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## Pension incentives, labor supply and heterogenous pension systems

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# MEMORANDUM

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## **Pension Incentives, Labor Supply and Heterogeneous Pension Systems**

**Dag S. Holen**

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# Pension incentives, labor supply and heterogeneous pension systems\*

Dag S. Holen<sup>†</sup>

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27.03.2007

## Abstract

People with an uncertain health condition might face a double worry. They fear to get disabled, and if they are disabled, that they will receive a low pension. To keep

their health they should work less. To improve their disability pension they should work more. This paper demonstrates that the latter effect is the strongest empirically. Thus to protect one self against the income loss of a bad event, the bad event is more likely to happen. Comparing register data from disabled and non-disabled individuals shows that being disabled increases income in the last year before the time of disablement. Further, more generous pension systems increase pre-disablement income even more.

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# 1 Introduction

Currently there are about 300,000 persons receiving disability pension in Norway, more than ten percent of the working age population. The average age of newly disabled persons is falling and the extent of other forms of early retirement is increasing. Can studying economic incentives in the disability pension system help explain why so many persons below retirement age are unable to work?

People with an uncertain health condition might face a double worry. They fear to get disabled and if they become disabled that they receive a low pension. To keep their health they should work less. To improve their disability pension they should work more. This paper demonstrates that the latter effect is the strongest empirically. Thus to protect oneself against the income loss of a bad event, the bad event is more likely to happen.

Disablement is a serious and dramatic event for any individual. It is important to avoid becoming disabled, but also important to avoid a low pension level if indeed one should become disabled. This has conflicting implications on labor effort: working less may reduce the risk of becoming disabled, but working more increases income and thereby the disability pension level. The focus of this paper is the economic incentives for increasing income prior to disablement and how these incentives depend on the particular pension system and the individual's income level.

All inhabitants in Norway are included in the public pension system ("Folketrygden") and are entitled to disability pension based on past income if they become disabled. In addition, many individuals have supplemental, mostly occupational, pension arrangements. Occupational pension covers 50 percent of Norwegian employees and are important for the pension level. OECD (2007) states that the occupational pension raises the disability pension level from 60 percent of the average production worker earnings to 80 percent. The single biggest occupational pension system is the civil service pension system ("Statens pensjonskasse, SPK"), covering around 930,000 individuals, 27 percent of the population aged 16-79 the same year (SPK (2005)). A special feature of the civil service pension system is that it is coordinated with the public pension system, guaranteeing that yearly pensions from the public and civil service pension system add up to at least two thirds of the yearly salary at the time of disablement.<sup>1</sup> The civil service pension system is more

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<sup>1</sup>Before 2000: only up to 8 G, income between 8 G and 12 G was weighted as one third of income at

generous than the public system for all income levels. The public pension system is thus not relevant for persons covered by the civil service pension system.<sup>2</sup> Persons only covered by the public pension system and those covered by the civil service pension system can then be seen as two groups with mutually exclusive pension systems, from the individuals' point of view.

Clearly additional pension sources play an important role for the incentive structure regarding disability pension. Additional income sources play a role in determining the well being when receiving disability pension. Golosov and Tsyvinski (2006) points out the role for asset testing in an optimal system of disability insurance. Financial wealth, including additional pension rights should ideally be included in a model of disability pension behavior. In the case of SPK pensions, this point is particular important because of the interplay with the public pension system. By only looking at the incentives created by the public system, we risk misspecifying the financial incentives of a large part of the population. If financial incentives matter for retirement behavior we thus may draw very wrong conclusions regarding the effects of the system.

In Holen (2007a) I describe the rules of the disability pension in the public pension system. Using a model of pension incentives and labor supply I describe how the pension rules create pension incentives for adjusting income in the years before the time of disablement. These incentives vary across individuals on the basis of their age and income history. I analyze register data on actual disabled individuals in the period 1992-2001 with individual income data from 1967-2001 and find pension motivated income adjustment in these data: on average income falls in the years before disablement, but income falls the least for individuals where the pension level respond more to a fall in income.

In order to identify the mechanisms for pension motivated income adjustments, the analysis in Holen (2007a) assumes that public pension is the only form of income once retired and that there are no savings. Abstracting from savings makes it possible to keep track of the income history while getting closed form solutions. Abstracting from other sources of income than the public disability pension makes it possible to look at the

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lower levels. After 2000: up to 12 G.

G is the basic measuring unit in the public pension system. From May 1st 2006 it was set to 62,892 NOK, about 10,000 USD.

<sup>2</sup>As long as income is above the level that generates the minimum pension level.

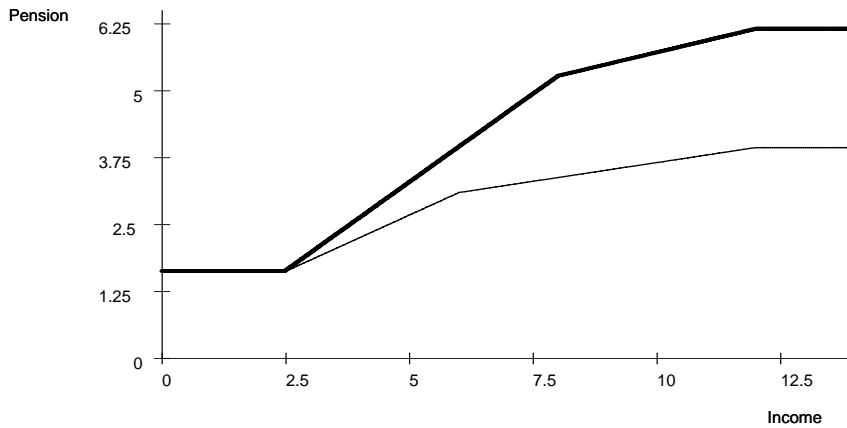


Figure 1: Pension in G by income in G for the civil service pension system (thick line) and the public pension system (thin line).

mechanisms of this system in detail.

This paper presents a model of pension incentives and labor supply, meant to capture the economic incentives of the public and civil service pension system. Within this model, an individual has incentives for increasing labor supply, thereby increasing income and subsequently disability pension, when he knows that he is becoming disabled in the next period. Further, the marginal pension return on income is up to 2.3 times higher in the civil service pension system than in the public pension system. The incentives are thus stronger for a person covered by the civil service pension system relative to only being covered by the public pension system. Lastly, within each of the two pension systems the incentives are stronger the stronger the marginal pension returns of income before the time of disablement. The marginal pension returns on income depend on the income level and the age at the time of retirement. The two pension systems as a function of pre-disablement income are shown in Figure 1.

In contrast to Holen (2007a) the model in this paper takes explicitly into account that public pension is not the only source of income after disablement and that individuals may save in order to smooth consumption over time. In order to keep the model tractable, the rules in the public pension system are simplified, and I assume that the pension level is determined by last period income level only. Given that the time of disablement is known two periods prior to the actual time of disablement, the difference in labor supply between

the last two years before the time of disablement depends on the marginal pension returns to income.

This paper examines whether incentives for increasing disability pension can explain pre-disablement income. A sample of 12,578 individuals that started receiving disability pension in 1993-1997 is studied. 43.6 percent of these were covered by the civil service pension system. The remaining 56.4 percent were only covered by the public pension system. According to my model of pension incentives and labor supply, the pension incentive variables should explain differences in data on last period income between disabled and non-disabled individuals and between the public pension and civil service pension groups. In order to control for the possibility that the pension incentive variables capture effects not modeled, I include the pension incentive variables for the whole sample even though they are only relevant for the disabled according to my model. The various specifications of the model include the public pension incentives and civil service pension incentives variables for all four groups. In addition the model is estimated for different parts of the sample separately.

My analysis shows that disablement matter for income before disablement. One might expect people that face possible disablement to work less in order to keep their health and that their income thus falls. My data show no such fall in income just prior to disablement compared to the control group. Disablement does significantly increase last period income. Persons covered by the civil service system have an even higher increase in income. However, stronger pension incentives within each pension system do not increase income: for two persons that are both becoming disabled and are covered by the same pension system, stronger incentives for income adjustment decrease income.

The results indicate that making disability pension depend on last period income to a large extent may create the wrong incentives for persons with uncertain health conditions. Individuals may work more to improve the situation if they should become disabled, but at the expense of increasing the probability of actually becoming disabled.

Section 2 presents a simple model identifying the role of the different pension systems on the labor decision before the time of disability. Section 3 describes the data. Section 4 describes the empirical strategy. Section 5 presents the results. Section 6 performs some sensitivity analysis and Section 7 concludes.



## 2 A model of pension incentives and labor supply

The model in this section is a standard lifecycle model with consumption and labor supply. There is a possible probability of becoming disabled and being forced to retire before the normal retirement age. If so, one will receive a yearly pension based on past labor income. I assume that individuals have a lifetime utility function

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

where  $C$  denotes consumption 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 denoted by  $\bar{T}$ , representing the compulsory retirement age of 67. The first period of retirement is denoted  $T \in \{1, \dots, \bar{T}\}$ . If the person has become disabled,  $T < \bar{T}$ ,  $T$  is called the time of disablement. If  $T = \bar{T}$ , the person retires from old age. The number of periods receiving pensions is  $N - T + 1$ , where  $N$  is the number of periods, which is assumed fixed with  $N > \bar{T}$ .

$P_t(j)$  denotes the probability of being in state  $j$  at time  $t$ . Everyone is retired after age 67, such that  $P_t(R) = 1$ , for  $t \geq \bar{T}$ . Retirement is assumed to be an absorbing state such that  $P_t(R) = 1$  if  $j = R$  at  $t - 1$ .

Utility is assumed to be additively separable in labor and consumption:

$$U^j(C_t^j, L_t^j) = u(C_t^j) + v(L_t^j) \quad , \quad (2)$$

with  $u'(\cdot) > 0$ ,  $u''(\cdot) \leq 0$ ,  $v'(\cdot) < 0$  and  $v''(\cdot) \leq 0$ .

The budget constraint is described as

$$C_t^j + a_{t+1} = (1 + r) a_t + I_t^j \quad ,$$

where  $a_t$  is financial assets at the beginning of time  $t$ ,  $r$  is the interest rate and  $I_t^j$  is state dependent income at time  $t$ .

Income is described as

$$\begin{aligned} I_t^A &= w_t L_t^A \\ I_t^R &= f_i(I_1^A, \dots, I_{T-1}^A) \quad , \end{aligned}$$

where  $w_t L_t^A$  is labor income,  $\{I_1^A, \dots, I_{T-1}^A\}$  is the income history up until the time of retirement and  $f_i(\cdot)$  is the pension function.  $i = \{p, c\}$  determines whether the individual is only included in the public pension system ( $p$ ) or is included in the civil service pension system ( $c$ ). I assume that it is not possible for an individual to switch between pension systems.

For the details of the public pension system ( $f_p(\cdot)$ ), see Holen (2007a). In general, the entire income history matters for the pension level. In some cases, in particular for the civil service system, income level in the last period before retirement is the only thing that matters. To simplify, this is assumed to hold in general for both pension systems and all cases such that both pension functions  $i = p, c$  satisfy

$$\frac{\partial f_i(I_1^A, \dots, I_{T-1}^A)}{\partial I_t^A} = 0 \quad ,$$

for  $t < T - 1$ . Assuming that only last period income determines the pension level in the public pension system overstates the importance of income in the last period. The difference between the two systems in this respect is typically larger.

After retirement, the maximization problem is straightforward. It follows from the pension function and the assumption that retirement is absorbing, that pension income is constant after retirement,  $I_t^R = I_T^R$  for all  $t \geq T$ .

By summing over all the remaining budget constraints, and substituting in for  $a_t$ ,  $t = \{T + 1, T + 2, \dots, N\}$ , we then get

$$\sum_{s=0}^{N-T} (1+r)^{-s} C_{T+s}^R + (1+r)^{-(N-T)} a_{N+1} = \sum_{s=0}^{N-T} (1+r)^{-s} I_T^R + (1+r) a_T \quad (3)$$

The left-hand side of (3) is the present value of consumption and final period assets. The right-hand side is the present value of total income while retired. For simplicity I assume restrictions on debt in the final period and no bequest motive, yielding  $a_{N+1} = 0$ .

The first order conditions can be expressed as

$$\frac{u'(C_{T+s}^R)}{u'(C_{T+s'}^R)} = (\beta(1+r))^{s-s'} \quad , \quad (4)$$

for  $s, s' \in \{0, \dots, N - T\}$ .

In the following I assume  $u(C) = \ln C$ . Then, (4) is equivalent to

$$C_{T+s}^R = (\beta(1+r))^{s-s'} C_{T+s'}^R \quad (5)$$

Combining (3) and (5) optimal consumption for any  $s' \in \{0, \dots, N - T\}$ , can be expressed as:

$$\bar{C}_{s'}^R = \frac{(\beta(1+r))^{s'}}{\sum_{s=0}^{N-T} \beta^s} \left[ \sum_{s=0}^{N-T} (1+r)^{-s} I_T^R + (1+r) a_T \right] \quad (6)$$

$$\begin{aligned} &= \phi_{s',T} [R_T I_T^R + (1+r) a_T] \\ &= \phi_{s',T} \Pi(I_T^R, a_T) \quad , \end{aligned} \quad (7)$$

where

$$R_T \equiv \sum_{s=0}^{N-T} (1+r)^{-s}$$

is the time  $T$  present value of receiving a pension of one for the  $N - T - 1$  periods of retirement,

$$\Pi(I_T^R, a_T) \equiv R_T I_T^R + (1+r) a_T$$

is the time  $T$  present value of total income and wealth while retired, and

$$\phi_{s',T} \equiv \frac{(\beta(1+r))^{s'}}{\sum_{s=0}^{N-T} \beta^{s'}}$$

is the share of lifetime income consumed at time  $s'$ . Note that  $R_T$  and  $\phi_{s',T}$  all depend on the number of periods receiving pensions,  $N - T - 1$ .

The value function at the time of retirement can thus be expressed as a function of the pension level and financial assets at the time of retirement:

$$V_T^R(I_T^R, a_T) = \sum_{t=T}^N \beta^{t-T} (\ln(\phi_{t-T,T} \Pi(I_T^R, a_T)) + v(0))$$

Given that the individual is not disabled in period  $t$ , his maximization problem is thus

$$V_t^A(a_t) = \max_{C,L} \{u(C_t^A) + v(L_t^A) + \beta [P_{t+1}(R) V_{t+1}^R(I_{t+1}^R, a_{t+1}) + P_{t+1}(A) V_{t+1}^A(a_{t+1})]\}$$

s.t.

$$\begin{aligned} C_t^j + a_{t+1} &= (1+r) a_t + w_t L_t^A \\ I_{t+1}^R &= f_i(I_1^A, \dots, I_t^A) \end{aligned}$$

Assuming  $j = A$  at time  $t$  and that retirement is certain in two periods, such that  $P_{t+1}(R) = 0$  and  $P_{t+2}(R) = 1$  and thus that  $t + 2 = T$ , the first order conditions can be

expressed as:

$$\begin{aligned} u' (C_{T-2}^A) &= \beta \frac{\partial V_{T-1}^A (a_{T-1})}{\partial a_{T-1}} \\ w_{T-2} u' (C_{T-2}^A) &= -v' (L_{T-2}^A) \quad , \end{aligned}$$

for time  $T - 2$  and

$$\begin{aligned} u' (C_{T-1}^A) &= \beta \frac{\partial V_T^R (I_T^R, a_T)}{\partial a_T} \\ w_{T-1} u' (C_{T-1}^A) + v' (L_{T-1}^A) &= -\beta \frac{\partial V_T^R (I_T^R, a_T)}{\partial I_T^R} \frac{\partial f_i (I_1^A, \dots, I_{T-1}^A)}{\partial I_{T-1}^A} w_{T-1} \quad , \end{aligned}$$

for time  $T - 1$ .

Assuming now that  $\beta(1+r) = 1$ , the first order conditions can be expressed as

$$\log \left( \frac{v' (L_{T-1}^A)}{v' (L_{T-2}^A)} \right) = \log \frac{w_{T-1}}{w_{T-2}} + \log \left( 1 + \beta R_T \frac{\partial f_i (I_1^A, \dots, I_{T-1}^A)}{\partial I_{T-1}^A} \right) \quad (8)$$

Assume now that  $v(L) = -\varphi L^\gamma$ , with  $\gamma > 1$  and  $\varphi > 0$ . Equation (8) can then be expressed as

$$\log \left( \frac{L_{T-1}^A}{L_{T-2}^A} \right) = \frac{1}{\gamma - 1} \left[ \log \frac{w_{T-1}}{w_{T-2}} + \log \left( 1 + \beta R_T \frac{\partial f_i (I_1^A, \dots, I_{T-1}^A)}{\partial I_{T-1}^A} \right) \right] \quad (9)$$

The left hand side of (9) is the growth in labor supply between  $T - 2$  and  $T - 1$ . The first component inside the brackets on the right hand side of (9) is the growth in wages in the same period. The second component is related to the pension system. This component is zero if there is no response in the pension level from an increase in the income level. It is increasing in the marginal response of the pension level and in the number of periods one will be receiving pension. This component can be seen as an additional price on leisure at time  $T - 1$ , since increasing income in this period increases the pension level and thereby consumption in the next period and all following periods. When the pension level is based on last period income only, this addition to the price on leisure only applies for the last period before the time of disablement. For a constant wage, the price of leisure is higher in the last period and there should be a growth in the labor supply according to the first order condition of the model.

Finally, let  $\omega_{T-1} = \log\left(\frac{w_{T-1}}{w_{T-2}}\right)$  be relative changes in wages in the last two periods before the time of disability and let

$$PP = \log\left(1 + \beta R_T \frac{\partial f_p(I_1^A, \dots, I_{T-1}^A)}{\partial I_{T-1}^A}\right) \quad (10)$$

$$CP = \log\left(1 + \beta R_T \frac{\partial f_c(I_1^A, \dots, I_{T-1}^A)}{\partial I_{T-1}^A}\right) \quad (11)$$

be the pension incentive variables for the public and the civil service pension systems respectively. Equation (9) can then be written as

$$\log(I_{T-1}^A) = \log(I_{T-2}^A) + \frac{\gamma}{\gamma-1}\omega_{T-1} + \frac{1}{\gamma-1}[\xi^p PP + \xi^c CP], \quad (12)$$

where  $\xi^i = \{0, 1\}$  are indicator functions,  $i = \{p, c\}$ .  $\xi^p$  equals 1 if the individual is only covered by the public pension system and 0 otherwise.  $\xi^c$  equals 1 if the individual is covered by the civil service system and 0 otherwise.

Alternatively, equation (12) can be expressed as

$$\log(I_{T-1}^A) = \log(I_{T-2}^A) + \frac{\gamma}{\gamma-1}\omega_{T-1} + \frac{1}{\gamma-1}[PP + \xi^c AP], \quad (13)$$

where  $AP = CP - PP$  is the additional pension incentive following a membership in the civil service pension system.

The model has three implications for pre-disablement income:

a) Knowing that one is likely to become disabled, creates incentives for increasing income and thereby the disability pension.

b) The civil service pension system is more generous than the public pension system. This creates additional pension incentives for persons covered by the civil service system.

c) The incentives for increasing income vary within the two pension systems, depending on the age at the time of disablement and the response in the pension system for the current income level.

### 3 Data

The data is taken from the database FD-Trygd, which has information about every inhabitant in Norway, in particular every person receiving disability pensions from 1992 to

2001. There are a total of 190,015 persons in the register that meet a number of sample selection criteria based on entry into disability pension spell later than January 1992, active working life (with registered income) before the time of disablement and some technical criteria (see Holen (2007c) for details).

In addition to information about public pension, I need data on other sources of pension income. I have information about whether the individuals received disability pension from the civil service pension system or from other pension systems. I have information on the civil service pension system for persons that received disability pension in the period 1992-1997. Information on other sources of pension income is from the period 1993-2001.

In order to identify persons that either only received public disability pension or that received civil service disability pension, I only look at persons that started their disability pension spell in the period 1993-1997. Within this period I exclude all individuals that received pensions from any other source than the public and civil service system. The reason for this is that I do not have specific information about how pensions from these other sources are calculated and I can not derive the economic incentives for these individuals.

I impose an income criterion on the sample. I focus on differences in pension systems for similar income and restrict my sample to individuals that were earning an income between 5 G and 9 G two years before the time of disablement. These are "medium" income levels and further cover a range where the difference in pension systems is significant. The total number is 12,578 individuals, of which 43.6 percent are covered by the civil service pension system.

It normally takes some time from the event that makes the individual disabled to the time when he starts receiving disability pension. The time of the event that makes the individual disabled is called the time of disablement and is thus different to the time of entry, which is the start of the disability pension spell.<sup>3</sup> I want to avoid effects of the public pension reform in 1992 on pension incentives and thus restrict my sample to individuals that had a time of disablement between 1992 and 1997.

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<sup>3</sup>See Holen (2007c) for a discussion on the distinction between the time of disablement and the time of entry.

My model predicts that there are pension incentives for increasing income when faced with disablement as a probable event in the near future. In order to compare income development of the persons that were actually disabled to a case without pension incentives, a control group of non-disabled individuals is introduced, assigned with a counterfactual time of disability between 1992 and 1997. Given the income and age at time of disablement, the pension incentive variables are constructed for this group as well.

The control group consists of two parts that match the age profile of the public pension and civil service parts of the disabled group: the number of individuals for each year of disablement and each of the nine age groups is the same between the disabled group and the control group in both the public pension and civil service groups. The total number of individuals in the control group is thus 12,578 as well and 43.6 percent of the control group that are assigned with a dummy for civil service pension system. In addition, the control group all was also earning an income between 5 G and 9 G two years before the (contra factual) time of disablement.

The descriptive statistics for the different groups of the sample are shown in the appendix.

## 4 Empirical strategy

The empirical question is whether the fact that persons covered by the civil service pension system and thereby have a higher pension sensitivity, also have a higher increase in income before disablement, i.e. if the relationship found in equation (13) can be found in the data. For any income that gives a pension above the minimum pension level,  $AP \geq 0$ , with strict inequality as long as income is below the cut off level at 12 G. It follows that for the income interval examined here that  $AP > 0$  for all individuals in the sample. I use the income level at  $T - 2$  to determine the derivatives of the respective pension functions. I do not have information about wages. For the empirical specification, this has to be handled by control variables (lagged income, age and gender).

My model predicts that the pension incentive variables,  $PP$  and  $AP$ , do not matter for persons not foreseeing the time of disability, in particular not for persons that have been randomly assigned with a counterfactual time of disability. Further, the additional

pension incentive variable does not matter for persons only covered by the public pension program. However, these variables may capture additional effects of the income dynamics not modeled here. In order to check for such effects, the model is estimated by only imposing the relevant variable for each individual first. Then the incentive variables are included for more groups, estimating whether the variables have an effect on the relevant group, net of the general effect for the whole sample.

Let  $CONTROLS_i$  be the set of control variables (lagged income, age, marital status and sex) for individual  $i$ ,  $D_{1i}$  be a dummy for actual disablement (=1 if individual  $i$  has been registered as receiving disability pensions in the period 1992-2001) and  $D_{2i}$  be a dummy variable for the civil service pension program (=1 if individual  $i$  is covered by the civil service pension program).

#### 4.1 Empirical specifications

The main question asked here is: Does the pension variable significantly explain variations in income before retirement? The model predicts that higher pension returns to income leads to an increase in income in the last period before the time of disablement. Further, the model predicts that persons that are covered by the civil service pension system and therefore have a higher pension return on income should have a higher increase all other things equal.

The problem is that the pension returns to income variables may capture effects that are not in the model. If so, a correlation between the pension incentives and income is not necessarily a result of people acting on the pension incentive. Controlling for any non-modeled effect is done here by including the variables for parts of the sample where the model predicts that these variables have no effects in order to capture the possible non-modeled general effects. If in fact there are non-modeled effects, the test of the model is whether there are any effects of the pension incentive variables for the parts of the sample where the model predicts such effects, net of the general effects for the whole sample.

The model predicts no effects on the pension incentive variables,  $PP$ ,  $CP$  and  $AP$  for the part of the sample that are not disabled, i.e. where  $D_{1i} = 0$ . Further, the pension incentive variable for the civil service pension system,  $CP$ , or alternatively the additional pension incentive variable following membership in the civil service pension system,  $AP$ ,



have no effects on the part of the sample that is only covered by the public pension system,  $D_{2i} = 0$ , according to the model.

Equation (13) is estimated with an empirical specification of the form

$$\log(I_{T-1}^A)_i = \begin{cases} \alpha_0 + \alpha_1 D_{1i} + \alpha_2 D_{1i} D_{2i} + \alpha_3 \log(I_{T-2}^A)_i \\ + \alpha_4 PP_i + \alpha_5 AP_i + \alpha_6 D_{1i} PP_i + \alpha_7 D_{1i} AP_i \\ + \alpha_8 D_{1i} D_{2i} AP_i + \bar{\alpha}_9 CONTROLS_i + \varepsilon_i \end{cases}, \quad (14)$$

where  $\varepsilon_i$  is assumed to be i.i.d and  $\sim N(0, \sigma^2)$ . The coefficient  $\alpha_0$  is the intercept term,  $\alpha_1$  captures any discrete effect of foreseeing disablement and  $\alpha_2$  captures effects of foreseeing disablement for persons covered by the civil service pension system, net of any general effects for all disabled. The coefficient  $\alpha_3$  captures direct effects of income in the previous period, and  $\alpha_4$ - $\alpha_8$  capture effects of the pension incentive variables. According to my model, the pension incentive variables,  $PP$  and  $AP$ , are only relevant for persons foreseeing disablement and should thus be zero for the control group. If so,  $\alpha_4$  and  $\alpha_5$  should equal zero. Further, the additional pension incentive from being covered by the civil service pension system should only be relevant for persons actually being covered by the civil service pension system, and  $\alpha_7$  should be zero as well. However, I can not rule out that these variables capture any other effects on the income dynamics and I thus estimate the model with and without the coefficient restrictions implied by the model.

I present four different versions of equation of equation (14) and the restrictions imposed as Models 1 to 4. Model 1 restricts the pension incentive variables to only affect income for the parts of the sample implied by the theoretical model. The restrictions of Model 1 are thus

$$\alpha_4 = \alpha_5 = \alpha_7 = 0.$$

Model 2 allows for general effects of the public pension incentive, but restricts the additional pension incentive to only have effect on income for disabled persons covered by the civil service pension system. The restrictions of Model 2 are thus

$$\alpha_5 = \alpha_7 = 0.$$

Model 3 allows for general effects of both pension incentive variables, but restricts the additional pension incentive variable only to have an effect on income, net of the general

effect, for persons being covered by the civil service pension system. The restriction of Model 3 is thus

$$\alpha_7 = 0.$$

Model 4 is equation (14) unrestricted. The coefficients of interest are  $\alpha_1$  and  $a_2$ , measuring the discrete effect on income of foreseeing disablement for all disabled and the additional effect of foreseeing disablement for the civil service part of the disabled group, respectively and  $a_7$  and  $\alpha_8$ , measuring the effect of a marginal effect of a stronger pension incentive for the public pension part and the civil service part of the disabled group, respectively.

## 5 Results

The regression results for the key variables in Models 1-4 are presented in Table 1. The four models have the same sample, but they differ in the degree to which any possible general effect of the pension incentive variables are controlled for.

Compared to the income of the control group, becoming disabled significantly increases income. This holds for all four specifications. Inside the disabled group, being covered by the civil service pension system significantly increases income further and does so for all four specifications as well. Being disabled increases income by from 5.8 percent to 12.3 percent, depending on the model specification. Being covered by the civil service pension system, increases income by an additional 5.6-11.0 percentage points.

In contrast to the predictions of my model, increased pension incentives within a pension regime does not increase income. Increased pension returns to an increase in income negatively affect income for both pension regimes. The results do not depend on model specification.

The results indicate that pension incentives matter for income before disablement. The positive effect on pension incentives is of a discrete nature: when there is a pension incentive present, income increases and the increase is larger for the most generous system. Increased generosity of the pension system thus increases income when comparing individuals with different pension incentive regimes. However, when comparing individuals within the same pension regime, the effect is the opposite.

Table 1: Regression results, key variables, Models 1-4

Variable	Model			
	1	2	3	4
	Coefficient (St. Error)	Coefficient (St. Error)	Coefficient (St. Error)	Coefficient (St. Error)
Disable	0.123 (0.008)	0.058 (0.009)	0.083 (0.009)	0.075 (0.014)
Disable + civil service	0.056 (0.007)	0.057 (0.007)	0.109 (0.007)	0.110 (0.007)
<b>Pension incentives</b>				
Public disable	-0.094 (0.005)	-0.051 (0.006)	-0.065 (0.005)	-0.062 (0.007)
Additional disable and civil service	-0.023 (0.007)	-0.024 (0.007)	-0.106 (0.007)	-0.109 (0.008)
Public general		-0.059 (0.004)	0.033 (0.005)	0.031 (0.005)
Additional general			0.146 (0.004)	0.144 (0.005)
Additional all disable				0.006 (0.008)
<b>Income</b>				
$\log(I_{T-2})$	0.699 (0.011)	0.634 (0.012)	0.664 (0.012)	0.664 (0.012)
$\log(I_{T-3})$	0.104 (0.008)	0.100 (0.008)	0.097 (0.008)	0.096 (0.008)
Adj. $R^2$	0.372	0.377	0.409	0.409
N	25,045	25,045	25,045	25,045

My results are in contrast to what is found in Holen (2007a). There, becoming disabled on average has a negative effect on income before disablement, but when comparing two disabled persons, an increase in pension incentives increases income. The data sam-

ple in Holen (2007a) is somewhat different than in this paper, although the population from which it was selected is the same. Further, Holen (2007a) disregards other pension system than the public system, in which the pension incentive variable is constructed in a more sophisticated way. The results are thus not strictly comparable. Nevertheless, it is interesting that the results are the opposite in Holen (2007a) and this paper.

The pension incentive variables do have general effects on the income in all four models and thus capture some income dynamics not included in my model. The general effect of the public pension incentive is significantly negative in Model 2 and significantly positive in Models 3 and 4. The significant effects may be from the fact that age is only controlled for by age groups or may come from the difference in the income level between the disabled group and the control group. One may argue that one should use more than age as a match criterion. It would have been possible to construct the control group to match disabled group in income history, gender, education and many more dimensions. I have only used age, because age is believed to be an important factor for both income and health development. Significant effects of the pension incentive variables nevertheless illustrate the importance of constructing a control group.

Interpreting the results is not straightforward, given the simplicity of the model. Taken literally, the model states that individuals that foresee becoming disabled. Given the pension system they by which they are covered they then consider how a change in income will affect their pension level and through this affect their economic situation for the period they receive pension (i.e. the rest of his life). For a given wage he then increases his labor supply accordingly, balancing the increased disutility of working with increased consumption for the rest of his life. However, increasing labor in order to get a higher income may not be as easy in real life. In particular, the civil service pension is based on the fixed yearly income, not including overtime pay. It is possible however to reduce one's position, e.g. to a 50 percent position. When having uncertain health, it may be a natural thing to do. In this setting, staying in a 100 percent position in order to avoid a reduced pension is captured as pension motivated income adjustment as well. Another interpretation is that disability pension is used as an early retirement plan, where the employer gives the worker a wage increase before the worker applies for disability pension, giving the worker a higher pension at a low cost for the employer.

## 6 Sensitivity analysis

I estimate the model for the different groups in the sample separately. I do not look at the Additional pension incentive variable in this section, but include the Civil service pension incentive variable, defined in (11), for persons covered by the civil service pension system and the Public pension incentive variable, defined in (10), for persons only covered by the public pension system. The general empirical specification of the model in this section is thus

$$\log(I_{T-1}^A)_i = \begin{cases} \alpha_0 + \alpha_1 D_{1i} + \alpha_2 D_{2i} \\ + \alpha_{3i} (1 - D_2) PP_i + \alpha_4 D_{2i} CP_i \\ + \alpha_5 D_{1i} (1 - D_{2i}) PP_i + \alpha_6 D_{1i} D_{2i} CP_i \\ + \alpha_7 \log(I_{T-2}^A) + \bar{\alpha}_8 \text{CONTROLS}_i + \varepsilon_i \end{cases} \quad (15)$$

The sample consists of two groups subgroups. The sample can thus be divided in eight different parts: all disabled, all non-disabled, all public pension member, all civil service members and the four different combinations of disabled and pension system. The restrictions on the values of the two dummy variables,  $D_1 = 1$  if a person is disabled and  $D_2 = 1$  if a person is covered by the civil service pension system, for each model are presented in Table 2.

Table 2: Sample restrictions for Models 5-12

	<b>Model</b>							
	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>
<b>Disabled</b>								
$D_{1i} =$	1	0	{0, 1}	{0, 1}	1	0	1	0
<b>Civil service</b>								
$D_{2i} =$	{0, 1}	{0, 1}	0	1	0	0	1	1
N	12,506	12,539	14,102	10,943	7,031	7,071	5,475	5,468

Table 3 presents regression results for key variables for Models 5-8. We see that when estimating the model on disabled only, there is no significant effect on income of being covered by the civil service pension system. Further, stronger pension incentives for income adjustment negatively affect income for both pension systems.

Table 3: Regression results, key variables, Models 5-8

	<b>Disabled</b>	<b>Not disabled</b>	<b>Public Pension</b>	<b>Civil Service</b>
<b>Variable</b>	Coefficient (St. Error)	Coefficient (St. Error)	Coefficient (St. Error)	Coefficient (St. Error)
Disable			0.051 (0.012)	0.282 (0.023)
Civil service	-0.035 (0.025)	-0.275 (0.017)		
<b>Pension incentives</b>				
Public general			-0.069 (0.006)	
Public disabled			-0.046 (0.008)	
Public only public	-0.105 (0.005)	-0.028 (0.006)		
Civil Service only civil	-0.038 (0.011)	0.105 (0.007)		
Civil service general				0.127 (0.006)
Civil service only disabled				-0.116 (0.010)
<b>Income</b>				
$\log(I_{T-2})$	0.577 (0.015)	0.870 (0.017)	0.592 (0.017)	0.918 (0.016)
$\log(I_{T-3})$	0.124 (0.010)	0.081 (0.014)	0.117 (0.011)	0.056 (0.014)
Adj. $R^2$	0.364	0.391	0.347	0.451
N	12,506	12,539	14,102	10,943

When estimating the model on non-disabled only, however, there is a significant negative effect on income by being covered by the civil service pension system. Remember

Table 4: Regression results, key variables, Models 9-12

	<b>Public Pension</b>		<b>Civil Service</b>	
	Disabled	Not Disabled	Disabled	Not Disabled
<b>Variable</b>	Coefficient	Coefficient	Coefficient	Coefficient
	(St. Err)	(St. Err)	(St. Err)	(St. Err)
<b>Pension incentives</b>				
Public	-0.124	-0.057		
	(0.007)	(0.007)		
Civil Service			0.005	0.132
			(0.007)	(0.007)
<b>Income</b>				
$\log(I_{T-2})$	0.460	0.757	0.836	0.980
	(0.023)	(0.024)	(0.018)	(0.022)
$\log(I_{T-3})$	0.131	0.085	0.026	0.076
	(0.014)	(0.085)	(0.016)	(0.017)
$\log(I_{T-4})$	0.025	0.015	0.015	0.012
	(0.010)	(0.012)	(0.011)	(0.012)
$\log(I_{T-5})$	0.055	0.026	0.021	0.012
	(0.007)	(0.009)	(0.007)	(0.009)
<b>Male</b>	-0.022	-0.020	0.007	-0.003
	(0.008)	(0.006)	(0.003)	(0.006)
<b>N. years</b>	0.003	0.000	0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Adj. $R^2$	0.292	0.388	0.576	0.407
N	7,031	7,071	5,475	5,468

that this variable does not actually mean that they are covered by the civil service though, but rather captures the age composition difference between the public pension and civil service pension system for the ones actually disabled in my sample. The two pension incentive variables also significantly affect income. The public pension variable negatively affects income and the civil service pension variable enters positively. These variables

capture the effect increased income has on the present value of the stream of yearly pensions if the individual should be disabled the next year. The control group has not been registered as receiving disability pension up to the years 2001 and the year in question has been randomly picked. There are thus no reasons why the pension incentives should have a particular importance for this group and the pension incentive variables capture some income dynamics outside the model. This illustrates the importance of including a control group to the estimation.

Looking at the two pension system separately, we see that being actually disabled positively affects income, more in the civil service pension system than in the public pension system. The net effect of stronger pension incentives for the disabled part of the sample, negatively affects income. The main results do not change when treating the two pension systems separately.

Table 4 presents regression results for key variables for Models 9-12. As in Models 7 and 8, we see that without the control group, we find the results are either negative or insignificant. Without the control group, the conclusions would be the opposite of what my main results indicate. When we look at the results from Models 10 and 12, however, we see that the pension incentive variables have significant effects on income. These models are estimated only on persons that have not become disabled and the pension incentive variables should not capture any of the effects in the model. Again, this illustrates the importance of comparing the income path of the disabled group with a group without such pension incentives.

## 7 Conclusion

The fact that over ten percent of the population aged 18-67 in Norway are currently receiving disability pension and are, at least partly, unable to earn a living by working is something we should treat with much concern. A large share of the population living on pension may cause a strain on the welfare state. In a situation where the general population is ageing and an increasing share of the population is going to be above the normal retirement age of 67 does not improve the situation.

Disablement is not only a serious problem for the welfare state and the economy as a



whole. Being unable to earn an income from working at a young age is dramatic. Having well-functioning systems for providing insurance against the economic consequences of disability is important.

This paper looks at some aspects of the Norwegian disability insurance system from the individual with uncertain health's point of view. In order to try to avoid becoming disabled, the individual may want to work less. If working less reduces the individual's disability pension should he become disabled anyway, the cost of such precaution may be too high. In fact, the pension system creates incentives for working more, increasing the disability pension. These incentives depend on the expected remaining lifetime, the income level and the pension system of which the individual is a member. I compare individuals covered by only the public pension system, by which all individuals in Norway are covered, with individuals covered by the civil service pension system. The civil service pension system is more generous than the public pension system and the economic incentives for increasing pension through increased income before disablement is stronger here. I also compare the income development of a sample of disabled persons with a sample that has (not yet anyway) become disabled.

I find that becoming disabled increases income compared to the non-disabled. Further, individuals covered by the civil service pension system in the sample increase the income even more. Stronger incentives inside each pension system do not increase income.

My results indicate that persons with uncertain health conditions adjust the income in such a way that the disability pension level increases in the event that they should become disabled. If persons can, to some extent, reduce the risk of becoming disabled by working less, this mechanism in the pension system can increase the numbers of disabled workers. The adverse effects of the disability insurance system can be avoided by making the disability pension depend on past income to a less degree.

## Appendix: Descriptive statistics

Table 5 shows descriptive statistics for key variables in the sample. In order to get numerical values for the pension incentive variables, I set the yearly interest rate to four percent and the number of periods lived to 80.

Table 5: Key variables by group in sample

Variable		Disabled		Control group		Total		
		Public	Civil	Public	Civil	Public	Civil	Total
<b>Pension Incentives</b>								
Public	mean	1.62	1.51	1.48	1.47	1.55	1.49	1.52
	std	(0.49)	(0.46)	(0.47)	(0.47)	(0.49)	(0.46)	(0.48)
Additional	mean	0.66	0.79	0.77	0.75	0.71	0.77	0.74
	std	(0.41)	(0.43)	(0.44)	(0.44)	(0.43)	(0.43)	(0.43)
<b>Income</b>								
$I_{T-1}$	mean	5.83	6.14	6.31	6.26	6.07	6.20	6.13
	std	(1.49)	(0.98)	(1.44)	(1.42)	(1.48)	(1.22)	(1.38)
$I_{T-2}$	mean	6.12	6.23	6.46	6.44	6.29	6.33	6.31
	std	(0.95)	(0.87)	(1.04)	(1.03)	(1.01)	(0.96)	(0.99)
$I_{T-3}$	mean	5.92	6.21	6.38	6.41	6.15	6.31	6.22
	std	(1.46)	(1.06)	(1.40)	(1.37)	(1.45)	(1.23)	(1.36)
$I_{T-4}$	mean	5.83	6.18	6.35	6.39	6.09	6.29	6.17
	std	(1.78)	(1.20)	(1.63)	(1.56)	(1.73)	(1.40)	(1.59)
$I_{T-5}$	mean	5.76	6.17	6.33	6.38	6.04	6.27	6.14
	std	(1.85)	(1.33)	(1.73)	(1.74)	(1.81)	(1.55)	(1.71)
<b>Age</b>	mean	55.01	56.92	54.91	56.78	54.96	56.85	55.78
	std	(8.88)	(7.29)	(9.06)	(7.63)	(8.97)	(7.46)	(8.40)
<b>N.years</b>	mean	24.51	25.15	24.54	25.26	24.53	25.21	24.82
	std	(4.24)	(3.35)	(4.10)	(3.47)	(4.17)	(3.41)	(3.87)
N		7090	5488	7090	5488	14180	10976	25156

For the disabled group, the public pension incentives are stronger for the part of the sample that is only covered by the public pension system. The additional pension incentive

is stronger for the civil service group, where this variable is relevant. Remember that the relevant pension incentive variable is the public pension variable for the public pension group and the sum of the public pension variable and the additional pension variable for the civil service group. The pension incentive variable for the public pension group is then 1.62 and 2.30 for the civil service group. The pension incentive is thus 42 percent stronger for the civil service group. The impact this should have on the growth in income according to my model depends on the value of  $\gamma$ . For  $\gamma = 4$  and a constant wage, the pension incentive implies that income should on average grow by 80 percent for the public pension part of the disabled group and 115 percent for the civil service part of the disabled group. The control group has weaker public pension incentives for both pension regimes, but the additional pension incentive is stronger for the non-disabled public pension group.

Income is increasing up to the second to last year for both the public pension and the civil service group. The fall in income the last year may be related to health that eventually leads to disablement, but the same income pattern applies for the control group as well, even though the time of disablement is set randomly for this group. This may be from a general hump shaped pattern of income over age and that the high average age in the sample means that an increasing part of the sample are passing the peak point in the age profile of income. This illustrates the importance of selecting the control group in such a way that its age profile matches the disabled group.

The average age is around 55 years. It is higher in the civil service group and lower in the control group for both pension regimes. Matching age by five year age group has not equalized the average age totally between groups, but there is no large difference.

The number of years with a positive registered income is around 25 years. The data on income only goes back to 1967 and the last year before disablement is 1996 in my sample. Hence, the maximum number of years with positive income is 30 years. Although the average age is somewhat lower in the control group, the average number of years with a positive income is slightly larger.