0.074
1b	-0.026	-0.161	0.104
1c	-0.033	-0.188	0.114
2a	-0.018	-0.078	0.053
2b	-0.015	-0.135	0.086
3a	-	-0.11	-
3b	-	-0.029	-
4a	0.073	-0.629	0.444
4b	0.076	-0.167	0.102
4c	-0.032	-0.133	0.124
4d	-0.034	-0.109	0.103
4e	-0.059	-0.115	0.116
4f	-0.030	-0.075	0.071
4g	-0.033	-0.101	0.093
4h	-0.014	-0.103	0.072
4i	0.024	-0.094	0.034
5a	-0.033	-0.188	0.114
5b	-0.018	-0.376	0.247
6a	-0.030	-0.075	0.030
6b	-0.028	-0.197	0.099
6c	-0.018	-0.090	0.032