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AFP and OP data construction techniques

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Abstract: The paper presents some procedures that can be used for recovering the quantitative characteristics of early retirement (AFP) and private (occupational) pensions when their values are not directly observed. The developed techniques are then used for analysing the potential compensation ratios for the limited sample of households in Norway.

Keywords:

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Introduction

The following paper reviews the procedures developed to construct quantitative characteristics of early retirement pensions (AFP) and private pensions in Norway and presents some analysis for the created data. This data is planned to be used in related projects to characterize households' and individuals' potential pension income.

Retirement behaviour is a theme of increasing interest and importance in the recent labour economics research as demographic changes in many countries lead to higher proportion of elderly individuals in the population. Pay-as-you-go pension systems adopted in most countries are likely to put an increasingly heavy fiscal weight on future taxpayers. Alternative pension schemes, which have been already introduced in the labour market are known in practice, but are far less examined due to the shortage of relevant data.

The pension systems in Norway have long historical traditions both in public and private sectors. The first general retirement scheme for civil servants were carried out through The Pension Fund for State Employees (SPK) established in 1917. At the same time private occupation based pensions appeared on the insurance market. After World War II coverage with occupational pensions was significantly expanded. When earnings-related components in social security pensions were introduced in 1967 the occupational pension systems started to look as it does nowadays. Finally, in 1988 an early retirement scheme (AFP) was established. The voluntary retirement age in that scheme has been gradually reduced from 66 to 62 years by the spring of 1998.

The pension system in Norway provides three main types of pensions:

- NIS (public pensions), the government pensions available to most working Norwegian citizens,
- early retirement pensions (AFP), enabling eligible individuals to retire early with pension (in general), which has the same earnings base as social security pensions, and
- private or employer based (in the private or public sector) pensions (OP), which coexist with the pensions provided by the state.

For the last two types a general overview of legal regulations and techniques used for data construction are described below.

The data consists of register data linked through personal identification number. It is possible to merge these data with spouse information to create households and

also with other information from different files. Data came from the labour market authorities, tax files and official registers containing demographic census. The main goal was to create quantitative characteristics for AFP and private pensions for eligible persons based on the recorded information and official regulations. The population in the sample includes single persons and married couples with one of the spouses born in the period 1928-1955. All the calculations were made for year 1996. The main results are after-tax AFP pensions and after-tax employer based private pensions for both spouses for married couples, in which one of the spouses is aged 64 (the age of AFP eligibility in 1996). Predicted pensions together with data on individuals' income were used to calculate compensation ratios for the individuals from the sample population (people becoming 64 in 1996). Observations were divided in three groups to estimate the relationship between wage income in the last year before AFP eligibility and AFP pension, private pension or summed AFP and private pension (whichever is applicable).

The paper is organized as follows. Chapter 1 presents description of AFP rules, identification of AFP-companies and eligible individuals from the existing data. Based on extracted information potential AFP pensions were calculated for eligible individuals. Summary statistics and distribution histograms are presented to describe predicted pensions.

Chapter 2 is devoted to private pension. First, investigation of individuals with observed OP was carried out to build a sample for private pension occurrence study. Then a regression model was fitted to describe the occurrence rules, and finally, it was used to construct potential private pension values for all eligible individuals. Descriptive statistics and graphs are presented in the last section of the chapter.

Chapter 3 contains calculations of compensation ratios for both AFP-pensions and private pension with respect to wage income in the last year. Only persons becoming 64 in 1996 are included in the analysis here.

The final section concludes the work done and discusses possible directions for further analysis and constructed data utilization.

Chapter 1. Early retirement scheme

1.1. Description of AFP rules (institutional settings)

The early retirement scheme, AFP (Avtalefestet Pensjonsordning) was introduced in 1989 as a result of negotiations between unions and employers. This scheme covers the whole public sector and part of the private sector companies. Self-employed are not included. The number of AFP participants is constantly rising with new companies coming into the scheme and take-up rate increasing.

The scheme allows those employed in AFP-eligible companies and meeting individual requirements to retire earlier then the retirement age in social security (67 years). Like social security pensions, AFP-pension is contingent on income. The minimum age of early retirement was 66 years when the scheme was set up, and it was reduced to 62 years in 1998. Table 1 below shows minimum ages for participants in the AFP-scheme.

Period	Minimum age
01.01.89	66 years
01.01.90	65 years
01.10.93	64 years
01.10.97	63 years
01.03.98	62 years

Table 1. Minimum retirement ages under AFP scheme.

Persons who are employed in the AFP-companies and attending minimum AFP age should meet following requirements to be eligible to AFP-scheme:

- Have been employed in the company the last 3 years or been covered by AFP-scheme for the last 5 years;
- Have earnings at a level at least corresponding to the basic pension G the year AFP is taken up;
- Had earnings at least equal to the basic pension (G) the year before;
- Are not receiving pensions or similar payments from employer, not requiring work effort in return;
- Have had at least 10 years since the age of 50 in which earnings were at least equal to the basic pension;

- Have an earnings-history such that the average earnings in 10 best years since 1967 was at least two times basic pension.[1)]

Calculation of public pensions for persons who are 67 years old is based on the pension points (recalculated value of earnings with regard to basic pension in every particular period, see Haugen, 2000). When person is 67 it's quite easy to calculate the final pension points (or so-called endpoints), which is the basis for the pension. In the case with AFP-pension it's not a straightforward task, because the pension can be taken up earlier than at 67. The AFP pension is equal to the potential pension at age 67. So, future pension points (FPP) is predicted as the maximum of the followings:

$$FPP = max\{\frac{PP_{t-1} + PP_{t-2} + PP_{t-3}}{3}, SLP^{AFP}\},$$

where t is the year when the final (take-up of AFP) pension point is calculated,

PP_i is pension point in the period i,

$$SLP^{AFP} = \frac{\sum_{n=1}^{20} PP_n^*}{20},$$

PP_n^* is income in the best 20 years of earnings history calculated in pension points.

In other words future pension points is the maximum between:

- The mean of the pension points earned in the last 3 years,
- The mean of the pension points the individual earned in the best 20 years (or the mean of the years with pension points more than 1 G if there are less than 20 of these).

The number of positive pension points used for calculation of AFP pension includes these "future" calculated years.

AFP pension depends on basic pension, supplementary pension, final pension point, the number of years in earnings history, marital status, employment in private or public sector.

A basic pension is paid to all persons permanently residing in the country, equalling 1G for single person and 0,75G for married persons. With less than 40 years of residence, the basic pension is reduced proportionally. This reduction is mainly

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[1)] These rules were in a fact in 1996 and were used in creating data since analysis is supposed to be done for that period. This explain year 1967 as the point of the last 30 years before 1996. Later there were some changes in AFP-rules, for example concerned to supporting part retirement by AFP scheme.

applied to immigrants (there are very few of them in the sample, they are not paid attention to in the analysis).

Supplementary pension (*SP*) boosts pension income for those with very low earnings or without earnings (disabled persons).

An earnings based pension (*EP*), based on individual's earnings history, based on wage incomes relative to the basic pension.

Calculations were done for data in 1996. The rules of calculation of AFP-pension in that period are introduced below

G (1996) = 40 410 (basic pension per year in NOK).

Pensions are calculated with regard to marital statuses, which are:

(1) – single persons;

(2) – married person, spouse is employed with income less than 1G;

(3) – married person, spouse is employed with income greater than 1G;

(4) – married person, spouse is retired with pension less than 1G;

(5) – married person, spouse is retired with pension greater than 1G.

Supplementary pension (*SP*) for different marital statuses are calculated in following way:

*(1) ST1=(1/3)*24146+(2/3)*25235*

*(2) ST2=(1/3)*48282+(2/3)*50471*

*(3) ST3=(1/3)*24146+(2/3)*25235*

*(4) ST4=(1/3)*24146+(2/3)*25235*

*(5) ST5=(1/3)*21910+(2/3)*22899*

Earnings based pension (*EP*) is calculated in the same way for all three types of households. The period of working history is divided in 2 parts: before 1991 and after because of difference in coefficients in the calculating rules.

N is the length of observed earnings history (number of years with positive income),

N1 is the number of periods before 1991 and *N2* is the number of years with positive income after 1991.

*EP=(G*FPP*0.45)*((N1)/(N))+(G*FPP*0.42)*(N2/(N)).*

AFP pensions are calculated for eligible spouses with regard to marital status:

(1) AFP1=G + max (EP,ST1),

(2) AFP2=G + max (EP,ST2),

*(3) AFP3=(0,75*G) + max (TP,ST3),*

*(4) AFP4=(0,75*G) + max (TP,ST4),*

*(5) AFP5=(0,75*G) + max (TP,ST5).*

AFP pensions, like the other types of benefit, are subject to taxation. There are special tax rules, which are applied to early retirement benefits. They depend on marital status and pension benefit. Since the analysis is supposed to be done for households and there is no information on disability, the target population is in the same tax class (married persons with spouse either employed or retired).[2)]

Income = AFP-pension	Sum of taxes to pay
0 – 63 063	0
63 063 – 115 161	0,44 * AFP-pension – 27 748
115 161 – 149 000	0,254 * AFP-pension – 6 524
149 000 – 220 500	0,31 * AFP-pension – 14 868
220 500 – 248 500	0,405 * AFP-pension – 35816
248 500 –	0,447 * AFP-pension – 46 253

Table 2. AFP pension tax rules in 1996.

In addition a tax-exempted flat sum of 11 400 (for 1996) is added to the after-tax value of the pension.

Special care has to be taken about taxes. If a person receives several types of pensions (or salary and pension) the taxation may become more complex than presented here. Otherwise if a person receives only AFP pension it is done according to table 2 figures.

1.2. Selecting of AFP-companies and individuals

The purpose is to construct a set of potentially AFP-eligible persons and their pensions to use it in a following analysis. The creation of the data was based on previous results and the matching of data was done in the same way with regard to new information (the whole period from 1992 to 2000 is now being used). Target population includes households where one of the spouses' birth year is between 1928 and 1955.

The basic idea here is to identify people who have retired under the AFP-programme and identify their employers. This information was extracted from the register files (*'afpo', 'afpp', 'afpo00' and 'afpp00'*), which contain data on persons' spells (especially start date) of AFP-retirement. Data contains monthly observations of participating in AFP-program for every person covered by the scheme. Previous

[2)] More precise description of tax rules for AFP pensions see related paper (Haugen 2000).

information for 1992-1997 years was extended with data for 1998-2000 years *('afputtak9200')*. The register files are separate for private and public sectors. Corresponding to this split, identified persons are employed in one of the sectors. This information is important for constructing pension wealth and calculating AFP-pension.

Two files corresponding to the private and the public sectors were compiled. If there were several observations of start date of retirement for one person, the first retirement period was chosen.

The next step is to find the companies where these people were working the calendar year before they retired with AFP. The previous working year was chosen in order to meet requirements of the AFP-programme. All available data on working history (register files *atmlto92-97* for 1992-1997 years and the corresponding created file *'arb9297'*) were included to find employers in the particular year depending on AFP-start date. Employers in the particular year, conditioned on workers having AFP-start date are identified corresponding to register files. If there were several observations for one person the one with the highest wage was picked up. A problem with this matching is the restricted information on working history (up to 1997). So, all retirees who started later then 1997 were associated with the last employer in 1997. It sounds quite reasonable with regard to AFP-requirements. The final data from this step (file *'abedrift9200'*) includes information on employees and their employers at the date when AFP-retirement was picked up. The final set of companies includes 5475 observations.

The list of potentially AFP-eligible persons was created based on information about employers in 1996 (*'atmlto96'*). This dataset is supposed to be used later in the analysis and should correspond to this period. The created set of employees who are supposed to be covered by the AFP-program (now or later in the future) contains 1242582 observations.

In addition to the constructed list of AFP-companies, there exist two lists of companies, which participate in the AFP-programme (one for banking institutions and one for insurance companies). Persons who were working in those companies in 1996 are AFP-eligible, but the companies may already have been identified. These data gave 9109 new observations of persons in AFP-companies (46540 persons were already identified by the procedure described above). The final set of AFP-eligible persons includes 1251691 observations (file '*AFPelig_pers1'*). The whole set of

employees in that particular year is 1863145. This results correspond to previous results that there should be about 60% (See Haugen, 2000), and here 67%, AFP eligible persons among working population.

Information on whether a person is employed in an AFP-company allows us to include corresponding dummy variable in econometric analyses. In order to get more information on the particular class of persons with regard to potential pension, we also calculate the pension points at the age of AFP-eligibility.

1.3. Calculation of potential AFP pensions

Calculations were based on the earnings history (defined in pension points, see Ministry of Social Affairs, 2002) from 1967 to 1997 (file *'p_poeng'*, program *'AFP_poeng'* is described below) Earnings history includes 31 period correspondingly to number of observed years from 1967 to 1997. Only persons with a complete set of observed earnings were chosen to find common trend (of curvature) of payments during working period with regard to age (assuming that there exists one).

$$p_i = \alpha + \beta * t_i + \gamma * t_i^2,\ i=1...N,$$

where p_i is pension points (calculated with regard to basic pension), t_i is the period in the working history (from 1 to 51 corresponding to age from 19 to 69), and α, β, γ are unknown parameters, and N is the number of persons in the sample. In the following analysis only estimates for β, γ will be used. Estimates of these parameters are:

β - estimate	t Value	γ - estimate	t Value	N obs	R^2
0,21814	726,98	-0,00364	-602,59	4 445 307[3)]	14,5 %

Table 3. Earnings prediction model.

Assuming that all people have earnings history, which could be described by this concave function with difference only in the initial points, constant term for person i is calculated for every person in following way:

$$\hat{\alpha}_i = \bar{p}_i - \bar{\bar{p}}_i,$$

[3)] Number of observation 4 445 307 corresponds to 143 397 persons with 31 observations for everyone.

where $\hat{\alpha}_i$ is a constant term, $\overline{p}_i$ is the average of observed values of pension points, and $\overline{\overline{p}}_i$ is the average of predicted values by regression for person *i*. Initial value (constant term) is the difference between observed average and average of predicted values calculated by regression. This allows for creating the whole earnings history for every person.

Based on employees with the whole earnings history and their ages it seems reasonable to introduce one's working history from the age of 19 to 69. Thus it includes 51 points and we can easily move from 31 points (corresponding to observed period from 1967 to 1997) to 51 with the assumption that working history may start at the age of 19:

'new point = 'old point' + 67 –'birth year' + 19;

where 'new point' introduces observation in the new scale,

'old point' corresponds to the initial scale with 31 observations,

67 (the same as 1967) is the first year of observation of earnings history,

19 is the starting year of working period.

Calculation of the whole earnings history is based on the observed periods with positive earnings. Earnings' observations from this period are kept and earnings history is continued with predicted values of earnings calculated by regression up to the age of 69 (*'poeng_f'*). This gives an opportunity to take any of these points to calculate pension. Potential points for the age of 66 (the year before retirement) were calculated (see Section 2.4.).

In 1996 the AFP age was 64 years and earnings history up to age 63 was extracted from the created files. A person could retire at the age of 64 with a pension calculated what it should be at the age of 67, so accordingly, earnings histories were continued with three more observations as the maximum between average point during the last three years and final points, which is the average during the best 20 years of earnings history. Based on this information, potential pensions for different types of households and for two sectors of the economy (public and private) were calculated (program *'Pens_cont64'*, file *'btopensj'*). Types of families are (to define the status of household one need to take into account ages of the spouses):

- spouse is retired;
- spouse is employed with the income less than 1G (G is the basic pension in 1996);
- spouse is employed with the income greater than 1G.

There are several requirements concerning income for a person to become AFP-eligible (see Section 2.1). Since calculations are based on predicted values of earnings history, it was assumed that individuals would continue to work in AFP-eligible companies. But all of them should meet requirements on income, which are easily tested (program *'afp_rule'*). It reduces the sample of AFP-eligible individuals from target population by 14 %. The final set of potential AFP-eligible persons with predicted AFP-pension within the analysed sample are 539 060 (file *'btopensj1'*).

A household is considered to be AFP-eligible if at least one of the spouses is eligible for AFP. We have calculated the potential pension for AFP-eligible spouses with regard to the state of another spouse (program *'savings_3afp'*). If they both are included in this program, pensions for older spouse was calculated assuming that he (she) would retire earlier (or at least has this opportunity) when another spouse is still employed. For the younger spouse pension is calculated assuming that the older spouse is already retired and get pension above minimum level (applying AFP rules). If the spouse who is older than 68 in 1996 has already retired without AFP he (she) is supposed to get lower pension since we don't have at our disposal any information on his (her) earnings history to calculate potential pension. Incomes for spouses were calculated based on the created earnings history for the period corresponding to spouse's age of AFP-eligibility and pension's calculations (here age of 63). After definition of marital statuses for all households potential AFP-pensions were predicted (characteristics see Section 2.4.) (file *'regrdata1'*) Each household is characterized by AFP eligibility of either both spouses or just one of them (in order to provide future separate analysis, variable *'af'*), potential after-tax AFP pension of husband and wife if eligible (variables *'afp_p_t_h'* for husband and *'afp_p_t_w'* for wife) and summarized potential AFP pension before and after taxes for spouses if both eligible (variables *'afp_hh'* before tax and *'afp_hh_at'* after tax).

1.4. Summary statistics

Potential pensions are calculated in 1000 NOK. Some results of calculations are introduced below by summary statistics and distribution histograms.

Calculations of predicted earnings history gave an opportunity to calculate pension points for any period during working history for observed population. As an example of calculation results described above, characteristics of pension points at the age of 66 are following:

N	Mean	Std Dev	Min	Max
974890	3.4803039	1.4559299	-1.0330034	8.8315717

Table 4. Descriptive statistics, pension points at the age of 66.

The distribution of calculated values (predicted if there were no observations in that period and observed if there were observed values from earnings history):

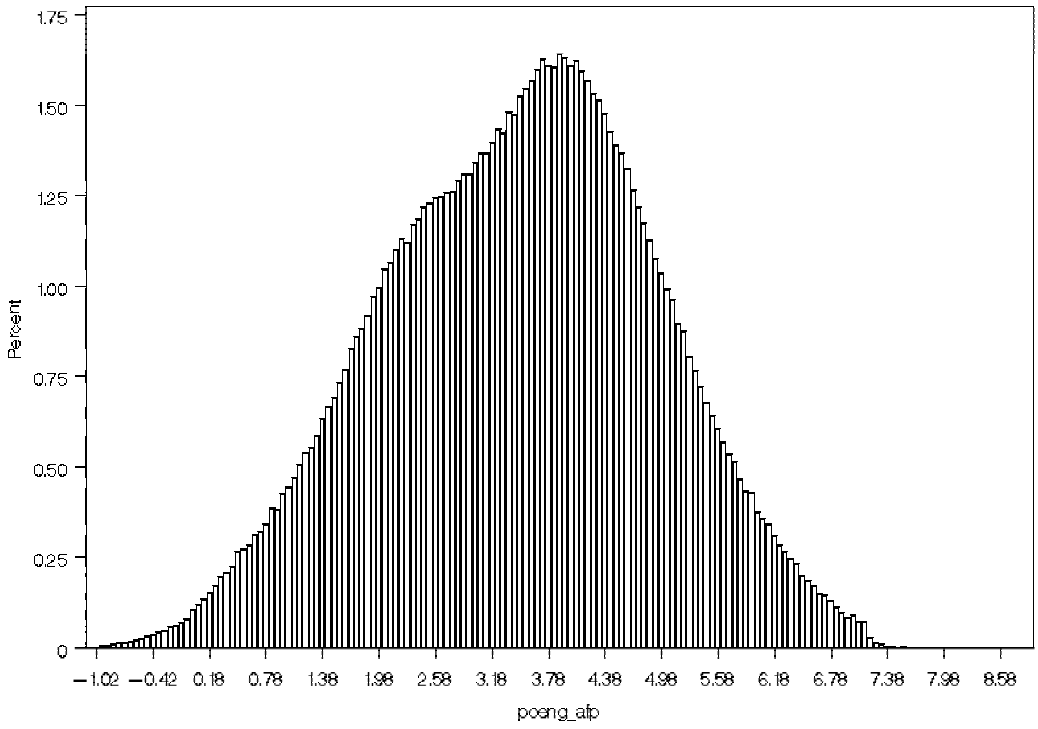

Fig. 1. Histogram for pension points predictions for the age of 66.

Negative values were obtained as a result of small values of observed pension points in earnings history. There are not included in consequent analysis since there exist requirements to be AFP eligible (that was examined later with creating the AFP pensions). The distribution and maximum values are believed to be reasonable since the upper bound for pension points due to calculations rules is 7 and means for observed pension points are about 3,5. Predicted values are calculated for some period in the future and leads to higher mean according to common trend of income through the time.

This data is used in further analysis to include household's eligibility to the AFP-scheme as an explanatory variable in savings function. Quantitative characteristic of AFP-eligibility is introduced by predicted after-tax AFP-pension per year at the age of AFP-eligibility (64 years old in 1996). AFP rules require taking into account marital status of eligible persons. To calculate AFP pensions one needs to consider the household and both spouses. As mentioned above AFP pensions are

introduced at the age of eligibility with regard to spouse's position. The characteristics of predicted AFP pensions are the following:

N	Mean	Std Dev	Min	Max
171484	94.1877363	18.1487157	55.7399480	139.2805040

Table 5. Descriptive statistics, AFP pensions in 1000 NOK, 1996.

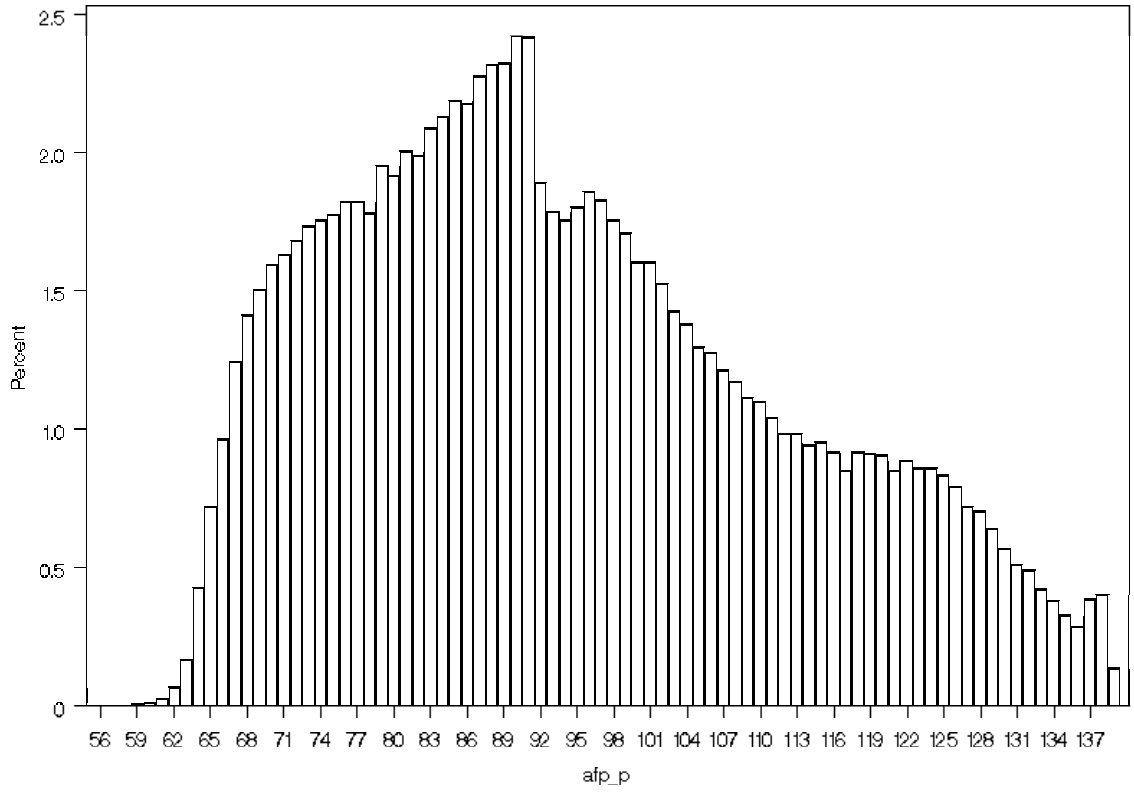

Fig. 2. Histogram for predicted AFP pensions.

The minimum point corresponds here to minimum AFP pension according to the rules. The form of distribution could be explained by difference in pension values for males and females. Lower pensions correspond to females and could be an issue of relatively smaller income during the working period. Pensions for males are higher and could be explained in a way that seems reasonable.

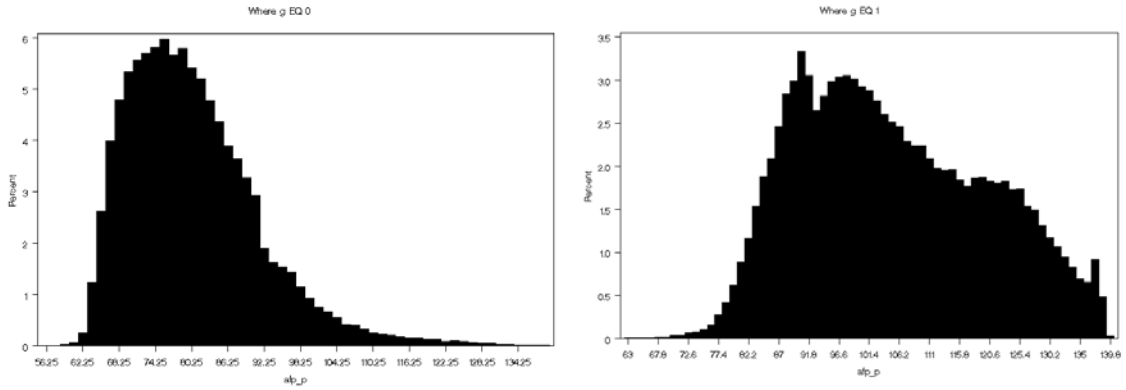

Fig. 3. Histogram for AFP pension predictions (female left, male right).

Gender	N obs	Mean	Std div	Minimum	Maximum
Male	95 691	105,08	15,04	62,96	139,28
Female	75 793	80,43	10,98	55,74	139,16

Table 6. Descriptive statistics, AFP-pensions in 1000 NOK, 1996.

The composition of households allows us to consider aggregated AFP pension wealth for both spouses. Access to AFP of both wife and husband makes calculations a bit more complicated. Final results of calculations are introduced below as characteristics and distribution of joint after-tax AFP pensions per year for households (assuming single AFP pension):

N	Mean	Std Dev	Min	Max
129104	125.1060368	46.8544200	55.7399480	277.2680423

Table 7. Descriptive statistics, after-tax AFP-pensions in 1000 NOK for households, 1996.

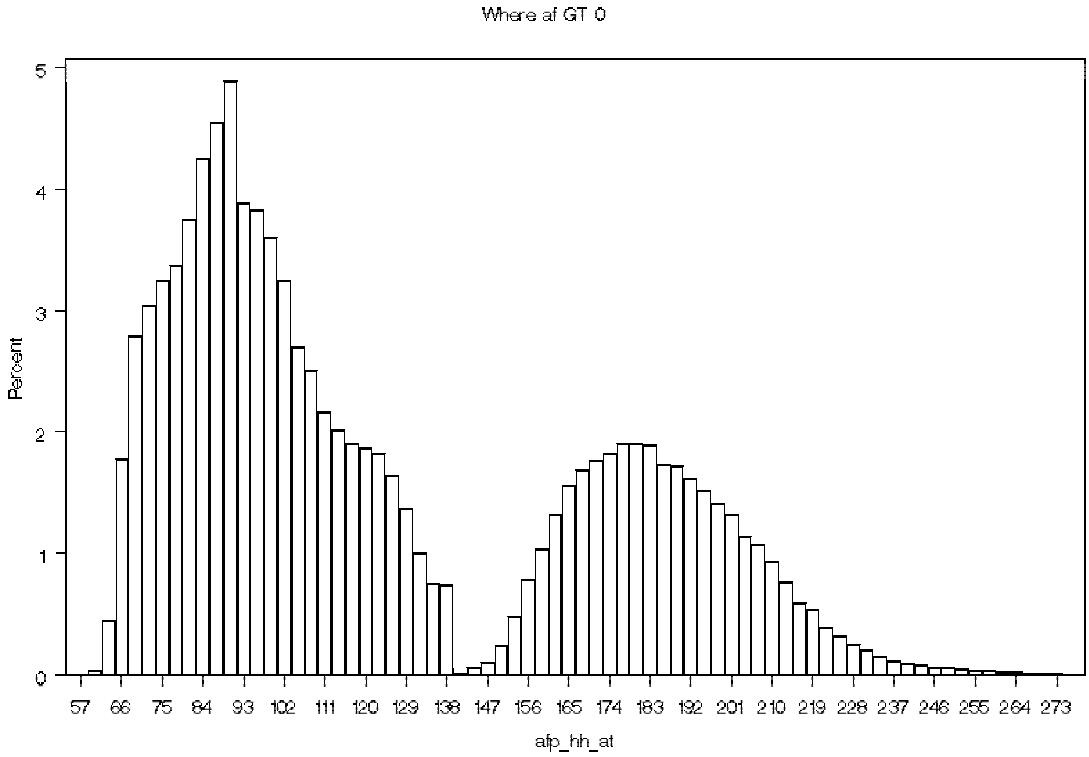

Fig. 4. Histogram for AFP pension predicted for households.

These two-mode distribution can easily be explained by considering pensions separately for two groups of households (with just one AFP eligible spouse and both of them). It seems reasonable to do this in order not to combine individual pensions and joint pensions in analysis.

AFP pension per household, if only one of the spouses is eligible: (predicted yearly values in 1000 NOK reduced by taxes)

N	Mean	Std Dev	Min	Max
86724	95.1426229	18.1642304	55.7399480	139.2805040

Table 8. Descriptive statistics, AFP-pensions in 1000 NOK.

AFP pension per household if both of the spouses are eligible (yearly values in 1000 NOK after taxation):

N	Mean	Std Dev	Min	Max
42380	186.4214477	20.3898509	130.5875413	277.2680423

Table 9. Descriptive statistics, AFP-pensions in 1000 NOK.

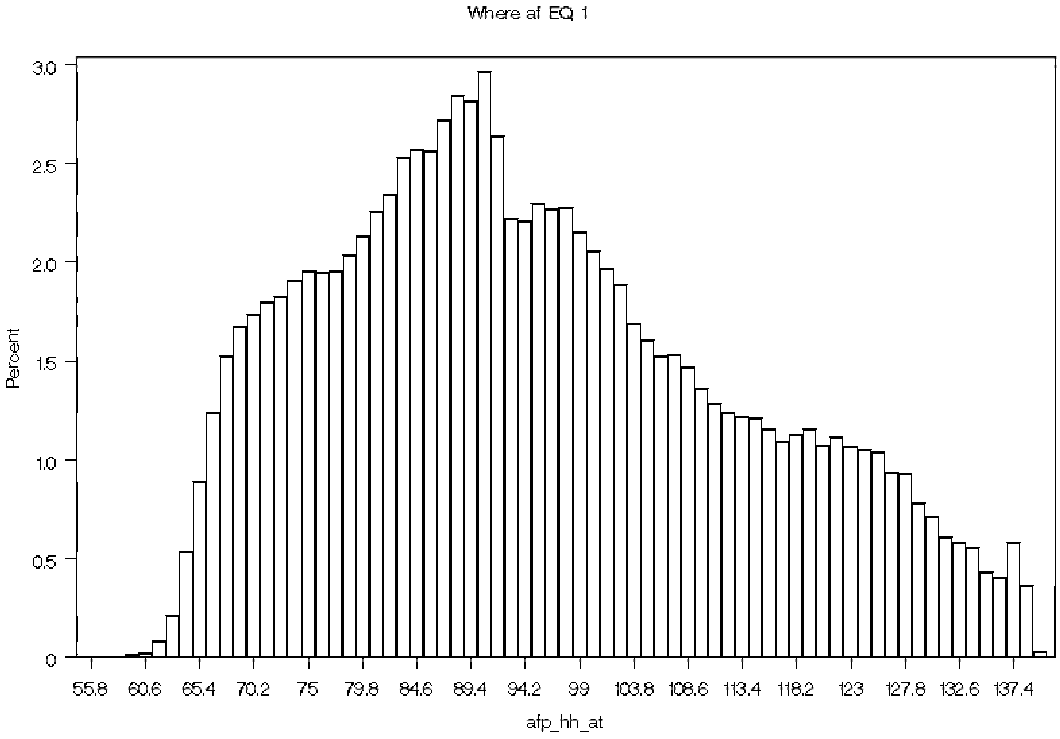

Fig. 5. Histogram for AFP predicted pension after tax (one spouse is eligible).

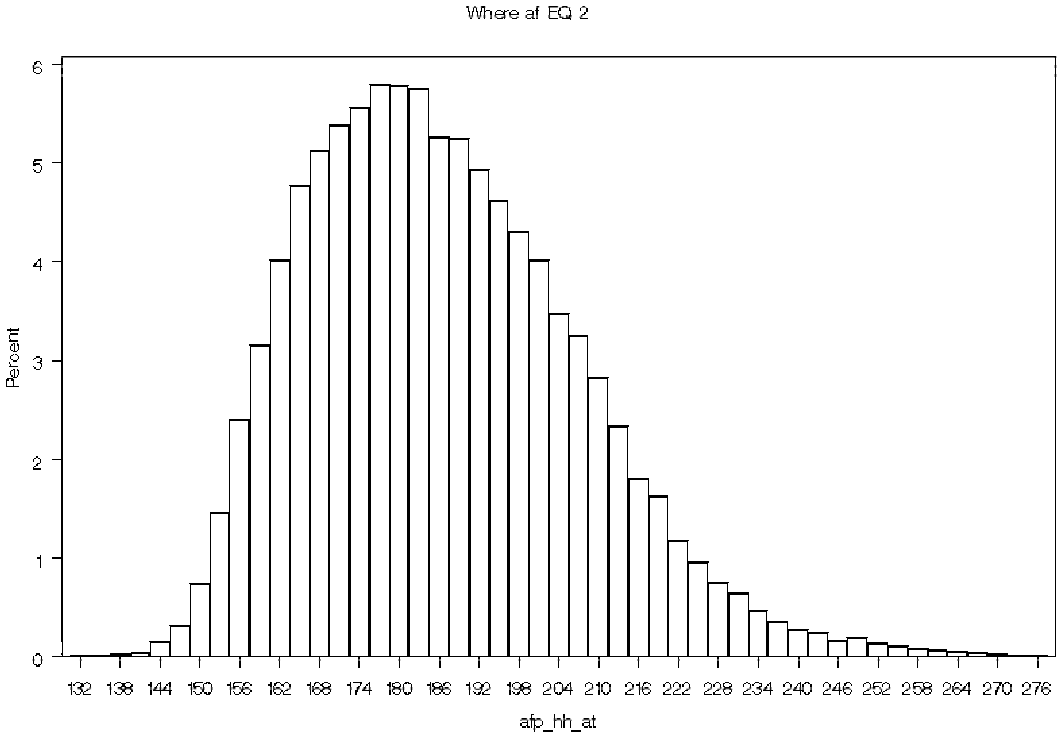

Fig. 6. Histogram for predicted after-tax AFP pension in 1000 NOK (both spouses are eligible).

Chapter 2. Occupational pensions

2.1. What is an occupational pension

So-called occupational or employer based pensions exist in addition to the public (NIS) pension provided by the state. It was first introduced in Norway in 1917 together with the first general retirement scheme for civil servants. This new product of the insurance market gave employers opportunity to deduct the payments paid to pre-funded occupational pensions from the tax base as it was set by the tax-code from 1922.

Today the occupational based pension has the same basic properties. In the private sector it is a pre-funded scheme operated through insurance companies or special funds. The payments made to these funds are tax-deductible, while the benefits received are taxed on the recipient's hand as pensions.

During the World War II the coverage by occupational pensions significantly expanded together with the general state (NIS) coverage. First the white-collar workers were taken into the scheme with the blue-collar generally taken later. Typically the occupational pension contract were different for these two groups of workers.

Occupational pension was forced to play a minor role after the means-testing in the national pension system was abolished in 1959 and the modern earnings-based system was introduced in 1967. In the public sector all types of pension coverage including pre-funded pensions were to be coordinated to ensure a guaranteed replacement ratio of about two thirds after 30 years of work. In private sector about sixty percent of the labor force were covered by the NIS pension, but traditional tax-reducing payments to pre-funded company plans were continued. The associated regulation was revised in 1968, the last time before the next major revision in 2001.

The tax treatment of private occupational pension plans has the following traditional pattern. Contributions both by employer and employee and returns on the accumulated funds are tax-deductible, while the benefits from the scheme are subject to income tax (as a pension) when paid out to the pensioner. In order to qualify for this favorable tax regime private company plans must obey the following rules.

First, an occupational pension plan must be insured with a life insurance company or established as a separate pension fund. Second, if a company chooses to establish a pension plan, all standard, full-time employees of the company must be

included. However, a waiting period of one year is allowed (five years for the workers below 25) and part-time workers with less than 50 percent of full time, temporary and seasonal workers can be excluded. Vesting is achieved after three years, but there is no guarantee for portability and transferability between company plans. This issue is addressed in a new revision of 2001. Third, even though there are no limits on the replacement ratios, the principle of proportionality must be satisfied. This principle states that private pensions can compensate for the fairly redistributive profile of the NIS pension, but only up to the point where they aim at perfectly proportional total replacement ratios. The total gross replacement ratios can not be higher for employees with higher earning levels than for the employees with lower earning levels. Finally, old age private pensions generally cannot start before age 67.

The pension plan may also contain disability and survivor benefits, and these may be picked up in the statistical procedures.

Although these rules have to be complied with in order to obtain tax deductions, any company is of course free to operate pension arrangements without a tax break. In a company survey , about one quarter of the companies answered that they give such provisions, but there is no information available on the type or amounts of benefit (Pedersen, 2000).

A full pension is usually accrued after 30 years of work. However, all decisions about establishing and design of occupation pension plan are decided within the company itself. Therefore the above age and tenure limitations can not be taken as strict.

These days the role of private pension coverage is commonly agreed to increase. As a survey shows [Pedersen, 2000], currently about 60% of employers in private sector offer occupation based pensions which leads to about 39% coverage of the whole labor force in Norway.

2.2. Selection of individuals with an occupational pension (OP)

The major problem of constructing the potential OP data is basically the same as for potential AFP pension. Since potential benefits are not available, it is only possible to obtain figures through indirect methods. However, there is one crucial difference in constructing OP figures, namely that there are no settled official rules for calculating this type of pension. It is generally up to the firm itself to define the accruing rules. Therefore we apply regression analysis for investigating these rules on

the reference group of the individuals observed receiving OP and assume that these rules can be used to calculate potential OP for the rest of the employees, under the assumption that the companies operate TPES compatible plans.

Thus, the plan of action consists of three parts. First observations on individuals who receive OP are collected, and the companies they work at are traced. Then a regression model is selected to best fit the data and finally the estimated equation is applied to calculate potential OP endowments for eligible people.

The only criteria for OP eligibility is working in a company operating OP. As described above, all employees at the PP-firm become OP eligible.

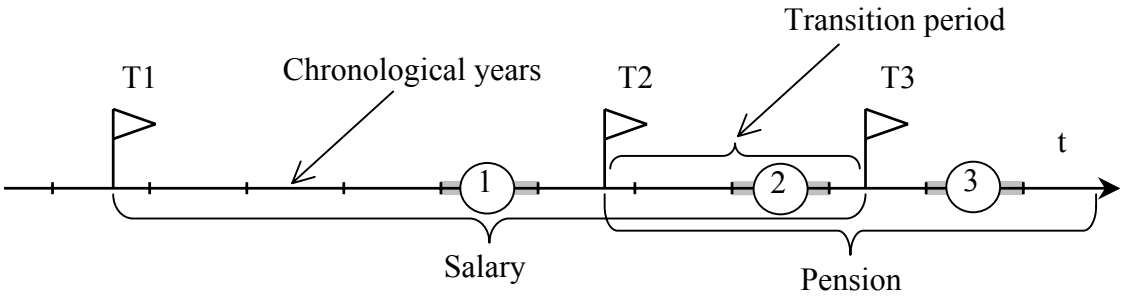

Fig. 7. General layout.

Figure 7 shows the general set up used in preparing the reference group data. For each individual we are looking for three important time moment – working start date (T1), first year when OP appeared (T2), and retirement date (T3). The latter two mark a transition period as we call it, when a person receives both salary and OP benefits. The definitions of moments T2 and T3 are correspondingly the first time pension is paid and the last time salary is received. Unfortunately, it is hardly possible to use any salary or pension figures reported during the transformation period since there's no way to investigate more closely how these figures were obtained from the yearly data the whole study is based on. That is why the further analysis is based on the 'clean' years – one full year of work before transformation period (year 1) and one full year of pension after transformation period (year 3). There is however an alternative view of the issue. It may happen that due to the unclearness of the figures describing the pension benefits during transition period the wage during this period is not affected and can be taken as normal. Then the analysis can be carried out on the years 2 and 3. We shall investigate this alternatives approaches below.

The data available for finding OP recipients covers the time range of 1992-1997. We try to utilize all the information that can be extracted from the initial files and therefore we don't distinguish between people retired in different years. The

arising problem of comparing salaries and pensions from different years was solved with adjusting all the values to the prices in year 1997 with the consumer price indexes.

The data is collected from the following initial files:

1. *trygd92 – trygd97* contain information on the types of benefits received by the individuals. From these files we are able to find recipients of OP in every year.
2. *atmlto92 – atmlto97* contain information on occupation, salary and start working date. This enables us to see where the pensioner worked before he or she retired, their last salary and tenure.

The outline of the program is as follows. Different years are brought into consideration one by one. For every year first the people who are simultaneously found on the employer register and found to be receiving OP are picked. The files are linked to the data files from FD-trygd, to remove survivor benefits (Etterlattepensjon) and disability (Uførepensjon).

The data on OP benefits is combined with the employment data. Unfortunately it is impossible to track down exactly what employment is providing an individual with OP since the organization code on the *trygd* files apparently refers to the organization which directly pays the OP benefit. Such an organization is likely to be an insurance company. That is why the data from *trygd* files is aggregated to form a single OP sum for one individual. The *atmlto* files also contain multiple records for a portion of individuals as they may work in several places at the same time. That is why it is necessary to construct a rule of choosing for every person one "main" job – the job, that we assume provides the OP. The main job is chosen according to the following rule – it is the earliest started job that paid no less than 40 000 NOK the last full year. Since the information on the last full year salary is not recorded in the current year file, the whole task of main job picking is placed at the very end of the procedure, while the year-by-year datasets contain multiple jobs with the same value for corresponding OP.

Second, some additional information for each year is collected. It includes the salary level from the last year and the pension level from the next year for each combination of person-job of the current year retirees. Besides, a special case is taken care of – there are some people, who retire at New Year's eve. Such people don't get picked, because they don't appear on both employer register and OP benefit files. It is not hard to track them, however; they are taken into the dataset together with the

information on the levels of pension and salary, and their transition period has length zero.

Finally, when the year-by-year datasets are ready, they are combined into one. This big dataset then has information on salary and pension for unique combinations of individuals with their jobs in particular years. In order to transform this data into the final dataset, describing last full year salaries and first full year pensions, two technical things have to be done. First, different years may contain different information on the working start date and transition period boundaries and for some years it also can be missing. Therefore the information appearing in at least one year is expanded to make sure all records for each person-job pair contain the same dates. While doing this the following is in effect: if two or more different start dates are encountered, the earlier one is taken (for work starting date and transformation period starting date), if two or more different transformation finishing dates are encountered, the later one is taken. This rule makes sure that in case of mistakes the questionable numbers will be associated with the transformation period, which is not taken into account any way.

Second, the problem of companies renumbering has to be addressed in order to match the same companies with different code numbers in different years. In the year-by-year datasets the following code numbers are taken (from *atmlto* files):

1992, 1993, 1994	*arbgivnr* (old);
1995	*anr* (old) and *orgnr_id* (new);
1996	*orgnr_id* (new);
1997	*orgnr* (new).

To simplify the further operations the composite organization number was constructed by joining the numbers referred to as old and new, making the *jbid* field of length 22. To match the old and the new number year 95 correspondence was used, the companies without corresponding old or new numbers were given zeros instead.

Finally, the records were sorted to for the following field structure in the final resulting dataset:

idnr	person ID;
idjb	composed employer ID (old & new - 22 digits);
st_tr	transition period starting date (YYMMDD);
sp_tr	transition period finishing date (YYMMDD);
lonn_pr	last full year salary;

lonn_tr	salary in the years that include transition period;
pp_tr	PP in the years that include transition period;
pp_nx	PP in the following full year;
st_reg	work starting date (YYMMDD).

After this structure was obtained for every combination of person-job, the main jobs were picked for each individual according to the rules described above. These gave a data set with one record for one PP-eligible individual working in one PP-company – altogether 155 027 individuals.

Finally, we linked with the files with recipients of disability or surviving spouse's benefit from the NIS. The assumption underlying this procedure is that if person receives either of these pensions from the NIS, any benefit from an occupational pension will be of the same kind. In this procedure 54 292 individuals were removed as survivor benefit recipients or disability pension recipients.

For the purposes of the following regression analysis it was decided to add some more fields to this basic structure. First of all it is reasonable to separate public and private sectors. A special dummy variable *priv* was introduced to indicate whether an individual works in a private sector company (*priv*=1) or in a public sector company (*priv*=2). The division was made roughly by selecting some industries (first three digits of ISIC code are 711, 720, 911, 912, 931, 933, 934, 939, 941, 942) which have been considered mainly public in Norway.

Furthermore, the industry dummies *ind*1-*ind*8 were added to the dataset, each containing 1 if an individual works in industry with corresponding first digit of ISIC code and 0 otherwise:

ind1	Agriculture, hunting, forestry, fishing;
ind2	Mining;
ind3	Manufacturing;
ind4	Electricity, gas, water;
ind5	Construction;
ind6	Wholesale and retail trade, restaurants and hotels;
ind7	Transport;
ind8	Financing, insurance, real estate and business services;
reference group	Public administration and defense.

Then the tenure or the number of years in the office was calculated. Here we face another problem. From the distribution of work starting dates (figure 7) we

clearly have a kink, corresponding to the year 1978, when the employer register had appeared.

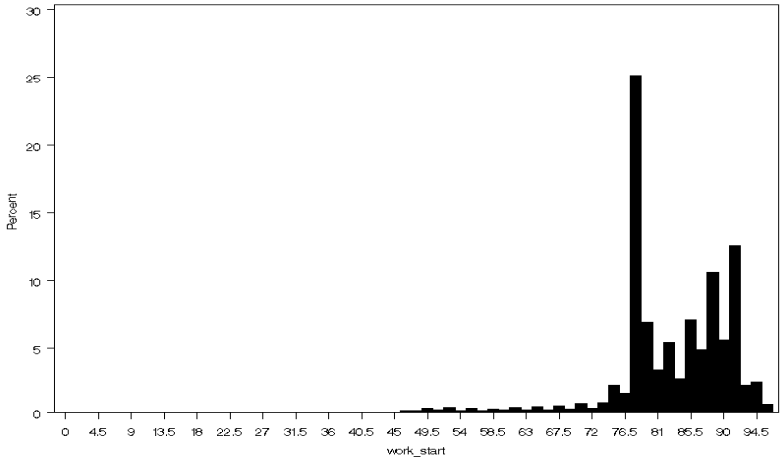

Fig. 8. Distribution of work starting date (from 1900 to 1996).

This makes the information on work starting dates at least look unreliable. An alternative approach to finding tenure is developed on the bases of individual earnings histories, expressed in pension points form *p_poeng* file. It is possible to find the first year when a person earned a substantial amount (so that the pension point is greater than one) for the first time and consider this year as an estimate of the work starting date. The third approach suggests combination of the two – if reported in the employer register starting date points to an unreliable time, when there were no register yet (1978 or earlier), we take the pension point based starting date, otherwise we take the date reported. Three corresponding tenure variables were formed:

tenure_p	Calculation is based on the pension points earning histories;
tenure_at	Calculation is based on the *atmlto* reported dates;
tenure_c	Combined calculation as described above.

Finally, a variable *retage* was constructed to control the retirement age of the people being analysed. It is simply calculated by subtracting the birth year from the transition start year.

Some initial filtering was performed to get rid of meaningless observations. Thus, records with missing *st_tr*, *lonn_pr* and *pp_nx* were dropped and the lower limit of 1000 NOK was imposed on *lonn_pr* and *pp_nx* forming the *reg* file of 26 371 observations. The drop in the number of individuals under consideration (from 100 735) is mainly due to the large transformation periods observed in the biggest part of the sample. If the transformation period touches the boundaries of the interval of

years 1992 to 1997 then at least one of the next year pension or previous year wage is missing. Only the individuals with both of these values present can be taken into the regression analysis. We observe 26 831 such individuals and 540 more are filtered out by the lower limit of 1000 NOK as outliers. With the sector division approach described above 11 757 (45.04%) individuals are classified as public sector workers and 14 348 (54.96%) as private sector workers leaving 266 records with missing *priv* variable.

2.3. Fitting regression models

We concentrate the analysis on private sector companies. In the public sector, the occupational pension is integrated with the NIS, so that the total is determined as two thirds of the income up to 8 G and two ninths of income between 8 and 12 G. (The reduction between 8 and 12 G was removed in 2000, but this does not affect our data.)

The main idea for the model is to try to explain the variability in OP by two factors – last salary and the number of years in office. Industry specific variables may also improve the regression quality. Also different rules of filtering out outliers and irrelevant observations have to be checked in order to find the kernel of the constructed data, which incorporates the information we are trying to discover. Below we review a sequence of regression models leading to the final equation used for estimation of potential occupational pensions for the certain group of people.

	Description Additional filtering	N obs	Adj. R-square	Factor	Estimate	t-value
1	*priv* =1; *tenure_p*>0	14247	0.2684	Intercept	-14779	-3.59
				lonn_pr	0.41201	68.49
				tenure_p	-26.93	-0.16
2	*priv* = 1; *tenure_c*>0	14041	0.2686	Intercept	-15868	-8.95
				lonn_pr	0.41371	70.72
				tenure_c	-13.85	-0.19
3	*priv* = 1; *tenure_at*>0	14047	0.2699	Intercept	-19675	-11.34
				lonn_pr	0.40951	70.50
				tenure_at	366.05	4.70
4	*priv* = 1; *tenure_p* ≥ 5	14171	0.2672	Intercept	-15874	-3.58
				lonn_pr	0.41225	68.33
				tenure_p	12.95	0.07
5	*priv* = 1; *tenure_c* ≥ 5	10810	0.2911	Intercept	-39254	-15.35
				lonn_pr	0.46085	65.31
				tenure_c	489.78	4.80
6	*priv* = 1; *tenure_at* ≥ 5	10820	0.2959	Intercept	-44374	-18.79
				lonn_pr	0.45897	65.65
				tenure_at	942.59	9.68
7	*priv* = 1; *tenure_p* ≥ *1*0	13894	0.2646	Intercept	-14494	-2.59
				lonn_pr	0.41601	67.87
				tenure_p	-74.73	-0.33
8	*priv* = 1; *tenure_c* ≥ 10	8126	0.2828	Intercept	-44411	-10.24
				lonn_pr	0.50714	55.68
				tenure_c	221.45	1.27
9	*priv* = 1; *tenure_at* ≥ 10	8148	0.2882	Intercept	-56071	-17.11
				lonn_pr	0.50236	56.10
				tenure_at	967.33	7.68

Table 10. Models for *pp_nx* as dependent variable. Choosing tenure variable.

We start from comparing different tenure calculations. Table 10 contains the properties of several estimated models. First we note that all the models have a reasonable fit with R-square little under 30%. All the intercept coefficients and the coefficients with *lonn_pr* are significant. But there are some problems with the significance of tenure variable. Specifications 1, 2, 4, 7 and 8 have insignificant tenure coefficient while only regressions with *tenure_at* display stable significance for this parameter. This justifies the usage of *tenure*_at variable in further analysis in spite of the its problems described above. The only question left is filtering out irrelevant observations. Keeping in mind the rules for tax exemption described above, we should aim the filtering process to 30 years of tenure and retirement age of 67 in setting up the threshold levels. On the other hand some people start receiving OP before they have worked in a company for 30 years (this follows from the considerable decline in

number of observations after applying higher limit on tenure) and the need for estimating potential OP for people not having worked for long forces us to keep the tenure threshold level much lower. We picked 5 years level for further investigations as it filters out clear outliers and leaves room for most of the sample to be studied.

The issue of filtering out low tenures is very closely related to filtering out low retirement age observations. In the studied dataset[4] 4.17% of the people are observed to retire with OP before they are 50 years old with the youngest retiree aged 20. This is due to some inaccuracy in identifying OP benefits present even after exclusion of survival benefits and disability pension recipients. This is why a threshold for retirement age is required as well. Together with the tenure filtering it will allow focusing on the exact group of people presenting the OP accruing dynamics more accurately. Possible levels for this threshold will be discussed a little later after the industry dummies and the two approaches to transfer period treating are analyzed.

	Description Additional filtering	N obs	Adj. R-square	Factor	Estimate	t-value
10	*priv* = 1; *tenure_at*>5	10820	0.3212	Intercept	-35531	-12.23
				lonn_pr	0.44552	63.79
				tenure_at	1206.99	12.45
				ind1	-6343.06	-0.77
				ind2	43988	7.07
				ind3	-28761	-11.69
				ind4	9374.95	2.08
				ind5	7061.27	1.78
				ind6	-2968.49	-1.02
				ind7	15462	3.97
11	Agriculture, hunting, forestry, fishing *priv* = 1; *tenure_at*>5; *ind1*=1	129	0.0396	Intercept	34127	2.98
				lonn_pr	0.12188	2.70
				tenure_at	-448.57	-0.61
12	Mining *priv* = 1; *tenure_at*>5; *ind2*=1	241	0.3535	Intercept	-79899	-2.27
				lonn_pr	0.63709	11.43
				tenure_at	2848.31	1.49
13	Manufacturing *priv* = 1; *tenure_at*>5; *ind3*=1	4526	0.4334	Intercept	-61598	-27.14
				lonn_pr	0.40381	51.59
				tenure_at	1635.13	23.75
14	Electricity, gas, water *priv* = 1; *tenure_at*>5; *ind4*=1	512	0.1498	Intercept	12403	1.20
				lonn_pr	0.35136	9.45
				tenure_at	225.48	0.67
15	Construction	711	0.2466	Intercept	4277.69	0.64

[4] 10 820 persons working in private sector with recorded tenure at least 5 years.

	Description Additional filtering	N obs	Adj. R-square	Factor	Estimate	t-value
	priv = 1; *tenure_at*>5; *ind5*=1			*lonn_pr*	0.31865	14.89
				tenure_at	870.70	2.75
16	Wholesale and retail trade, restaurants and hotels *priv* = 1; *tenure_at*>5; *ind6*=1	1935	0.2163	Intercept	-52769	-5.77
				lonn_pr	0.56690	22.40
				tenure_at	266.30	0.53
17	Transport *priv* = 1; *tenure_at*>5; *ind7*=1	756	0.4676	Intercept	160.04	0.02
				lonn_pr	0.43637	25.69
				tenure_at	-16.18	-0.04
18	Financing, insurance, real estate and business services *priv* = 1; *tenure_at*>5; *ind8*=1	1398	0.3462	Intercept	-15313	-2.52
				lonn_pr	0.38330	27.11
				tenure_at	685.43	2.08
19	*priv* = 1; *tenure_at*>5	10820	0.3111	Intercept	-40884	-12.65
				lonn_pr	0.45900	66.30
				tenure_at	1141.12	11.71
				Ind23	-21918	-7.80
				Ind14567	7122.99	2.55

Table 11. Models for *pp_nx* as dependent variable. Industry analysis.

Table 11 shows the results of incorporating industry dummies into the model. Specification 10 has industry specific intercepts. Since we only work with private sector the reference group “Public administration and defense” is not present, industry 8 “Financing, insurance, real estate and business services” plays its role in the model. Even though the adjusted R-square has increased compared to the specification 6, there are a lot of insignificant coefficients with industry dummies. Possible way to improve the situation is to run separate regression for all the industries which is done in specifications 11 to 19. Several problem arise here both with deteriorating fit and drastic decrease in number of observations for some industries. If we however divide the sample in larger groups we get better results. Specification 19 shows the model with two industry dummies – one representing mining and manufacturing, the other representing all the rest. This last specification leads to full significance of the coefficients. We shall use this division into two groups further on.

	Description Additional filtering	N obs	Adj. R-square	Factor	Estimate	t-value
20	*Original logic* *priv* = 1; *tenure_at* ≥ 5; *retage* ≥ *50*	10365	0.2957	Intercept	-47881	-19.10
				lonn_pr	0.47099	64.49
				tenure_at	963.30	9.63
21	*Original logic* *priv* = 1; *tenure_at* ≥ 5; *retage* ≥ *60*	9919	0.3886	Intercept	-45290	-23.14
				lonn_pr	0.44977	77.22
				tenure_at	1012.85	13.33
22	*Original logic* *priv* = 1; *tenure_at* ≥ 5; *retage* ≥ *67*	3898	0.4147	Intercept	-25327	-12.17
				lonn_pr	0.31409	51.91
				tenure_at	210.01	2.07
23	*Alternative logic* *priv* = 1; *tenure_at* ≥ 5; *retage* ≥ *50*	12140	0.1847	Intercept	-6707.38	-2.86
				lonn1R	0.35946	50.87
				Tenure_at	859.40	8.39
24	*Alternative logic* *priv* = 1; *tenure_at* ≥ 5; *retage* ≥ *60*	11557	0.2208	Intercept	-4052	-2.04
				lonn1R	0.33738	55.22
				Tenure_at	868.80	10.22
25	*Alternative logic* *priv* = 1; *tenure_at* ≥ 5; *retage* ≥ *67*	4237	0.2127	Intercept	-1059.19	-0.42
				lonn1R	0.24227	33.45
				Tenure_at	309.84	2.50

Table 12. Models of original and alternative logics for transformation period.

Next we turn to the question of how the transformation period (fig. 7) should be dealt with. Table 12 shows the results of a series of specifications designed to answer it. Several filters for the retirement age are added to the settled filtering rules (*priv*=1 and *tenure_at*≤5). Original logic represents the models estimated on the data from years 1 and 3 (dependent variable *pp_nx*)and the alternative logic represents the analysis on the years 2 and 3 (dependent variable *ppR1*, look fig. 7). It is clear from the table that for every pair of specifications with similar filters the alternative logic model is less sharply estimated and has much lower value of coefficient of determination. This shows clearly, that the assumption about insignificant interrelations between wage and OP in the transformation period should be rejected and the original logic applied for further modeling.

Then we investigate the question of proper retirement age threshold. In table 13 there are presented 8 specifications with different cut-off points for the retirement age. The rest of the filters are the same – *priv*=1 and *tenure_at*≥5.

	Description Additional filtering	N obs	Adj. R-square	Factor	Estimate	t-value
26	*priv* = 1; *tenure_at* ≥ 5; *retage* ≥ *60*	9919	0.3886	Intercept	-45290	-23.14
				lonn_pr	0.44977	77.22
				tenure_at	1012.85	13.33
27	*priv* = 1; *tenure_at* ≥ 5; *retage* ≥ *61*	9429	0.3642	Intercept	-41509	-21.04
				lonn_pr	0.42888	71.44
				tenure_at	914.86	11.81
28	*priv* = 1; *tenure_at* ≥ 5; *retage* ≥ *62*	8855	0.3535	Intercept	-38399	-19.19
				lonn_pr	0.41371	67.77
				tenure_at	822.00	10.22
29	*priv* = 1; *tenure_at* ≥ 5; *retage* ≥ *63*	8006	0.3547	Intercept	-37682	-18.34
				lonn_pr	0.40160	64.72
				tenure_at	747.20	8.69
30	*priv* = 1; *tenure_at* ≥ 5; *retage* ≥ *64*	7031	0.3587	Intercept	-33501	-15.76
				lonn_pr	0.39013	61.65
				tenure_at	536.93	5.81
31	*priv* = 1; *tenure_at* ≥ 5; *retage* ≥ *65*	6044	0.3658	Intercept	-28759	-13.05
				lonn_pr	0.37446	58.19
				tenure_at	430.27	4.28
32	*priv* = 1; *tenure_at* ≥ 5; *retage* ≥ *66*	4620	0.3764	Intercept	-24403	-11.35
				lonn_pr	0.32877	52.15
				tenure_at	267.58	2.61
33	*priv* = 1; *tenure_at* ≥ 5; *retage* ≥ *67*	3898	0.4147	Intercept	-25327	-12.17
				lonn_pr	0.31409	51.91
				tenure_at	210.01	2.07

Table 13. Models for *pp_nx* as dependent variable. Investigating retirement ages.

Quite outstanding - we observe full monotony in several characteristics. As the threshold level on the retirement age increases the coefficient with the salary goes down and is estimated less and less accurate, the coefficient with the tenure variable also decreases and is also estimated less and less accurate. The intercept goes down and is estimated with less accuracy as well up to the point of 66 years with little increase for the last model. The estimates in these specifications change quite a lot and this means that the prediction of the potential occupational pension will be very sensitive to the retirement age of the target population it is calculated for. Two main groups are the people retiring at normal NIS age of 67 and those receiving OP together with AFP pensions (at 64 years of age in 1996). This is why in our further analysis we will separate the sample into two divisions – retirement age between 64 and 66 and retirement age greater or equal to 67.

In all the specifications considered so far the significance of the coefficient with tenure variable seemed to be very sensitive to the filtering conditions. This is very likely due to the problematic tenure recording that was mentioned earlier. Table 14 contains next several specifications to investigate this issue.

	Description Additional filtering	N obs	Adj. R-square	Factor	Estimate	t-value
34	*priv* = 1; *tenure_at* ≥ 5; *retage* ≥ 67	3898	0.4147	Intercept	-25327	-12.17
				lonn_pr	0.31409	51.91
				tenure_at	210.01	2.07
35	*priv* = 1; *tenure_at* ≥ 5; *retage* ≥ 67	3898	0.4142	Intercept	-22565	-14.10
				lonn_pr	0.31556	52.50
36	*priv* = 1; *tenure_at* ≥ 5; 64 ≤ *retage* ≤ 66	3133	0.3568	Intercept	-43607	-11.00
				lonn_pr	0.49468	41.20
				tenure_at	637.20	4.33
37	*priv* = 1; *tenure_at* ≥ 5; 64 ≤ *retage* ≤ 66	3133	0.3532	Intercept	-34113	-10.30
				lonn_pr	0.49741	41.36

Table 14. Models for *pp_nx* as dependent variable. Tenure variable contribution.

Comparing pairwise the estimation results of specifications 34 and 35 and also 36 and 37 we conclude that the tenure variable does not contribute much for the goodness of fit and the quality of the regression. This is rather sorrow fact since tenure does undoubtedly play a significant role in determining the level of pension. But apparently the data available for the calculating of tenure is very unreliable and should not be used to investigate the OP occurring mechanisms.

The failure of tenure variable turns down the original idea on the final model structure and forces the usage of some simplified linear regression. The original equations are briefly outlined here anyhow for the sake of preserving them for future use (possible with more accurately recorded tenure). Main hypothesis proposed stated that the NIS and OP pensions together lead to some standard compensation ratio in the end of 30 years working life while for people retiring earlier it is reduced proportionally. With W denoting the last salary, T denoting the tenure and N denoting the NIS pension we get:

$aW = N + OP(30)$ for $tenure \geq 30$,

for $tenure < 30$ $\mathrm{OP} = \frac{T}{30} OP(30) = \frac{T}{30}(\mathrm{aW} - \mathrm{N}) = \frac{a}{30}\mathrm{TW} - \frac{1}{30}\mathrm{TN}.$

To check this model structure special regression equations through the origin were estimated with common settled filters (*priv*=1 and *tenure_at*≥5), different retirement age filters and with tenure calculated from after the year 1978. Since the

employer registers were started then such tenure would be the most reliable. The results are presented in table 15.

	Description Additional filtering	N obs	Factor	Estimate	t-value
38	*priv* = 1; *tenure_at* ≥ 5; *retage* ≥ 67; tenure calculated from after 1978	1762	*lonn_pr*tenure_at*	0.02700	24.89
			*NIS*tenure_at*	-0.00169	-6.54
39	*priv* = 1; *tenure_at* ≥ 5; *retage* = 67; tenure calculated from after 1978	1572	*lonn_pr*tenure_at*	0.02739	22.76
			*NIS*tenure_at*	-0.00167	-5.80

Table 15. Models for *pp_nx* as dependent variable. Special model structure.

Even though both models are quite sharply estimated, the coefficient with *NIS*tenure_at* variable is very far off the expected 1/30=0.0333. If we relax the assumption about the 30 years full tenure and let it be estimated from the model the estimator would be about 590 years. Replacement ratio *a* calculated from the estimators (by division) would be about 16. Clearly, the estimation displays not much sense.

The unfortunate conclusion from the models presented in tables 14 and 15 is that the tenure variables is highly unreliable and has to be dropped from the analysis.

Thus, we are forced to choose some linear regression from the best models estimated above. We use all settled filters and also incorporate into the model two combining industry dummies (where they become significant) and separate the sample into two groups by gender. The gender separation is done according to some indications that females may have generally lower yearly salary, this is supported by the pilot predictions that give much more negative OP predictions for females than for males. Table 16 contains the final results used for predictions.

	Description Additional filtering	N obs	Adj. R-square	Factor	Estimate	t-value
40	*priv* = 1; *tenure_at* ≥ 5; 64 ≤ *retage* ≤ 66; *sex* = 0 (Males)	2508	0.4308	Intercept	-13225	-2.03
				lonn_pr	0.53895	39.37
				ind23	-59890	-11.23
				ind14567	-15018	-2.77
41	*priv* = 1; *tenure_at* ≥ 5; 64 ≤ *retage* ≤ 66; *sex* = 1 (Females)	625	0.2244	Intercept	16099	3.11
				lonn_pr	0.34919	12.57
				ind23	-28087	-6.73
42	*priv* = 1; *tenure_at* ≥ 5; *retage* ≥ 67; *sex* = 0 (Males)	2939	0.4218	Intercept	-14345	-4.16
				lonn_pr	0.32600	44.00
				ind23	-20871	-6.76
				ind14567	-6406	-2.17
43	*priv* = 1; *tenure_at* ≥ 5; *retage* ≥ 67; *sex* = 1 (Females)	959	0.2213	Intercept	2509.34	1.35
				lonn_pr	0.16831	16.45
				ind23	-7275.62	-3.73

Table 16. Models for *pp_nx* as dependent variable. Final models.

2.4. Calculating potential occupational pensions

It is possible to calculate OP-related numerical values according to the final models presented in table 16 for any individual from annual salary with regard to gender and industry. But this should be done with extensive amount of care. First of all OP-eligibility needs to be checked. The individual must work in a OP-company in order to have any numerical measure of OP. Second, it is quite important to check the conditions used on the sample the regression was estimated on. Particularly, it is only possible to calculate OP for private sector workers. Similarly, they have to match both retirement age and gender criteria and have tenure of more than five years. Only for these people constructed OP variable will be relevant.

Still, the question remains open, what exactly OP related figures should be used. One approach is to calculate OP endowments by calculating potential private pension next year based on the last year salary if individual retired this year. Such setup is simple, since last year salary is all that is needed to calculate OP endowment. But it is also quite unrealistic for people who doesn't have an option to retire that year. Indeed, why would a forty-years worker think about his potential OP next year, if he can not retire? Then the endowment approach seems a little inaccurate.

The other approach in constructing OP relevant figures requires projecting the earnings history to the retirement age. This is the way potential OP can be calculated. The setup is more complicated – a model has to be developed to estimate the last salary before the retirement age and then this estimation is taken into the OP

regression to give potential pension at retirement age. Even though this approach incorporates more uncertainty it seems better from a practical point of view. Indeed, it is likely, that when taking economic decisions people make some estimations of their earnings till and potential pensions at the age they plan to retire.

This is why in current research the after tax potential private pension at age 64 (to be comparable with AFP figures) are estimated. They are calculated with the use of corresponding regression specifications 40 and 41 (for men and women respectively) and reported below. The earnings predictions were carried out in the same manner it is done for AFP estimation (see section 1.2).

Income = PP	Sum of taxes to pay
0 – 63 063	0
63 063 – 87 554	0,44 * OP – 27 748
87 554 – 149 000	0,254 * OP – 11 463
149 000 – 220 500	0,31 * OP – 19 807
220 500 – 248 500	0,405 * OP – 40 755
248 500 –	0,447 * OP – 50 472

Table 17. Tax function for OP pensioners with working spouses.

Tax rules for OP incomes are as follows (for year 1996). Since the data under consideration is household data, we consider only tax functions for married people. At least one of them receives PP. Then two groups should be distinguished. First, for those OP pensioners, whose spouse is working, the tax function looks like presented in table 17. Second, for those OP pensioners, whose spouse is also a pensioner the tax function looks like presented in table 18.

Income = PP	Sum of taxes to pay
0 – 63 063	0
63 063 – 100 828	0,44 * OP – 27 748
100 828 – 149 000	0,254 * OP – 8 994
149 000 – 220 500	0,31 * OP – 17 338
220 500 – 248 500	0,405 * OP – 38 286
248 500 –	0,447 * OP – 48 723

Table 18. Tax function for OP pensioners with retired spouses.

Again as in AFP case the presented tax functions are applicable only given that the individual receives only OP pension and not OP and AFP together. The taxation of such complex benefits is discussed below in section 3.3.

Since the OP data is based on the predicted values and refers to the retirement age, an assumption about pensioner spouse identification has to be made. We assume, that if a person (spouse) is over 64 and AFP-eligible, then he/she is pensioner, also

persons over 67 are pensioners for sure. Otherwise, they are assumed to be working. Here we lower the after tax OP by rising tax for those with spouses on disability pension, etc, but this inaccuracy is very small.

2.5. Summary statistics

Private pension at age 64 was constructed for the private sector employees from the household sample used for AFP calculation in section 1.4.

First we take a look at all these people as individuals disregarding the spouse-household information. In total the sample contains 448 860 individuals with 71.06% working in private sector. OP is calculated for 91 320 persons or 28.63% of all private sector employees (20.34% of whole sample). These coverage figures may seem to contradict those reported in earlier studies, but we have to bear in mind that public sector can be considered as wholly covered with government occupational pension, which brings the figures of OP coverage up to 49.28% of whole sample.

In calculations of OP values some negative predictions were obtained. These are mainly due to inaccuracy in earnings history forecasting and general OP estimation technique. The percentage of such negative predictions is low, however. In total 12.54% of all eligible persons (6.55% of males and 20.45% of females) were given negative pensions. These people then were thought of as they didn't have private pension at all.

Descriptive statistics for OP predictions are shown in table 19 while figures 9 and 10 display the distributions of predicted OP before and after tax.

Variable	N	N missing	Mean	Std Dev	Min	Max
PP	91320	357540	68.75166	24.41249	0.103796	137.14896
After tax PP	91320	357540	63.32383	19.38828	0.103796	113.77613

Table 19. Descriptive statistics for predicted individual OP (thousands NOK).

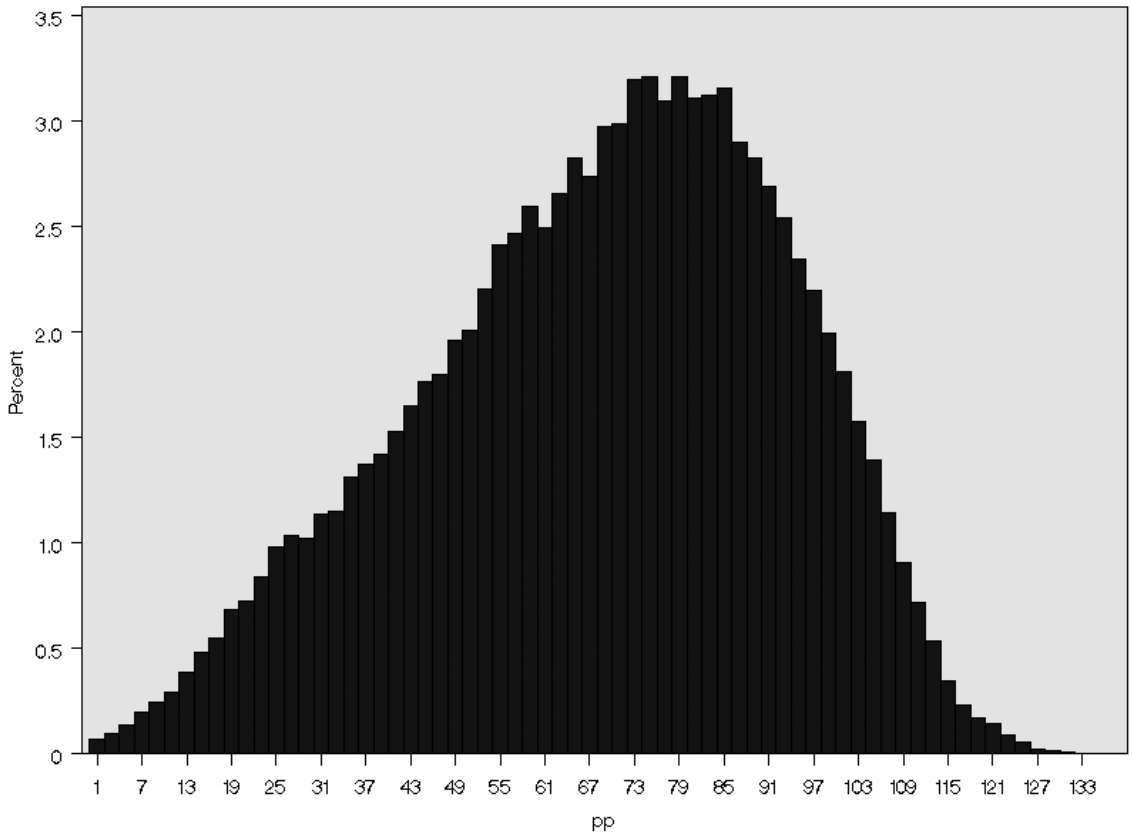

Fig. 9. Histogram for the constructed individual OP before tax (thousands NOK).

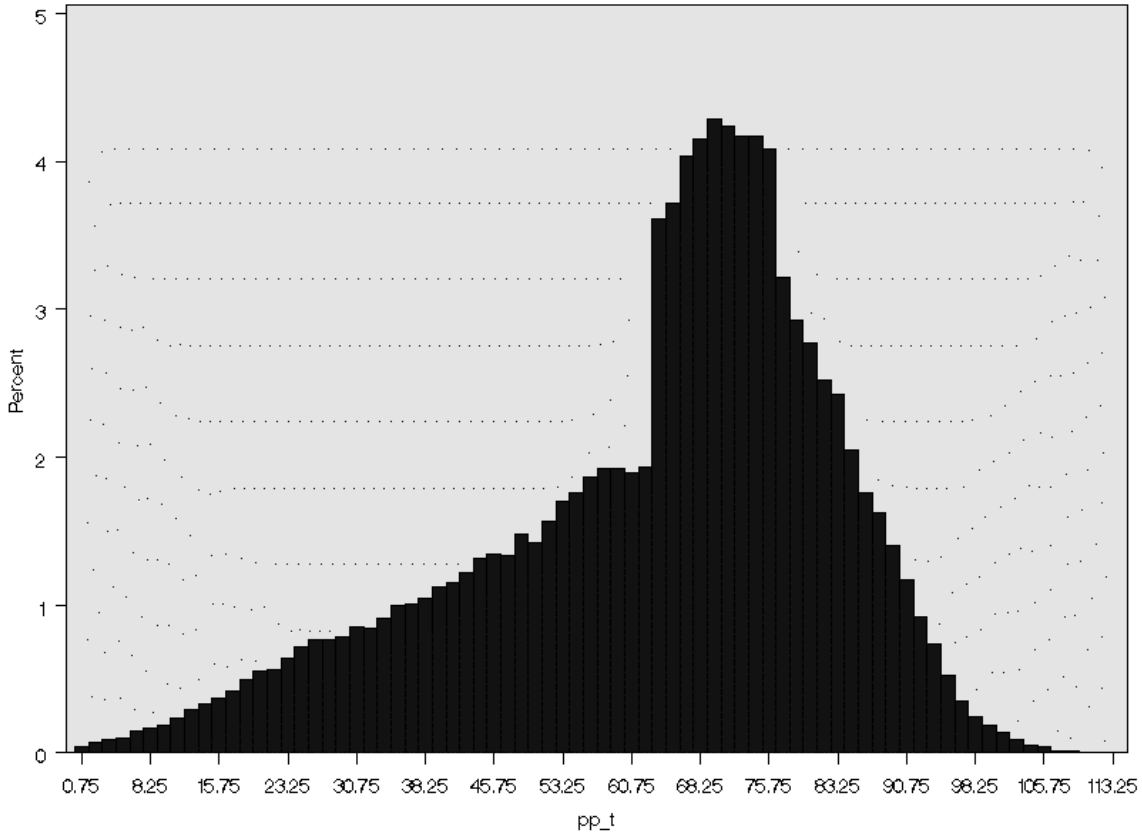

Fig. 10. Histogram for constructed individual OP after tax (thousands NOK).

Then we address the household information as well. Our sample contains 224 430 full households (having both husband and wife), 88.96% have at least one member working in private sector and 4.78% have both members working in private sector. OP figures were constructed for 78 777 households where 84.08% have one family member eligible for OP and 15.92% have both family members eligible. This implies that 39.46% of households with at least one family member working in private sector are covered with OP schemes through at least one family member (35.10% of all households).

Summary statistics are presented in table 20 with figures 11 and 12 presenting the distributions of constructed before and after tax (assuming single OP pension) household OP benefits.

Variable	N	N missing	Mean	Std Dev	Min	Max
Husband PP	61151	163279	80.39411	17.10325	7.19111	137.14896
Same after tax	61151	163279	72.74927	11.72792	7.19111	113.77613
Wife PP	30169	194261	45.15300	19.47828	0.103796	124.47153
Same after tax	30169	194261	44.21896	17.71965	0.103796	102.09005
Household PP	78777	145653	79.69840	32.40426	0.103796	245.35299
Same after tax	78777	145653	73.40635	27.84532	0.103796	203.49033

Table 20. Descriptive statistics for predicted household OP (thousands NOK).

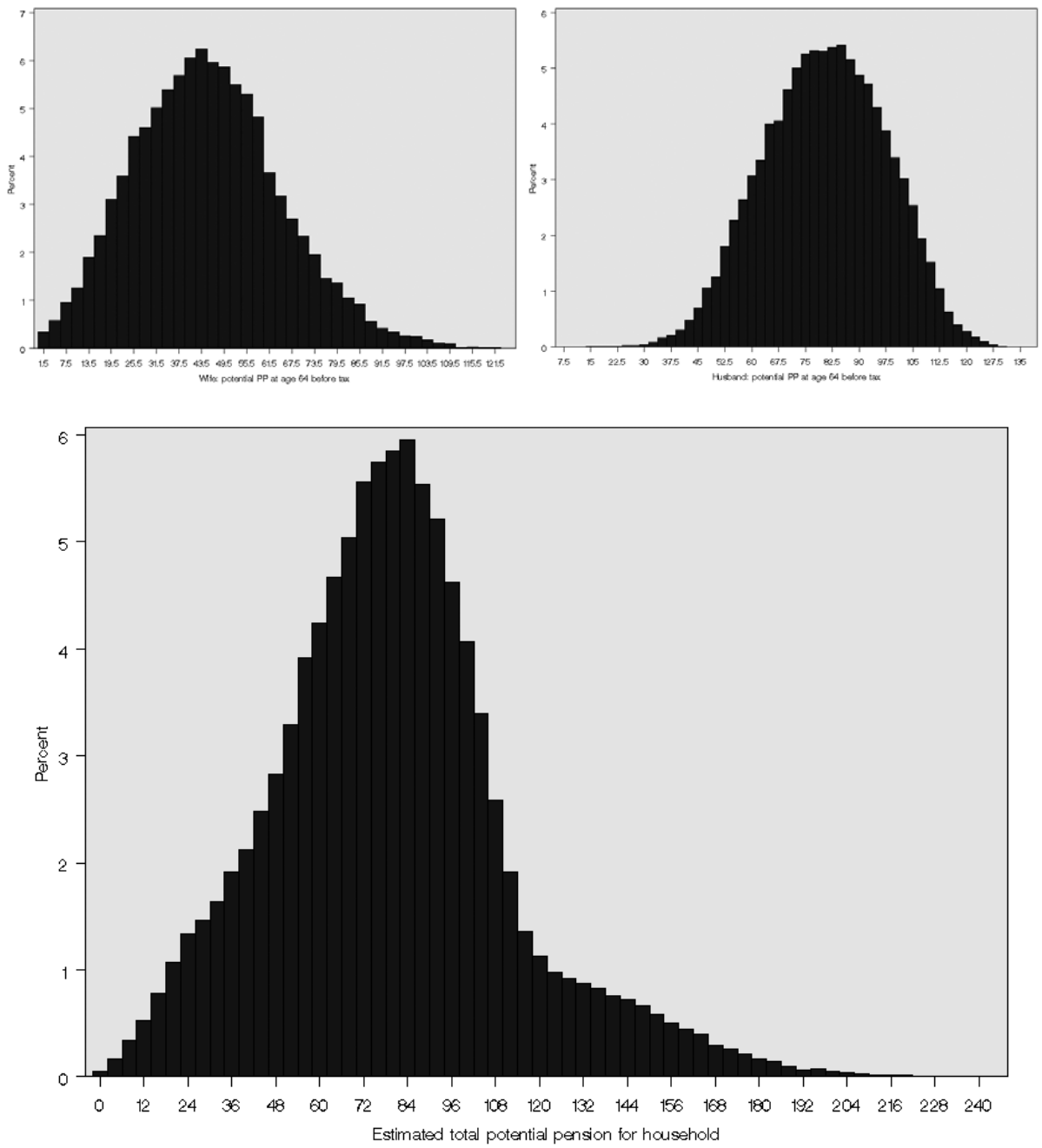

Fig. 11. Husband (top right), wife (top left) and household potential OP before tax (thousands NOK).

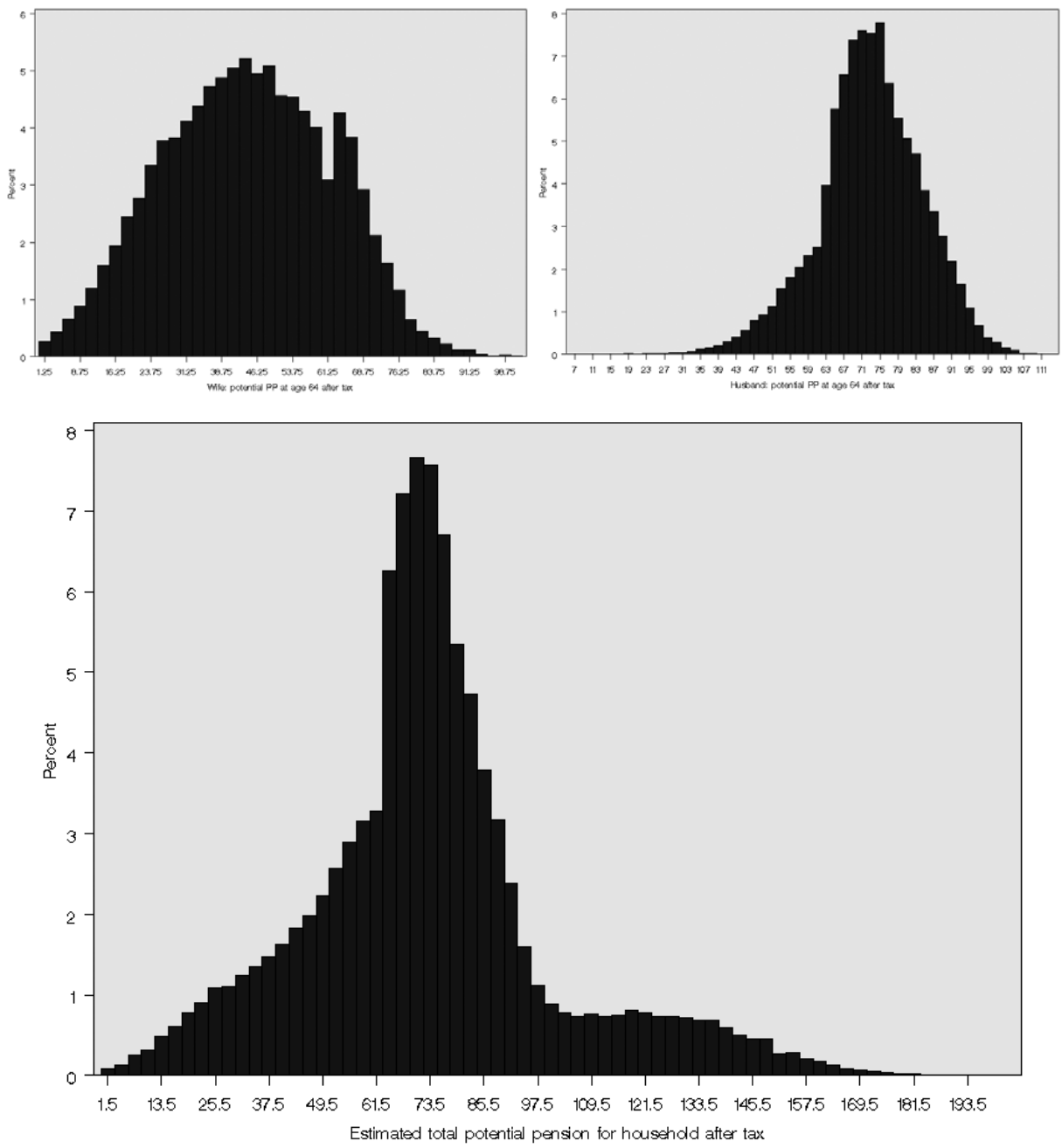

Fig. 12. Husband (top right), wife (top left) and household potential OP after tax (thousands NOK).

Chapter 3. Compensation ratios for individuals in private sector

This chapter is devoted to some initial analysis of the constructed data on AFP and OP pensions. Since people are able to pick up AFP pension from the age of 64 (for year 1996), we shall examine the compensation ratios for the individuals of this age in 1996 (so that we don't have to predict their preceding year wage income) from the sample population considered in the previous two chapters.

The whole population is divided into three groups – people eligible for private or public pension separately and those eligible for both types. Compensation ratios were calculated as the relationship between predicted pension for year 1996 (age 64) and observed wage income in year 1995 for both before and after tax. If an individual is eligible for both types of pension, separate ratios for the two were calculated as well as common ratios.

The total number of persons in the target group of population is 15 369: persons who are 64 in 1996 (from the set of households with one of the spouses 1928-1955 birth year). Since calculation of compensation ratio requires values of both pension and wage for individual, only persons with non-missing values were included in following analysis. There were 9 303 individuals who meet requirement of non-zero (and non-missing) value on wage in 1995 if any kind of pension is known. 6 310 of them are in private sector. The final group of population for further analysis contain 2 830 persons (i.e. persons at the age of 64 in 1996 in private sector who has eligibility to AFP or occupational private pension and consistent value of wage income in 1995). 820 of them are only AFP eligible, 425 are eligible to only occupational private pension, and 1 585 have an access to both kinds of pensions.

3.1. AFP pensioners

In this section compensating ratios were calculated based on the predicted AFP pension before and after tax for AFP only eligible persons. Analysis was done for two different cases with and without filtering out the outliers.

As it was argued above, there are 820 persons to be analysed in this section (persons who are AFP eligible only). The characteristics for calculated compensation ratios without any restrictions are the following.

Variable	N	Mean	Std Dev	Min	Max
Compensation ratio for AFP	820	0.72864	1.2417	0.23984	30.90920
Compensation ratio for AFP after tax	820	0.89746	1.09824	0.35747	26.66637

Table 21. Descriptive statistics for AFP pension compensation ratios (with outliers).

Obviously the data contains outliers, which should be taken care of. After examining several different methods to exclude them there was chosen the following one. We excluded 10 observations with highest compensation ratios after tax and 10 lowest ratios before tax from the sample. Also missing values were excluded. Descriptive statistics are introduced in the table below.

Variable	N	Mean	Std Dev	Min	Max
Compensation ratio for AFP	800	0.64074	0.2929	0.31381	2.8519
Compensation ratio for AFP after tax	800	0.81958	0.31960	0.45177	3.1066

Table 22. Descriptive statistics for AFP pension compensation ratios (no outliers).

Histograms for these two cases (before and after tax) are presented below.

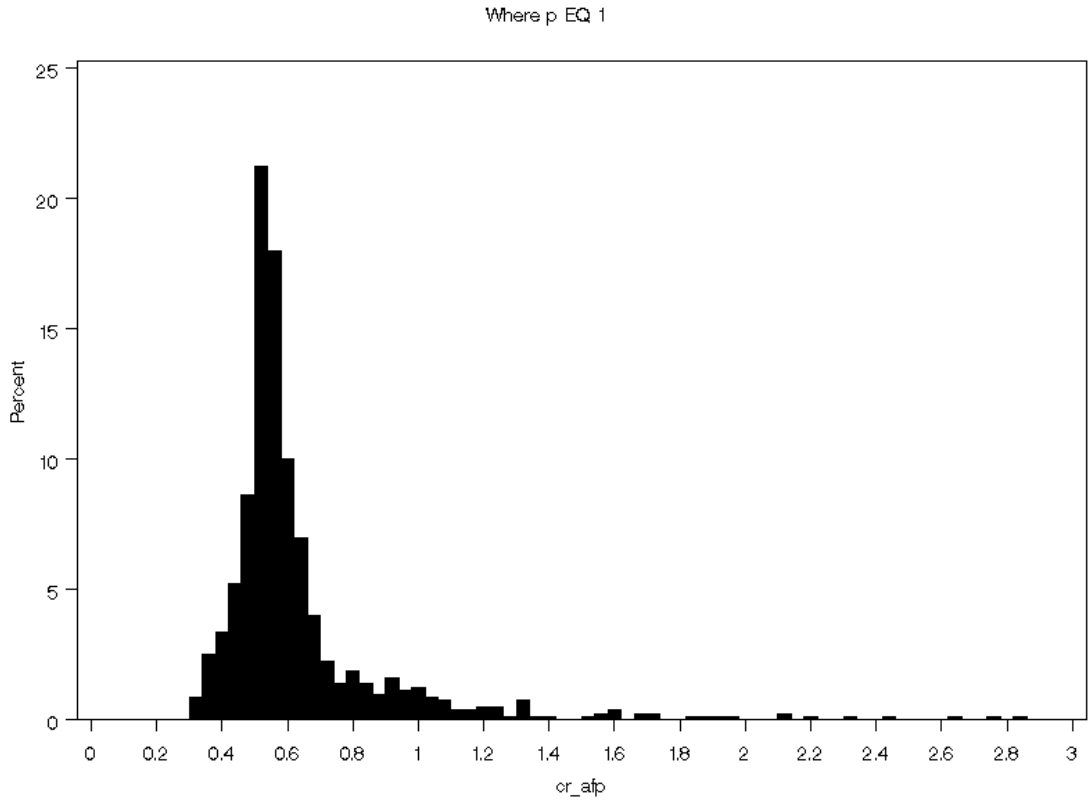

Fig. 13. Histogram of compensation ratio for AFP pensions before tax.

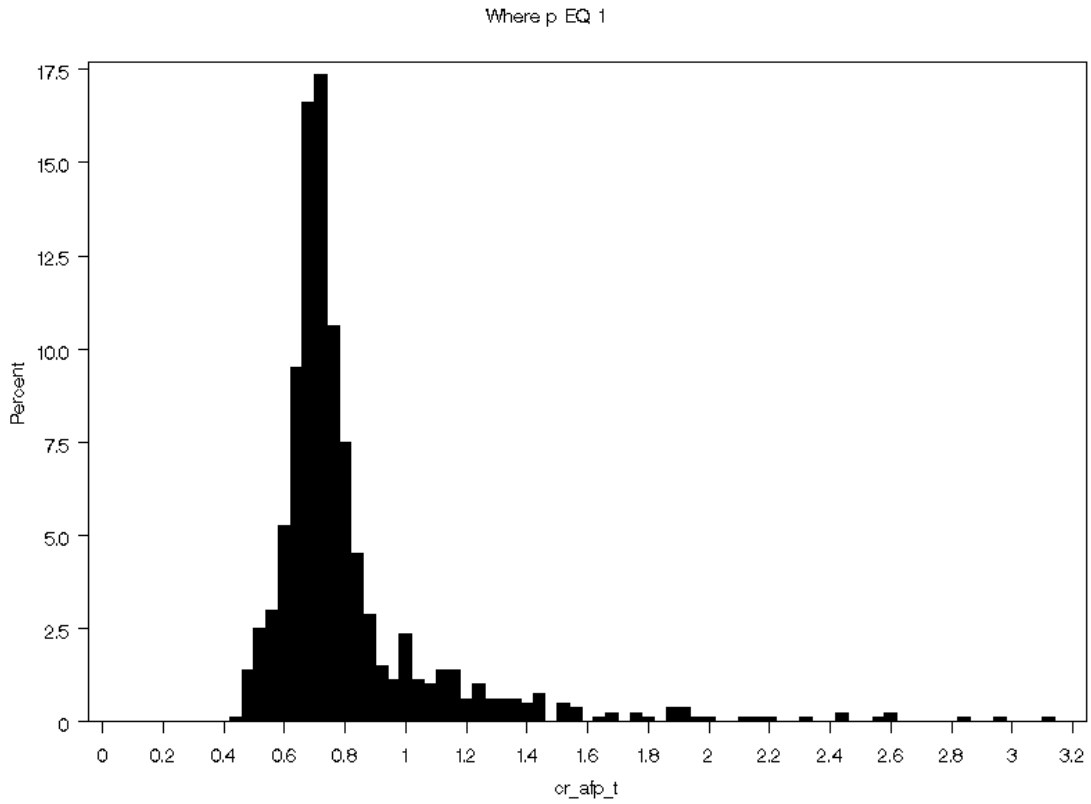

Fig. 14. Histogram of compensation ratio for AFP pensions after tax.

The results of calculations seem to be reasonable. The mean values correspond to the one we expected, especially with regard to calculation procedure of AFP pensions. Increase in 'after tax' compensation ratios compared with ones before tax could be explained by different taxation rules for these two types of income (since taxes on pension income are less than on wage income).

3.2. OP pensioners

In this section compensation ratios for occupational private pensions were calculated for sampled individuals who has access only to occupational pension schemes. Calculations were done for two different cases again – before and after taxes.

The total number of observation with eligibility to occupational private pensions and not to AFP pensions is 425 (see above). Descriptive statistics are presented in the table below.

Variable	N	Mean	Std Dev	Min	Max
Compensation ratio for OP before tax	425	0.76032	2.77142	0.04186	55.660
Compensation ratio for OP after tax	425	0.85684	2.57601	0.05708	51.908

Table 23. Descriptive statistics for OP pension compensation ratios (with outliers).

In this case we also need to make some restrictions to filter out the outliers as some extremes are observed. Again after testing several methods the same was chosen

as was used for AFP pensions. After excluding observations with 15 highest replacement ratios after tax and 5 lowest ratios before tax and dropping missing values, following summary statistics were received.

Variable	N	Mean	Std Dev	Min	Max
Compensation ratio for OP before tax	405	0.51804	0.30776	0.11075	2.19322
Compensation ratio for OP after tax	405	0.63497	0.31246	0.15242	2.25588

Table 24. Descriptive statistics for OP pension compensation ratios (no outliers).

Histograms for ratios before and after tax are drawn below to describe results more clearly.

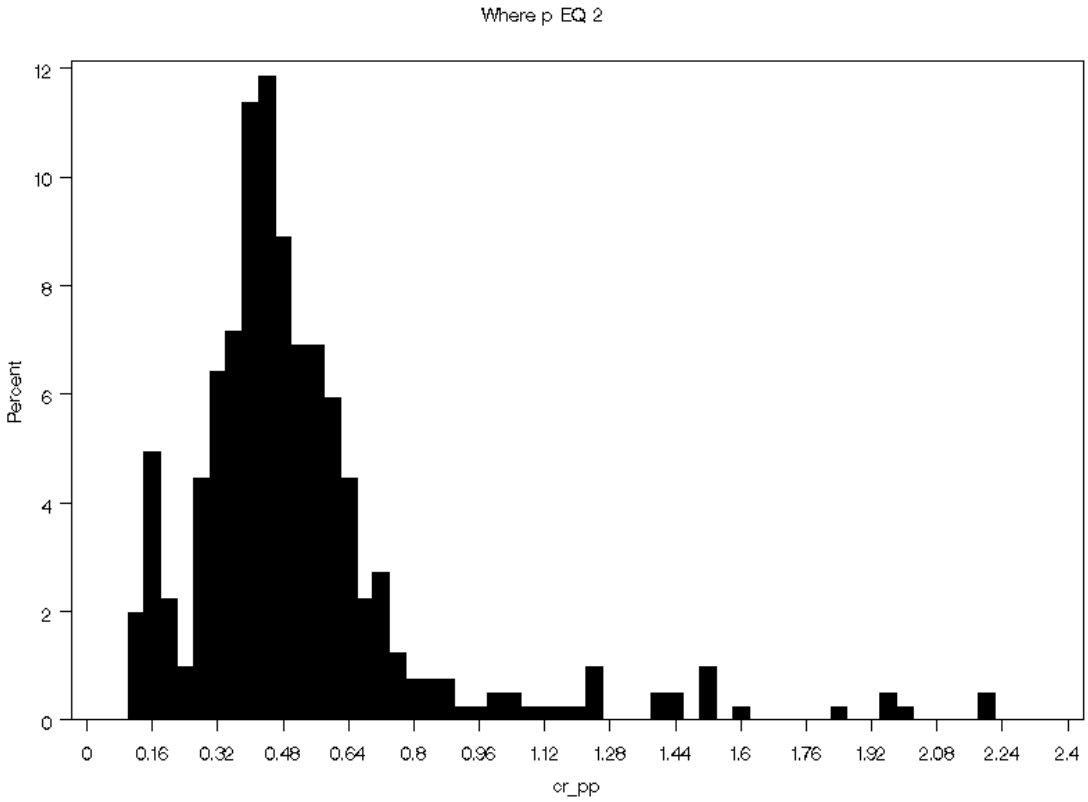

Fig. 15. Histogram of compensation ratio for occupational private pensions before tax

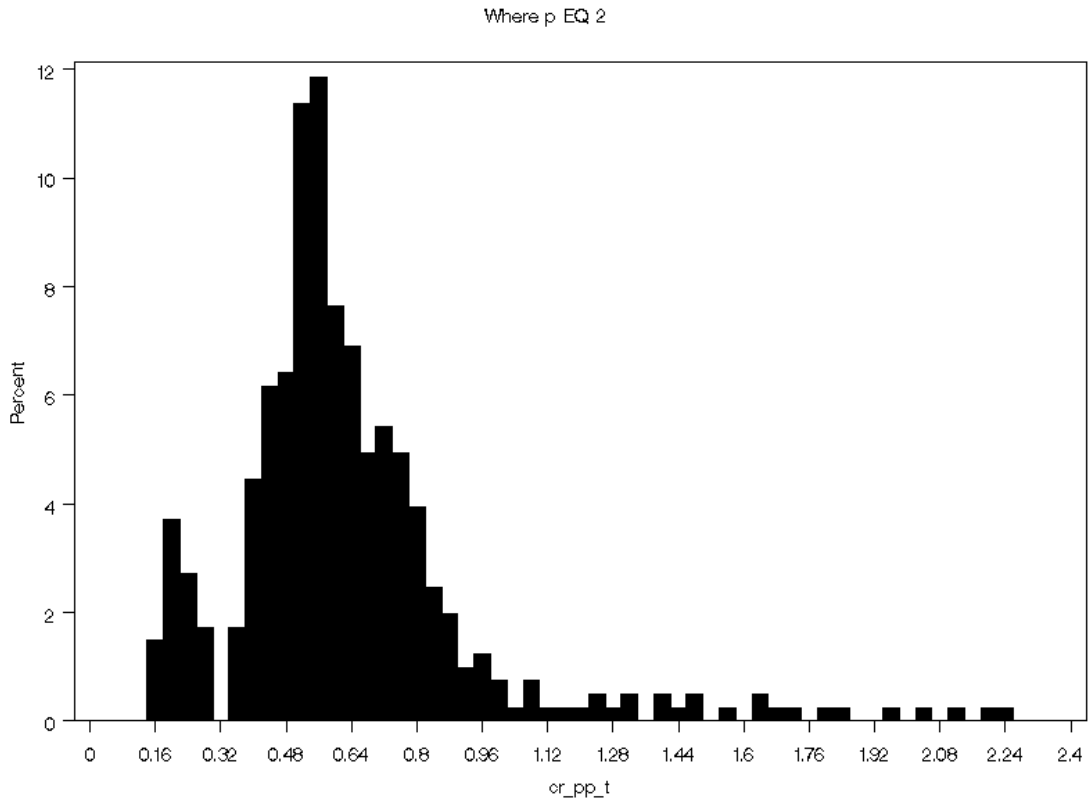

Fig. 16. Histogram of compensation ratio for occupational private pensions after tax.

Comparing to AFP pensions compensation ratios here have smaller values, but it is consistent with the theory and seems quite reasonable

3.3. AFP and OP pensioners

In this section we look at persons who are eligible to both AFP and private pensions. Analysis was carried out to find partial compensation ratios for the two pensions as well as the common ratio for total pension benefits.

Access to both types of pensions influences the value of potential pensions. There is no common rule, but empirical checks indicate that persons who have access to both AFP and OP get lower occupational pensions than those with access only to OP. The rate of reduction is on average 50%. A double eligibility, however, doesn't affect the value of AFP pension since it's calculated according to the official rules. Since future potential OP pensions have been calculated for eligible persons regardless to their eligibility to AFP, for the current group of people the reduction coefficient 0.5 for OP levels was applied. More work is being done on this.

The tax rules also differ a little for the people who are simultaneously eligible for AFP and OP pensions. First, the gross pension benefit is taxed, not the components individually. Next, it turns out that according to the current legislation the

AFP tax rules overwrite those of OP. Thus, AFP taxation is applied for the total pension. This makes it impossible to calculate separate compensation ratios after tax for different types of pensions.

There are 1 585 people observed with access to both pension types in the final group of population to be included into analysis. The first stage of analysis refers to unrestricted sample and gives results as presented below.

Variable	N	Mean	Std Dev	Min	Max
Compensation ratio for AFP (before tax)	1 585	0.64085	1.49096	0.17229	56.37276
Compensation ratio for OP (before tax)	1 585	0.21137	0.64785	0.00095	24.96971
Comp. ratio for sum pension before tax	1 585	0.85222	2.12882	0.26353	81.34246
Comp. ratio for sum pension after tax	1 585	1.00035	1.68000	0.36781	63.68267

Table 25. Descriptive statistics for total pension compensation ratios (with outliers).

It's easy to see that outliers significantly influence summary statistics. To avoid this some critical observations were once more deleted from the sample. This time the following method was chosen. Observations with 10 highest AFP replacement ratios after tax and with 10 lowest PP ratios before tax were excluded as well as observations with missing values on wage income. The following results were obtained.

Variable	N	Mean	Std Dev	Min	Max
Compensation ratio for AFP (before tax)	1 565	0.57611	0.21729	0.17229	3.34937
Compensation ratio for OP (before tax)	1 565	0.18700	0.18998	0.01503	1.41635
Comp. ratio for sum pension before tax	1 565	0.76310	0.29177	0.26353	4.76572
Comp. ratio for sum pension after tax	1 565	0.92873	0.29264	0.36781	4.60985

Table 26. Descriptive statistics for total pension compensation ratios (no outliers).

We observe a slight decline in both AFP and OP compensation ratios for the current group of people compared to the previous two. At the same time the total average pension compensation ratio rises up to almost one in after tax calculation. This seems quite reasonable that people having only one type of pension have greater

compensation ratio in this type, but smaller total ratio. Still, this phenomenon requires more accurate study.

The following figures present histograms on compensation ratios of total pension benefits for both before and after tax calculation.

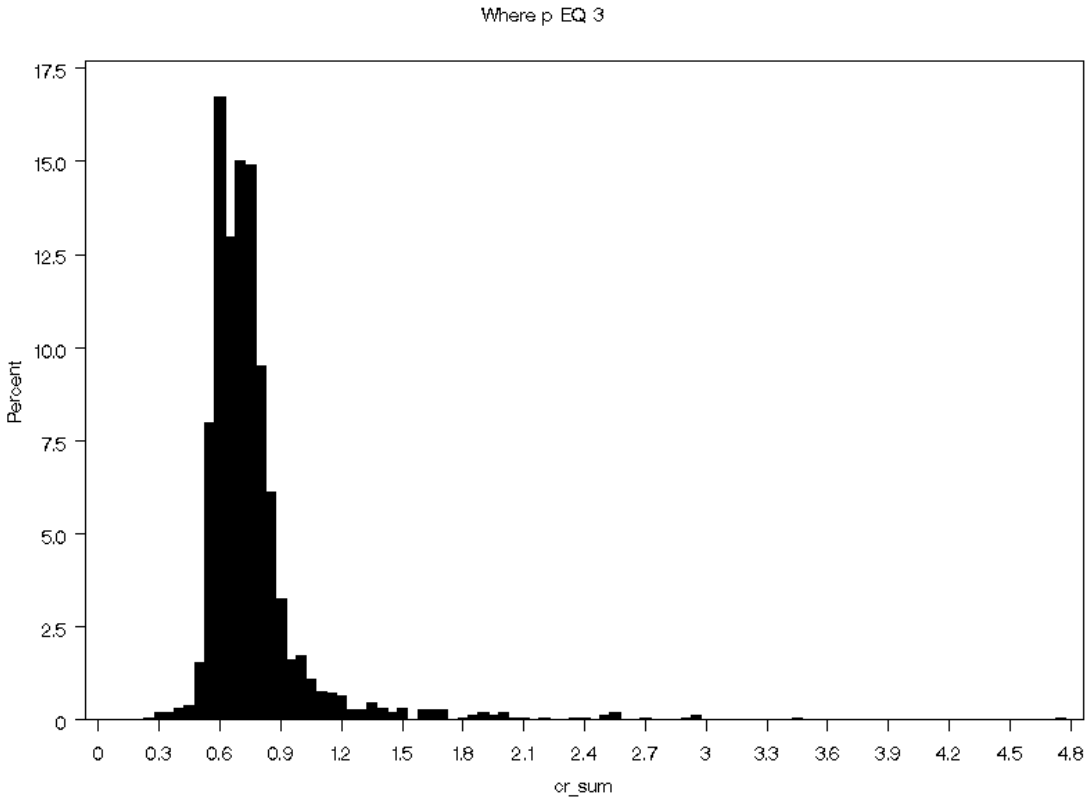

Fig. 17. Compensation ratios for total AFP and PP pension benefits before tax.

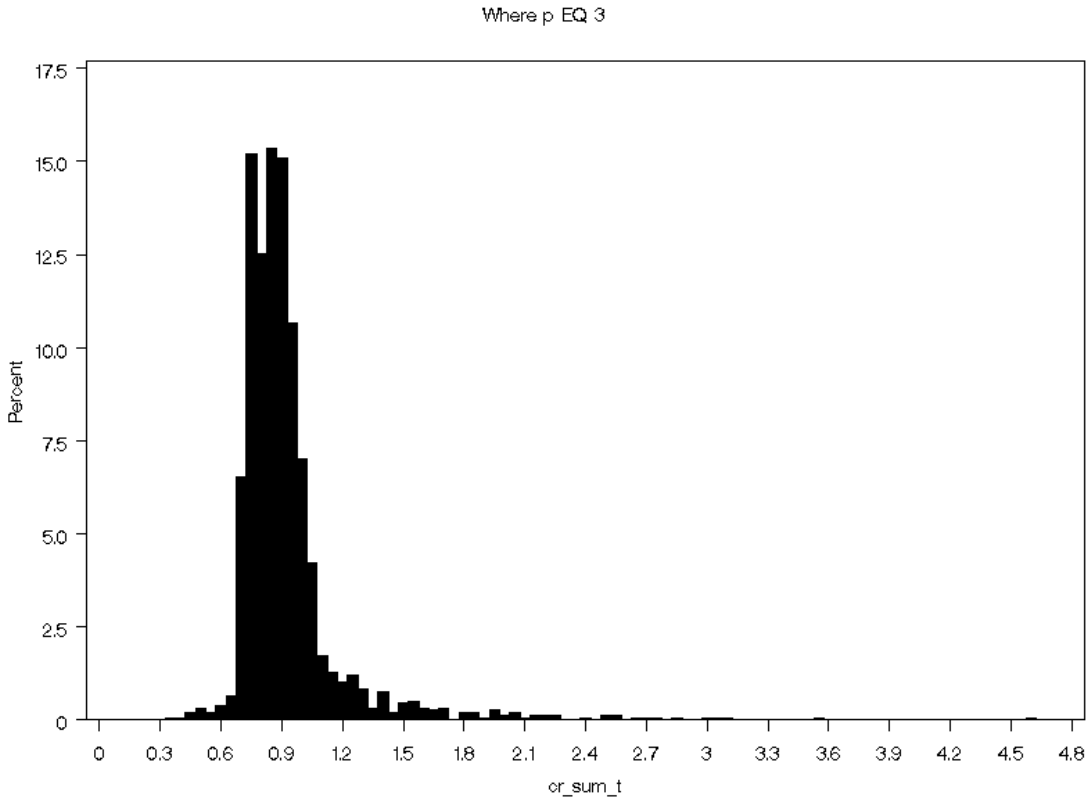

Fig. 18. Compensation ratios for total AFP and PP pension benefits after tax.

Conclusion

The current paper presents helpful techniques that allow construction of the unobserved potential AFP and private pension in Norway. These two types of pensions designed as secondary supply of income to retirees now play an increasing role. The quantitative characteristics of these pensions are hard to recover. In previous research often only dummy variables were used to indicate presence of these types of pensions.

The main idea of the described technique was to identify the companies paying private pension or AFP in the extensive dataset of micro data available from the employer register, tax file, demographic files, etc. Then it was possible to find persons working in such companies and to identify the persons eligible for these types of pension. In the case of AFP institutional rules were applied to construct the pension at a certain age, and in case of private pension a regression equation was applied. The latter equation was estimated on the set of observed private pension pensioners.

The described technique was used on the sample population (people who did not retire in 1996 and was born in 1928 or later), which will be studied in the related project. The quantitative characteristics will hopefully increase the quality of the data this project is based upon. Descriptive statistics and histogram charts are presented for this sample.

Based on the predicted values of pensions compensation ratios were calculated for people turning 64 in 1996. This is the first year these people have an option to retire through AFP scheme and some of them through private pension scheme, while their last working year wage income is recorded. Compensation ratios, the ratios relationship between pension benefits and wage income were calculated with both before and after tax values for three groups of individuals. Individuals from first two groups receive only one pension from the two types discussed and individuals from the third group receive both. Obtained values are presented through histogram charts and descriptive statistic tables.

The created data is likely to be very helpful in the studies of decision making processes on the labour market.

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