Statistics Norway
Statistisk sentralbyrå

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Documents

Measuring the stock of human capital for Norway

A lifetime labour income approach

Statistics Norway/Research

Acknowledgements

Financial support from Norwegian Finance Department is acknowledged. We thank Inge Aukrust, Torill Vangen, Anne Marie Rustad Holseter for great helps on data collection. Thanks also go to Thorvald Moe, Morten Henningsen, Lars Johannessen Kirkebøe, all participants at the OECD workshop on the Measurement of Human Capital in Turin, Italy on 3-4, November, 2008, as well as at several seminars held in Norwegian Finance Department and Statistics Norway, for useful discussions. However, the authors are solely responsible for any remaining errors and omissions.

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1. Introduction

Although economists have a long history of recognizing that human beings and their acquired abilities are important components of the wealth of nations (Petty, 1690; Smith, 1776; Farr, 1853; Engel, 1883), it is the seminal works by Schultz (1961), Becker (1964) and Mincer (1974) among others that have spawned the wide employment of the human capital concept as one of the standard tools utilized to analyse various issues in both research investigations and policy discussions.

For instance, according to advanced economic growth theory, human capital – the knowledge, skills, competencies and attributes embodied in individuals that facilitate the creation of personal, social and economic well-being (OECD, 2001) [1]- rather than physical capital, is considered to play a decisive role in determining a country's economic prosperity (e.g. Romer, 1986, 1989; Lucas, 1988; Aghion and Howitt, 1998).

Moreover, in recent debates on the path of sustainable development, the weak sustainability theory suggests that sustainability could be achieved by a country even with resources depletion, only if the country's other assets (such as human capital) can be used to substitute for the depleting resources and thus holding the total assets unchanged (e.g. Hamilton and Atkinson, 2006; Moe, 2007; Alfsen and Moe, 2008; UNECE, 2009).

Therefore understanding human capital including its measurement is of crucial importance not only for economists and policy makers but also for development strategists.

As distinct from physical capital, human capital is intangible, the stock of which is not able to be observed. Empirical human capital models are constructed based on various proxies of human capital measures. Thus it would be difficult to imagine that conclusions drawn from these models are independent of these differentiated proxies and that policy measures based on these conclusions are not biased.

[1] Despite of the wide use of the human capital concept, different people define human capital in different ways. For interested readers on the definition issues which are beyond the scope of this paper, please see Stroombergen, et al (2002). Strictly speaking, discussions on measurement issues should be conditional on that the definition of human capital is given. Here a relatively broader definition by OECD (2001) is employed.

The stock of human capital can be measured either directly or indirectly. The indirect way to measure human capital is to estimate it residually. For instance, Statistics Norway occasionally calculates Norwegian national wealth that is defined as inputs used to produce net national income as measured in the national accounts.[2] These inputs comprise those from natural resource stocks, human capital stock, physical capital stocks and financial assets. When calculating the value of the human capital stock, net national income is decomposed by making use of the streams of income from the other wealth components. The residual, or the unexplained part of net national income, is attributed to the stream of income from the human capital component. Moreover, the value of this component is set equal to an infinite stream of the residual. The calculation results indicate that human capital is by far the most important component of Norwegian national wealth (Greaker, et al., 2005).

A similar residual approach based on national accounts is also applied in other studies in which the human capital is calculated as the differences between total wealth and the sum of the tangible components of wealth, i.e., produced capital and natural capital (World Bank, 2005, 2006; Ruta and Hamilton, 2007).

Recognizing the essential role of human capital in research and policy discussions, this indirect residual approach is not satisfying in that it cannot explain why and how the human capital evolves, thus offering less valuable information for policy making. In addition, these indirect measures of the human capital are affected by measurement errors in all the terms entering the accounting identities, resulting inevitably substantial bias in the human capital measurement (Mira, 2009).

With respect to the direct way to measuring human capital, nonparametric methods instead of parametric methods (e.g. Kyriacou, 1991) are the majority. Within nonparametric direct measures in the literature, there are in general three approaches: cost-based approach, income-based approach and educational stock-based approach (Le, et al, 2003).

The cost-based approach is to measure human capital with reference to a stream of past investments, including investments coming from individual, family, employer and governments (e.g. Shultz, 1961; Kendrick, 1976; Eisner, 1985). This approach documents all

[2] See Aslaksen et al (1990), Brekke et al. (1997), Lindholt (2000) and Greaker et al. (2005).

costs that are incurred when producing the human capital. By focusing on the historical costs of production, this approach is also called "backward-looking" or retrospective approach (Le, et al, 2003).

The income-based approach is to measure human capital with reference to future earnings (e.g. Weisbrod, 1961; Graham and Webb, 1979; Jorgenson and Fraumeni, 1989, 1992a, 1992b). In contrast with the cost-based approach that measures human capital from the input side, the income-based approach measures human capital from the output side. This approach is considered to be "forward-looking" or prospective because it focuses on the total discounted values of all the future income streams regarded as returns to investments into human capital, which all individuals expect to earn throughout their lifetime (Le, et al, 2003).

The educational stock-based approach is to measure human capital with reference to current stock of individual characteristics in the population, such as adult literacy rates, school enrolment ratios, and average years of schooling of the working-age population, etc. (e.g. Ederer, et al, 2007; OECD, 2008). This approach is also called indicators approach (Fraumeni, 2009).

All three aforementioned approaches have their pros and cons, some shared by each other. The cost-based approach is considered to be relatively easy to apply because of the ready availability of data on both public and private expenditures in e.g., formal education as human capital investments. However, it has been criticized that the value of human capital is basically determined by the demand for it, not by the cost of production (Le, et al, 2003). In addition, it is hard, if not impossible, to distinguish expenditures between investment and consumption, ending up with arbitrarily allocating spending between them. For instance, during one's education part of expenditures goes into paying for foods and clothes.

The depreciation rate which matters a great deal for the cost-based approach is usually arbitrarily set. Further, appreciation that is evident in human capital utilization especially in early years is usually ignored. As claimed by Jorgensen and Fraumeni (1989, 1992a), the main disadvantage for the cost-based approach is that it ignores a fundamental feature of the process of education, the lengthy gestation period between the current outlays of educational

inputs and the emergence of human capital embodied in their graduates. Furthermore, some of the nonmarket benefits of human capital investments remain unrecorded.

By focusing on one's earning power the income-based approach values human capital at market prices, which are regarded as good signals of the real value of human capital services due to the interaction of demand and supply of human capital in the labour market. Thus this approach provides the most meaningful estimates if the necessary data are available (Le, et al, 2003). Further, the recent lifetime income approach advocated by Jorgenson and Fraumeni (1989, 1992a, 1992b) clearly have several advantages over other approaches (see Fraumeni, 2009).

However, the income-based approach is not immune from any drawbacks. For instance, in order to calculate expected future earnings, some subjective judgements should be made about the discount rate, real income growth rate, etc. Most crucially, there are also reasons to believe that labour market does not always function perfect. Hence, the wage rate typically used as a proxy for earning power in the income-based approach is not always equal to the marginal value of a particular type of human capital. In addition, differences in wages will not truly reflect differences in earning power under certain circumstances where trade unions may command a premium wage for their members and where real wages may fall in economic recessions.

The obvious difficulty with the educational stock-based or indicators approach is that the various characteristics do not have a common unit of measurement and are therefore not easily aggregated into an overall measure, thus making either temporal or cross-sectional comparisons of human capital less possible (Stroombergen, et al, 2002). Even using a single characteristic such as average years of schooling, the most common proxy of human capital stock in empirical analysis, it is found that it poorly misspecifies the relationship between education and the stock of human capital (WÖβmann, 2003). From national accounting perspective, the human capital indicators, though rich of information, are not easy to be transferred as a human capital account on par with conventional physical account in national account systems (Fraumeni, 2008, 2009).

To sum up, for the purpose of constructing a human capital account with volumes, values and prices as basic elements, rendering both temporal and international comparisons possible and reliable, the income-based, specifically, the lifetime income approach clearly has its advantage over other approaches.

In this paper we attempt to directly measure the stock of Norwegian human capital by means of the lifetime labour income approach as advocated by Jorgenson and Fraumeni (1989, 1992a, 1992b) for measuring the human capital in the US. We use data for 2006 as an example to illustrate how this approach can be applied, based on the statistics collected at Statistics Norway.

Several recent studies have applied the lifetime labour income approach to other countries more than the US in order to estimate the stock of human capital for, e.g., Sweden (Ahlroth et al., 1997), Norway (Ervik, et al., 2003), the U. K. (O'Mahony and Stevens, 2004), Australia (Wei, 2004, 2007), New Zealand (Le et al., 2005) and Canada (Gu and Wong, 2008).

This paper also serves for three practical purposes. First of all it is to show the feasibility of applying the lifetime income approach to measuring the stock of human capital by using *available* data at Statistics Norway. The second is to expound and document the detailed implementation methodologies employed for estimation, which will be applied for other years in future studies as well. The third is to present a snapshot of the Norwegian human capital stock in 2006. By reporting comprehensively rich information such as school enrolment rates, labour participation rates, employment rates, annual income and lifetime income, distributed by age, sex and educational attainment, detailed composition pattern of the human capital stock can be found, which may improve our understanding of the human capital stock and its components.

Results from this paper, combined with those for other years by applying the same approach, will lay a ground for further analysis on the evolution of the Norwegian human capital across these years, based on which a full account of human capital paralleled with physical account in national accounting systems may be constructed, which facilitates the possibility of international comparison of the human capital in the future (Mira, 2009).

The rest of the paper is structured as follows. In section 2 a brief overview of the lifetime labour income approach is provided. Data sources and data assembling are presented in section 3. The detailed estimation methods and the assumptions made are provided in section 4. Section 5 presents some interesting empirical results. Section 6 concludes.

2. Lifetime labour income approach

The lifetime labour income approach, advocated by Jorgenson and Fraumeni (1989, 1992a, 1992b), measures the human capital embodied in individuals as the total discounted present value of expected future incomes that could be generated in the labour market over their lifetime .

Generally speaking, this approach consists of three major steps. First, a database containing the economic value of labour activities for various categories of people should be constructed. This database includes at least information on the number of people, labour income, school enrolment rates and employment rates, etc., cross-classified by gender, age and educational level.

Secondly, an algorithm for calculating the lifetime income for a representative individual in each classified category in the database should be modelled. The fundamental assumption here is that an individual with a certain sex, age and educational level will in the next year obtain the same labour income and retain the same other characteristics (such as school enrolment rates, employment rates, and survival rates, etc.) as the one who is one year older in this year but has the same sex, age and educational level.

Thirdly, the calculated representative per capita measures will be applied to all individuals in each classified category to compute the human capital sub-stock for each category. Summing up the human capital sub-stock for each category across all classified categories yields the final estimation of the aggregate value of the human capital stock.

The Jorgenson and Fraumeni lifetime income approach can be treated as an accounting system, in which human capital stock is measured by lifetime income of both market activities (through labour market) and nonmarket activities (through household production and leisure), and human capital investment is measured as the change in lifetime income

when investment activity takes place, such as births, formal and informal education, health improvement efforts, etc (Fraumeni, 2009). This accounting system has the potential to be constructed on par with traditional physical account in national accounting systems.

For balanced comments on the lifetime income approach, interested readers are referred to Rothschild (1992), Conrad (1992), Ahlroth et al (1997), Dagum and Slottje (2000) and Le, et al (2003).

3. Data

The main data set constructed for calculating the stock value of human capital draws from the Norwegian register-based employment data collected by Statistics Norway in October for each year, which covers all people residing in Norway between age 15 and 74. The number of persons in the register-based data set in 2006 is 3,413,695, accounting for about 73% of the total population in Norway.[3]

For the purpose of this study, we truncate the age from the upper bound at an age limit that is defined as 67 and yield a sub-population of 3,197,201 persons. The reason for doing this is that in Norway the officially normal retirement age is 67. Therefore we assume that after 67 years old one can only receive zero market labour income.

Note that different from Jorgenson and Fraumeni (1989, 1992a, 1992b), we focus on the *labour force* instead of the whole population in this study. One practical concern is that earlier years' register-based employment data sets only cover the labour force rather than the whole population while we plan to undertake some analysis across the years in this project.

By excluding those out of the labour force, we finally obtain a dataset for the Norwegian labour force in 2006 with 2,396,678 persons, among which there are 1,262,695 male and 1,133,983 female persons. In total, the labour force is about 75% of the afore-mentioned sub-population.

Variables used in the estimation such as age, sex, status on the labour market (categorised as "out of labour force", "employed", "self-employed", "unemployed", "unemployed but

making efforts for entering labour market"), whether registered as a current student in 2006, in which level if studying, and the total annual wage/salary are directly obtained from the register-based employment data set.

It is appropriate to make some notes at this moment on the choice of the labour income variable employed in this paper. Different from Jorgenson and Fraumeni (1989, 1992a, 1992b), we exclude nonmarket labour activities in this paper simply because the evaluation of nonmarket labour activities is, if not formidable, still a contentious issue. Therefore, all labour incomes used in this study are referred to as market labour incomes. This qualification is also embraced by several other studies, see, e. g. Wei (2004, 2007) and Gu and Wong (2008).

At present we use the variable of the total annual wage/salary as a proxy for market labour income. The variable is reported at the reference week in October and so it is equal to actual annual payment only for those who have only one job and is working on this job at the reference week in October.

Although people with only one job in one year are the majority in the labour force, the annual wage/salary variable is not necessarily equal to actual annual payment for all types of people. For example, if someone changes his job frequently, this variable may not cover all his earnings from different job places during the whole year. Rather, only the earnings from the job he is taking in the reference week is reported. This problem can be solved by using data from other sources.

Annual labour incomes for self-employed people are assumed to be the same as those for employed people with the same age, sex and educational level. This assumption is also made by other studies (e.g. Wei, 2004, 2007; Greaker, 2008).

Another issue is that the annual wage/salary used in this paper is gross (before tax) payment. In order to know "net" labour earnings for individuals and "gross" labour earnings for society, we need to know the information on tax rates, payrolls, pension rates, student's grants, etc. All these issues should be solved in further studies when data needed are available.

[3] The Norwegian population at the beginning of the fourth quarter of 2006 is 4,671,871.

Table 1: Norwegian Standard Classification of Education

Tripartition of levels	Level	Level name	Class level
	0	No education and pre-school education	Under school age
Compulsory education	1	Primary education	1st - 7th class level
	2	Lower secondary education	8th - 10th class level
Intermediate education	3	Upper secondary, basic	11th - 12th class level
	4	Upper secondary, final year	13th class level +
	5	Post-secondary non-tertiary education	14th class level +
Tertiary education	6	First stage of tertiary education, undergraduate	14th - 17th class level
	7	First stage of tertiary education, graduate	18th - 19th class level
	8	Second stage of tertiary education, postgraduate	20th class level +
	9	Unspecified	

Source: NOS C751.

For the variable of educational level, the register-based employment data set provides detailed codes in terms of the Norwegian Standard Classification of Education (NUS2000). The first digit of these codes refers to each of the nine levels classified in the NUS2000 (see column 2 in Table 1).

When aggregating the educational level for human capital computation, we relegate missing values and the levels of 0 and 9 to the level 1, and define the level 1 as the lowest educational level in this study. This relegation is merely for the practical concern.

Furthermore, we adapt the class levels for 4, 5 and 8 in Table 1 respectively to "11th - 13th class level", "14th - 16th class level" and "20th - 22nd class level", as the majority of each of the three levels demonstrates in the detailed codes in NUS2000. Then the maximum classes (years) of each level, "7", "10", "12", "13", "16", "17", "19" and "22", correspond respectively to the eight educational levels, 1, 2, 3, 4, 5, 6, 7 and 8 (see column 2 and 3 in Table 1). It is these maximum classes (years) that are used in the human capital estimation programme and are denoted in all figures in this paper.

Table 2 presents the composition pattern of the Norwegian labour force by educational level, which indicates that final upper secondary education ("13"), undergraduate education ("17") and lower secondary education ("10") are in order the three largest shares in Norwegian labour force in 2006.

Table 2: Labour force composition by educational level in 2006.

Educational level	Frequency (persons)	Percent (%)	Cumulative Frequency	Cumulative Percent
Primary education	82664[a]	3.45[b]	82664	3.45
Lower secondary education	511946	21.36	594610	24.81
Upper secondary, basic	304756	12.72	899366	37.53
Upper secondary, final year	682281	28.47	1581647	65.99
Post-secondary non-tertiary education	74803	3.12	1656450	69.11
First stage of tertiary education, undergraduate	566649	23.64	2223099	92.76
First stage of tertiary education, graduate	159723	6.66	2382822	99.42
Second stage of tertiary education, postgraduate	13856	0.58	2396678	100.00

[a] Including 2634 persons with missing values, 2040 persons with either no or pre-school education (level 0 in Table 1) and 75477 persons with unspecified education (level 9 in Table 1).
[b] Including 0.11% missing values, 0.09% level 0 and 3.15% level 9.

In Table 3 and 4, the composition pattern is displayed further by male and female. The results show that the above three educational levels are still dominant. However, the ranking is different for male and female. Final upper secondary education ("13") is the largest part for male while undergraduate education ("17") is the largest for female.

Other variables such as labour participation rates, school enrolment rates and employment rates are derived from the original register-based data set.

Some variables used in the estimation are taken from other sources. Survival rates are taken from the StatBank, an online statistics data bank at Statistics Norway. Left years for students to finish their studies are obtained from Section for Education Statistics at Statistics Norway.

Table 3: Labour force composition by educational level (Male)

Educational level	Frequency (persons)	Percent (%)	Cumulative Frequency	Cumulative Percent
Primary education	47255	3.74	47255	3.74
Lower secondary education	280406	22.21	327661	25.95
Upper secondary, basic	140104	11.10	467765	37.04
Upper secondary, final year	398638	31.57	866403	68.62
Post-secondary non-tertiary education	50703	4.02	917106	72.63
First stage of tertiary education, undergraduate	236586	18.74	1153692	91.37
First stage of tertiary education, graduate	99287	7.86	1252979	99.23
Second stage of tertiary education, postgraduate	9716	0.77	1262695	100.00

Table 4: Labour force composition by educational level (Female)

Educational level	Frequency (persons)	Percent (%)	Cumulative Frequency	Cumulative Percent
Primary education	35409	3.12	35409	3.12
Lower secondary education	231540	20.42	266949	23.54
Upper secondary, basic	164652	14.52	431601	38.06
Upper secondary, final year	283643	25.01	715244	63.07
Post-secondary non-tertiary education	24100	2.13	739344	65.20
First stage of tertiary education, undergraduate	330063	29.11	1069407	94.31
First stage of tertiary education, graduate	60436	5.33	1129843	99.63
Second stage of tertiary education, postgraduate	4140	0.37	1133983	100.00

The values of the real annual income growth rate and the discount rate are set to be 2.5% and 3.5%, respectively, as used in Ervik, et al. (2003). Certainly, the choice of these values can be discussed and we will undertake some sensitivity analyses on this later.

4. Estimation method

A database covering the Norwegian labour force between age 15 and 67 in 2006 is constructed as described in the above section and is now ready for use.

We divide the labour force into two main groups: ***workers*** who are working in 2006 and ***students*** who are registered as current students in 2006.

1. The lifetime labour income for a representative worker is estimated as follows:

(1)

$$LINW_{age}^{edu} = EMR_{age}^{edu} AINW_{age}^{edu} + \left\{1 - \sum_{\overline{edu}} ENR_{age}^{edu-\overline{edu}}\right\} SUR_{age+1} EMR_{age+1}^{edu} LINW_{age+1}^{edu} \{(1+r)/(1+\delta)\}$$

$$+ \sum_{\overline{edu}} ENR_{age}^{edu-\overline{edu}} \left\{ \sum_{t=1}^{t_{edu-\overline{edu}}} SUR_{age+t} EMR_{age+t}^{edu} AINS_{age+t}^{edu-\overline{edu}} \{(1+r)/(1+\delta)\}^{t} \right. \quad ,$$

$$\left. + SUR_{age+t_{edu-\overline{edu}}+1} EMR_{age+t_{edu-\overline{edu}}+1}^{\overline{edu}} LINW_{age+t_{edu-\overline{edu}}+1}^{\overline{edu}} \{(1+r)/(1+\delta)\}^{t_{edu-\overline{edu}}+1} \right\}$$

where

$LINW_{age}^{edu}$ = present value of lifetime labour income for a representative individual with educational level of "*edu*" at age of "*age*".

$edu \in \{7,10,12,13,16,17,19,22\}$ and $age \in \{15,16,...,67\}$.

EMR_{age}^{edu} = employment rate for a representative individual with educational level of "*edu*" at age of "*age*".

$AINW_{age}^{edu}$ = current annual labour income for a representative individual with educational level of "*edu*" at age of "*age*".

$\overline{edu} \in \{7,10,12,13,16,17,19,22\}$ and $edu < \overline{edu}$.

$ENR_{age}^{edu-\overline{edu}}$ = school enrolment rate for a representative individual with educational level of "*edu*" pursuing for a higher educational level of "$\overline{edu}$" at age of "*age*".

SUR_{age} = surviving rate (the probability of surviving one more year) at age of "*age*".

r = annual real income growth rate.

δ = annual discount rate.

$t_{edu-\overline{edu}}$ = study period for a representative individual with educational level of "*edu*" studying for a higher educational level of "$\overline{edu}$".

$AINS_{age+t}^{edu-\overline{edu}}$ = (part-time) earnings for a student with educational level of "*edu*" studying for a higher educational level of "$\overline{edu}$", received at "$age+t$".

As shown in Eq. (1), the lifetime labour income for an individual worker is set equal to the current year income (the first term on the right hand side of Eq. (1)) plus the present value of his/her lifetime income in the next year (the second and the third terms on the right hand side of Eq. (1)). Since in the next year each worker will face two possibilities, namely, either continuing to work with the same educational level as before, or going to school studying for a higher educational level, the present value of his/her lifetime income in the next year is considered to be an expected value. That is, he/she will earn

$SUR_{age+1} EMR_{age+1}^{edu} LINW_{age+1}^{edu} \{(1+r)/(1+\delta)\}$ if he/she continues to work in the next year, of which the probability is $\left\{1 - \sum_{\overline{edu}} ENR_{age}^{edu-\overline{edu}}\right\}$. If he/she goes to school for higher education study in the next year, he/she will earn $\sum_{t=1}^{t_{edu-\overline{edu}}} SUR_{age+t} EMR_{age+t}^{edu} AINS_{age+t}^{edu-\overline{edu}} \{(1+r)/(1+\delta)\}^t$

$+ SUR_{age+t_{edu-\overline{edu}}+1} EMR_{age+t_{edu-\overline{edu}}+1}^{\overline{edu}} LINW_{age+t_{edu-\overline{edu}}+1}^{\overline{edu}} \{(1+r)/(1+\delta)\}^{t_{edu-\overline{edu}}+1}$, of which the probability is $\sum_{\overline{edu}} ENR_{age}^{edu-\overline{edu}}$.

The present value of the lifetime income in later years, $LINW_{age+1}^{edu}$ and $LINW_{age+t_{edu-\overline{edu}}+1}^{\overline{edu}}$ are estimated in the same way.

Here is an example. The lifetime labour income for a 35 years old man with undergraduate education is calculated as the following:

$$LINW_{35}^{17} = EMR_{35}^{17} AINW_{35}^{17} + \left\{1 - ENR_{35}^{17-19} - ENR_{35}^{17-22}\right\} SUR_{36} EMR_{36}^{17} LINW_{36}^{17} \{(1+r)/(1+\delta)\}$$

$$+ ENR_{35}^{17-19} \left\{SUR_{36} EMR_{36}^{17} AINS_{36}^{17-19} \{(1+r)/(1+\delta)\} + SUR_{37} EMR_{37}^{17} AINS_{37}^{17-19} \{(1+r)/(1+\delta)\}^2\right.$$

$$\left. + SUR_{38} EMR_{38}^{19} LINW_{38}^{19} \{(1+r)/(1+\delta)\}^3\right\}$$

$$+ ENR_{35}^{17-22} \left\{SUR_{36} EMR_{36}^{17} AINS_{36}^{17-22} \{(1+r)/(1+\delta)\} + SUR_{37} EMR_{37}^{17} AINS_{37}^{17-22} \{(1+r)/(1+\delta)\}^2\right.$$

$$+ SUR_{38} EMR_{38}^{17} AINS_{38}^{17-22} \{(1+r)/(1+\delta)\}^3 + SUR_{39} EMR_{39}^{17} AINS_{39}^{17-22} \{(1+r)/(1+\delta)\}^4$$

$$\left. + SUR_{40} EMR_{40}^{17} AINS_{40}^{17-22} \{(1+r)/(1+\delta)\}^5 + SUR_{41} EMR_{41}^{22} LINW_{41}^{22} \{(1+r)/(1+\delta)\}^6\right\},$$

where the present values of the lifetime income, $LINW_{36}^{17}$, $LINW_{38}^{19}$, $LINW_{41}^{22}$ are estimated by the same backward recursive method.

Following this backward recursion, the present value of lifetime labour income of the oldest working age (67 years old in this study) is calculated first. Since in the next year the lifetime income of the 67 years old is assumed to be zero, his/her present value of lifetime labour income in this year is just his/her current year's labour income. Then, this worker's present value of lifetime labour income can be used to estimate the next year's present value of lifetime labour income for a 66 years old worker with the same sex, age and educational level.

By working backward in this way for all categories classified by sex and educational level, all workers' present value of lifetime labour income can be estimated.

2. The lifetime labour income for a representative student is estimated as follows:

$$LINS_{age}^{edu-\overline{edu}} = EMR_{age}^{edu} AINS_{age}^{edu-\overline{edu}} + \sum_{t=1}^{\tilde{t}} SUR_{age+t} EMR_{age+t}^{edu} AINS_{age+t}^{edu-\overline{edu}} \{(1+r)/(1+\delta)\}^{t}$$
$$+ SUR_{age+\tilde{t}+1} EMR_{age+\tilde{t}+1}^{\overline{edu}} LINW_{age+\tilde{t}+1}^{\overline{edu}} \{(1+r)/(1+\delta)\}^{\tilde{t}+1} \quad (2)$$

where

$LINS_{age}^{edu-\overline{edu}}$ = present value of lifetime labour income for a representative individual with educational level of "*edu*" studying for a higher level of "$\overline{edu}$" at age of "*age*".

$\tilde{t}$ = left years for a student to fulfil his/her study.

As shown in Eq. (2), the calculation of the lifetime labour income for a student depends on how many years left for him/her to complete his/her currently registered higher education. Let us take an example of a 35 years old man with graduate education, studying for a

postgraduate degree in 2006. If the left year for finishing the postgraduate study is two, which means that he will study in the next two years and will go back to work in the year after, then the present value of his lifetime labour income is calculated as the following:

$$LINS_{35}^{19-22} = EMR_{35}^{19} AINS_{35}^{19-22} + SUR_{36} EMR_{36}^{19} AINS_{36}^{19-22} \{(1+r)/(1+\delta)\}$$

$$+ SUR_{37} EMR_{37}^{19} AINS_{37}^{19-22} \{(1+r)/(1+\delta)\}^2 + SUR_{38} EMR_{38}^{22} LINW_{38}^{22} \{(1+r)/(1+\delta)\}^3 .$$

We calculate Eq. (1) and Eq. (2) in sequence. That is, the human capital for workers is first calculated and that for students secondly.

3. The stock of human capital is estimated as follows:

$$(3)\ HC = \sum_{age} \sum_{edu} LINW_{age}^{edu} NW_{age}^{edu} + \sum_{age} \sum_{edu-\overline{edu}} LINS_{age}^{edu-\overline{edu}} NS_{age}^{edu-\overline{edu}},$$

where

HC = aggregate value of the human capital stock.

NW_{age}^{edu} = number of persons in a classified category with educational level of "*edu*" at age of "*age*".

$NS_{age}^{edu-\overline{edu}}$ = number of persons in a classified category with educational level of "*edu*" studying for a higher level of "$\overline{edu}$" at age of "*age*".

For the sake of simplicity we have suppressed the gender dimension in Eq. (1), (2) and (3). Actually these equations can be applied separately for men and women, as well as for peoples with different occupations or working in different sectors, if the data is cross-classified by these categories.

It is worth noticing that we have made several restrictions and assumptions when calculating the human capital, some of which are different from those in other studies.

We have set a restriction that studies only for higher (than that one has achieved) educational levels be allowed. Another assumption we made is that all studies, if taken, will and must finish at the end of the study period, neither earlier nor later. This is a strong assumption given that in reality there are some students finishing their studies earlier and some others later than the standard study periods, $t_{edu-\overline{edu}}$. However, this fact on the other hand also lends to us positive support to the assumption we made, i.e., we could argue that the two factors that some finish earlier and some later will cancel out with each other to some extent.

In further studies, we try to obtain the data on school succeed rates, defined as the probabilities for a student to finish his/her study at the first year, the second year, etc. of the standard study period.

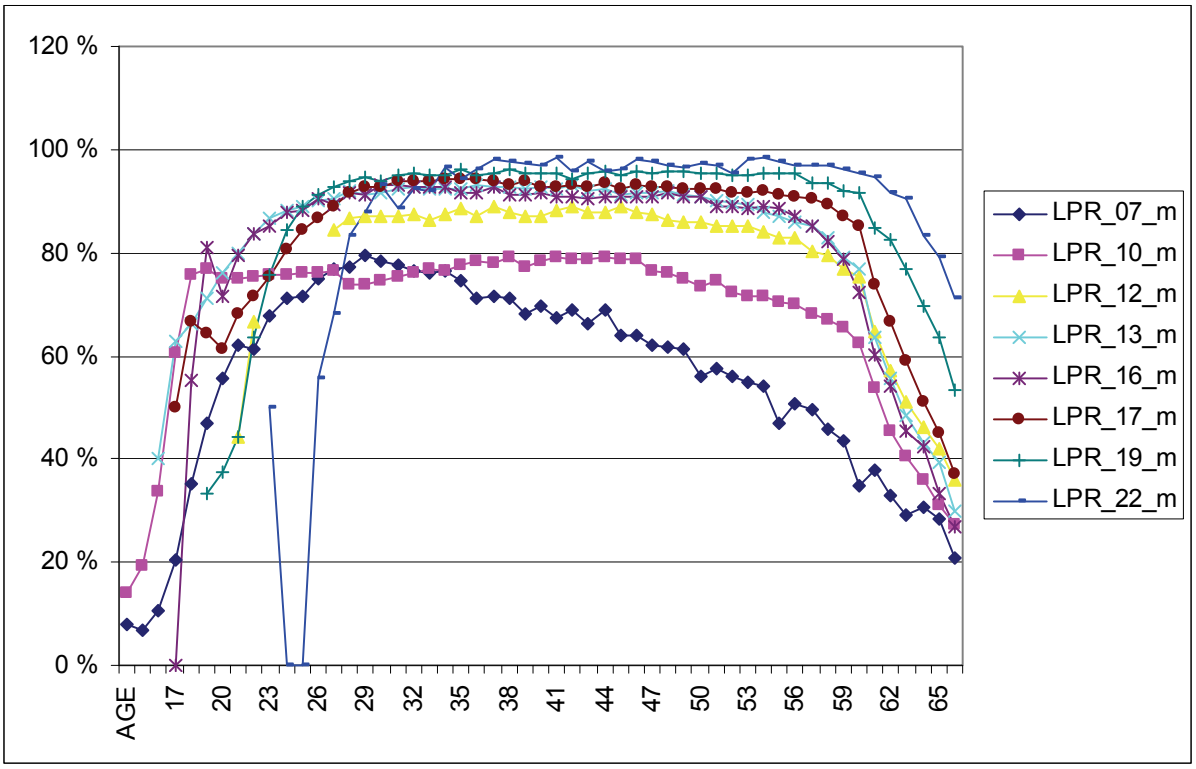
In this paper, schools are considered to be open for all ages, which is in accordance with the actual pattern displayed in Figure A9 to A22 in Appendix as well as in Figure 3 and 4 in Section 5 for empirical results. This assumption is different from other studies where an age limit is usually assumed to be held, after which no one could go to school. For instance, Wei (2004, 2007) assumes that an individual is not able to go back to school after 34 years old. Another difference we have made is that students' part-time earnings are counted in his/her labour income in our study, while in others they are not (e.g., Wei, 2004, 2007) because in other studies students' direct schooling costs during the study period are assumed to be exactly offset by their part-time earnings (Mincer, 1974).

5. Some empirical results

5.1. Labour participation rates

In spite of that we only calculate the human capital for the labour force in this study, the information on labour participation rates is useful for understanding the scope of the market activities in Norwegian economy. The information can be further used for the imputation of the value of nonmarket labour activities in future studies.

Figure 1: Labour participation rates by educational level and age in 2006 (Male).



The labour participation rate in this paper is defined as the ratio of those who are within the labour force and of educational level of "*edu*" at age of "*age*" against the corresponding population with the same educational level and age.

Figure 2: Labour participation rates by educational level and age in 2006 (Female).

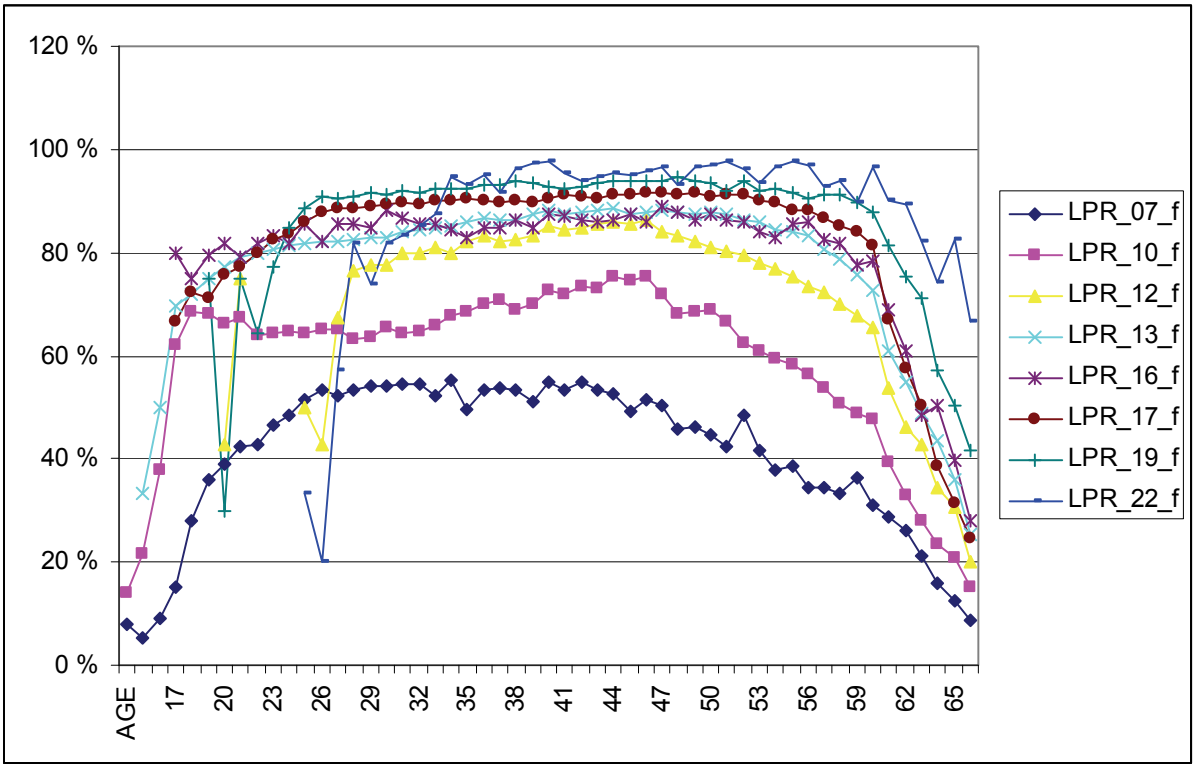


Table 5: Labour participation rate by educational level in 2006

Educational level	Male (%)	Female (%)
Primary education	48.29	36.28
Lower secondary education	64.06	56.07
Upper secondary, basic	77.75	69.36
Upper secondary, final year	86.23	82.07
Post-secondary non-tertiary education	87.01	83.07
First stage of tertiary education, undergraduate	88.20	86.47
First stage of tertiary education, graduate	92.60	90.97
Second stage of tertiary education, postgraduate	95.08	92.97

In Table 5 we present the labour participation rates by educational level for both male and female. The labour participation rates distinguished by both educational level and age are displayed in Figure 1 and 2. The detailed comparisons between male and female by the same educational level are reported in Figure A1 to Figure A8 in Appendix.

Based on the table and figures, we can draw several observations:

I. The higher the educational level, the higher the labour participation rate, which holds for both male and female.

II. Labour participation rates are lower at the two ends of the working life span. The age profiles (curves) look like upside down bathtubs for most educational levels except for primary educational level ("7"). The reason is that at early younger ages, many are in schools while at older ages there are many taking early retirements. For those with primary education ("7"), their labour participation rates reach peaks quite early and descend along the age afterwards.

III. Labour participation rates are larger for male than for female, especially for those with final upper secondary ("13") or lower educational levels. For those with post-secondary ("16") or higher educational levels, the differences are not significant.

5.2. School enrolment rates

The school enrolment rates at higher educational levels are the most important indicators of the dynamics of educational attainment, and therefore, are commonly used as a proxy for human capital.

The school enrolment rate in this paper is defined as the ratio of those with educational level of "*edu*" at age of "*age*" and currently registered as students studying for a higher educational level of "$\overline{edu}$" against all those with educational level of "*edu*" at age of "*age*".

Several observations can be made from the actual patterns of the school enrolment rates by educational level, age and gender (more detailed figures are displayed in Appendix):

I. Higher school enrolment rates occur primarily at younger ages, which is intuitive and obvious. However, the rates are still significant at older ages, especially, for those with final upper secondary education ("13") studying at undergraduate level ("17"), and for those with post-secondary education ("16") studying at undergraduate level ("17"), as well as for those with undergraduate education ("17") studying at graduate level ("19").

II. For those with post-secondary ("16") or higher educational levels, the school enrolment rates are larger for those studying at a one-level consecutively higher educational level than otherwise. In another words, step-by-step study is more common than jumping and skipping to much higher level studies. However, the pattern is different for those with lower than post-

secondary (“16”) educational levels. For instance, for those with final upper secondary level (“13”), the school enrolment rates are substantially lower for studying at post-secondary level (“16”) than for studying at undergraduate level (“17”).

III. In terms of gender differences, no significant differences can be found for those with lower education levels (primary education (“7”), lower secondary education (“10”) and basic upper secondary education (“12”)). For higher than these educational levels, the pattern is mixed: For some (“16” to “19”, “16” to “22”), there exist no significant differences; for some (“17” to “22”), the rates are higher at younger ages for male but have no significant differences at older ages; for some (“16” to “17”, “17” to “19”, and “19” to “22”), the rates are in general higher for male at younger ages but lower at older ages than for female.

Figure 3: School enrolment rates for those with final upper secondary education studying at post-secondary educational level in 2006.

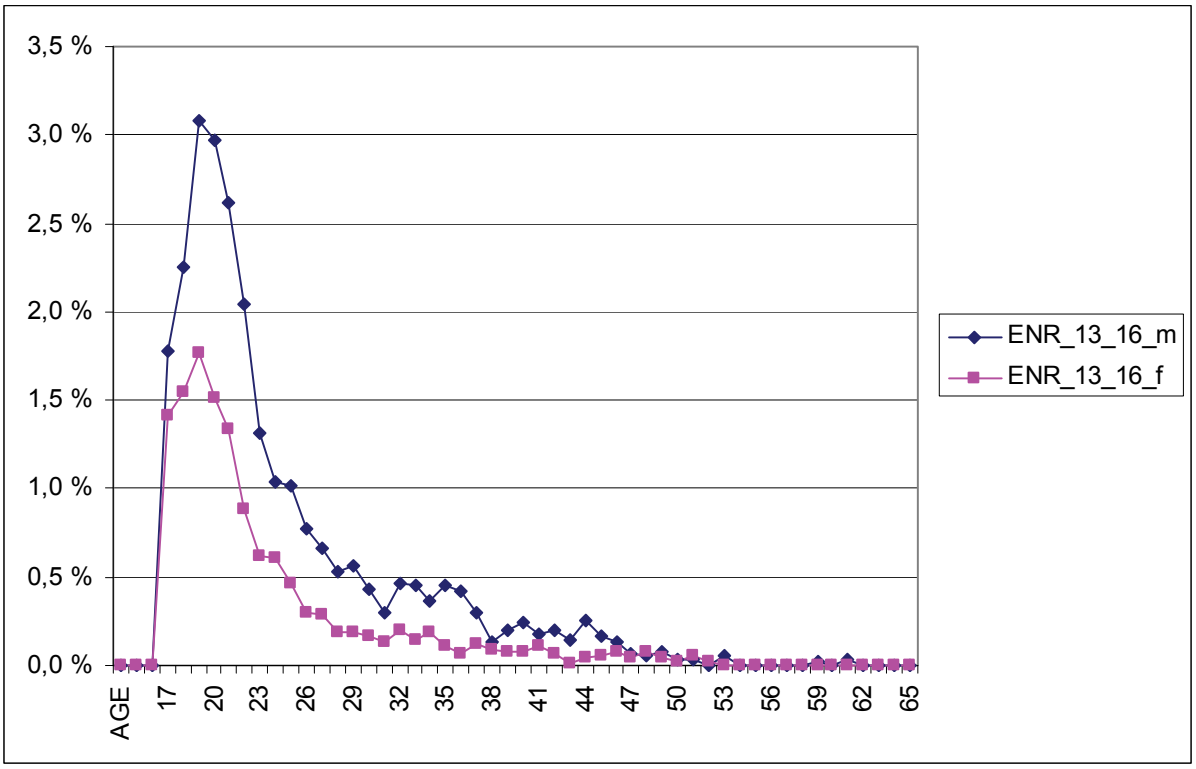
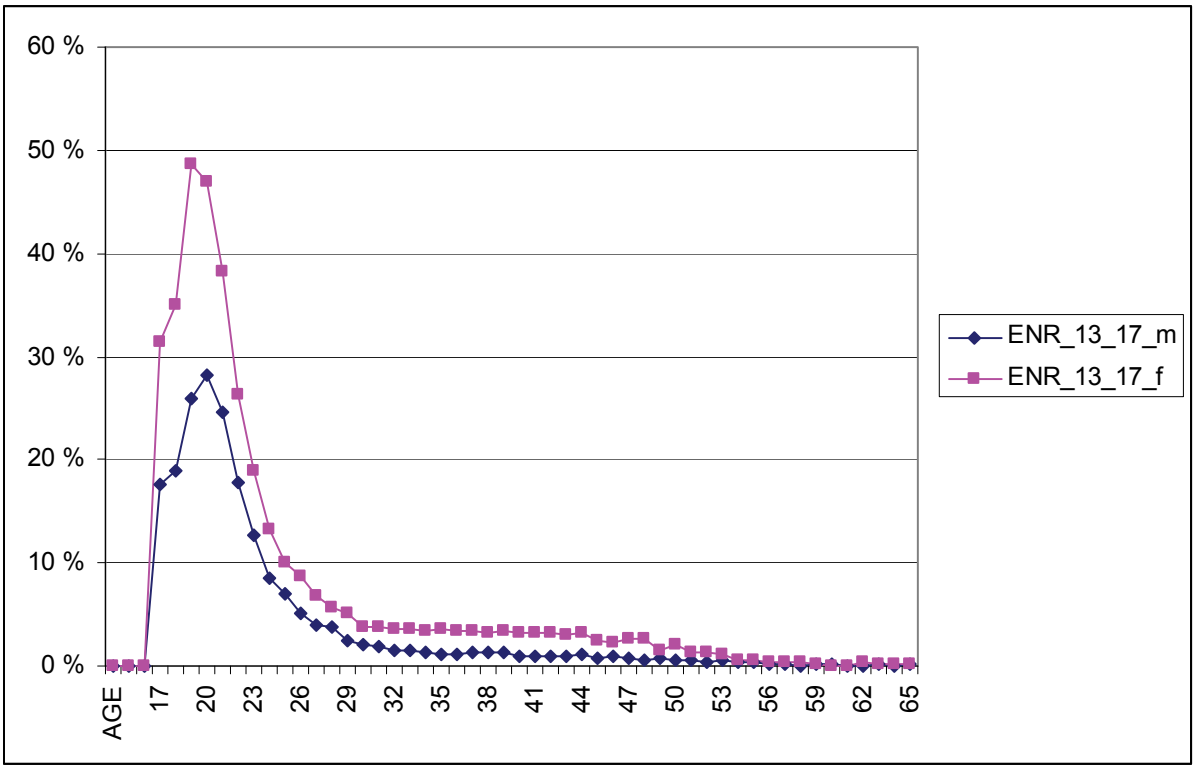


Figure 4: School enrolment rates for those with final upper secondary education studying at undergraduate educational level in 2006.



IV. Another one interesting observation is that for those with final secondary educational level ("13"), the school enrolment rates are systematically higher for female studying at undergraduate level ("17") but systematically lower for female studying at post-secondary educational level ("16") (See Figure 3 and 4). The reason could be that female students are smarter than their counterparts in terms of holding better school records needed for entering university. Another possible explanation could be that the majority of the post-secondary education ("16") is on the mechanics, engineering subjects, which, traditionally, are boys' professions.

5.3. Employment rates

The employment rate in this study is defined as the ratio of those with educational level of "*edu*" at age of "*age*" and currently working (either employed or self-employed) against the corresponding labour force. Figure 5 and 6 plot the employment rates by educational level for male and female, respectively. The detailed employment rates by age, gender and educational levels are presented in Appendix, from which we have several observations:

I. Broadly speaking, the higher the educational level, the higher the employment rate. This is true especially for basic upper secondary ("12") or lower educational levels.

II. For those with post-secondary ("16") or lower educational levels, the employment rates are lower at younger age for female but have no significant differences between male and female at older age. One substantial gender gap exists and lasts for quite a long period between male and female for those who have only the lowest educational level defined in this study, i.e., primary education ("7").

III. For those with undergraduate educational level ("17"), there are no significant difference between male and female at younger age but at older age the employment rates are higher for female than for male. One of the possible reasons may be that more females are counted in as employed although they only work part-time. There exists no significant difference between male and female for those with graduate educational level ("19"). For those with postgraduate educational level ("22"), the employment rates are systematically higher for male than for female.

Figure 5: Employment rates by educational level in 2006 (Male)

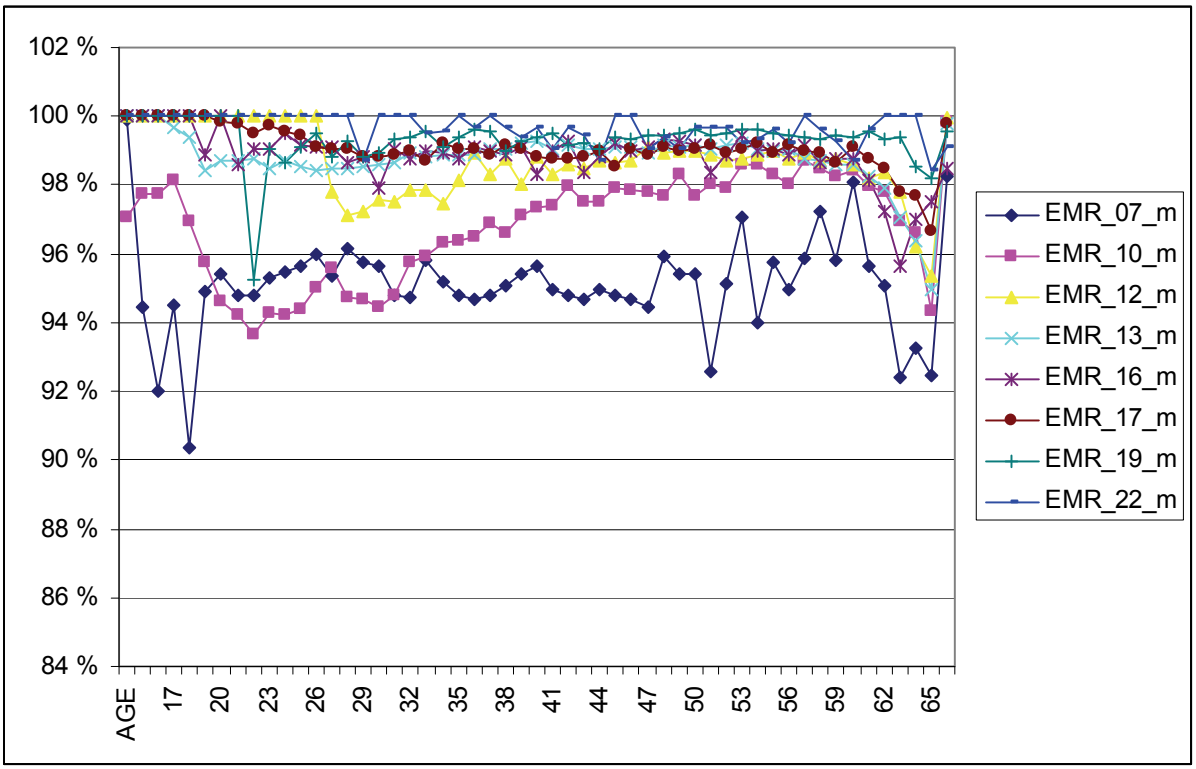
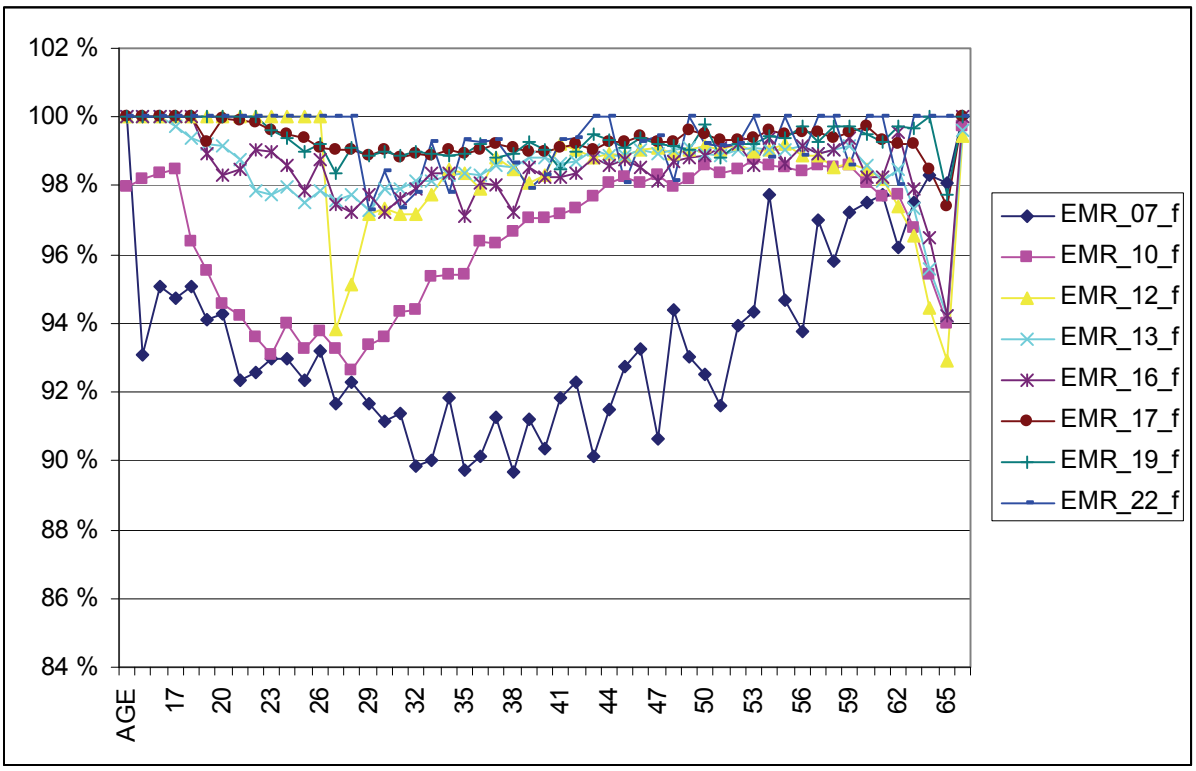


Figure 6: Employment rates by educational level in 2006 (Female)



5.4. Annual labour incomes

Figure 7 and 8 present annual labour incomes per capita in order to illustrate the characteristics of age-earnings profiles. We have several observations as follows:

I. Annual incomes increase along age and after reaching peaks they decrease.

II. In general the higher educational level, the higher annual income. The significant income gaps exist between those with post-secondary education ("16") or higher educational levels and those with final upper secondary ("13") or lower educational levels). The largest income gaps occur between graduate ("19") and lower levels as well as between postgraduate ("22") and lower levels, which may imply that the returns to investments into higher education (graduate ("19") and post-graduate levels ("22")) are considerably high.

III. Annual incomes are consistently higher for male than for female, irrespective of educational levels.

5.5. Lifetime labour incomes

Figure 9 and 10 plot lifetime labour incomes per capita for male and female aged from 15 to 67, from which we can make several observations as follows:

I. Lifetime labour incomes rise and then gradually decline for all educational levels, but the peaks are in younger ages compared to those for annual incomes.

Figure 7: Annual incomes by educational level in 2006 (Male)

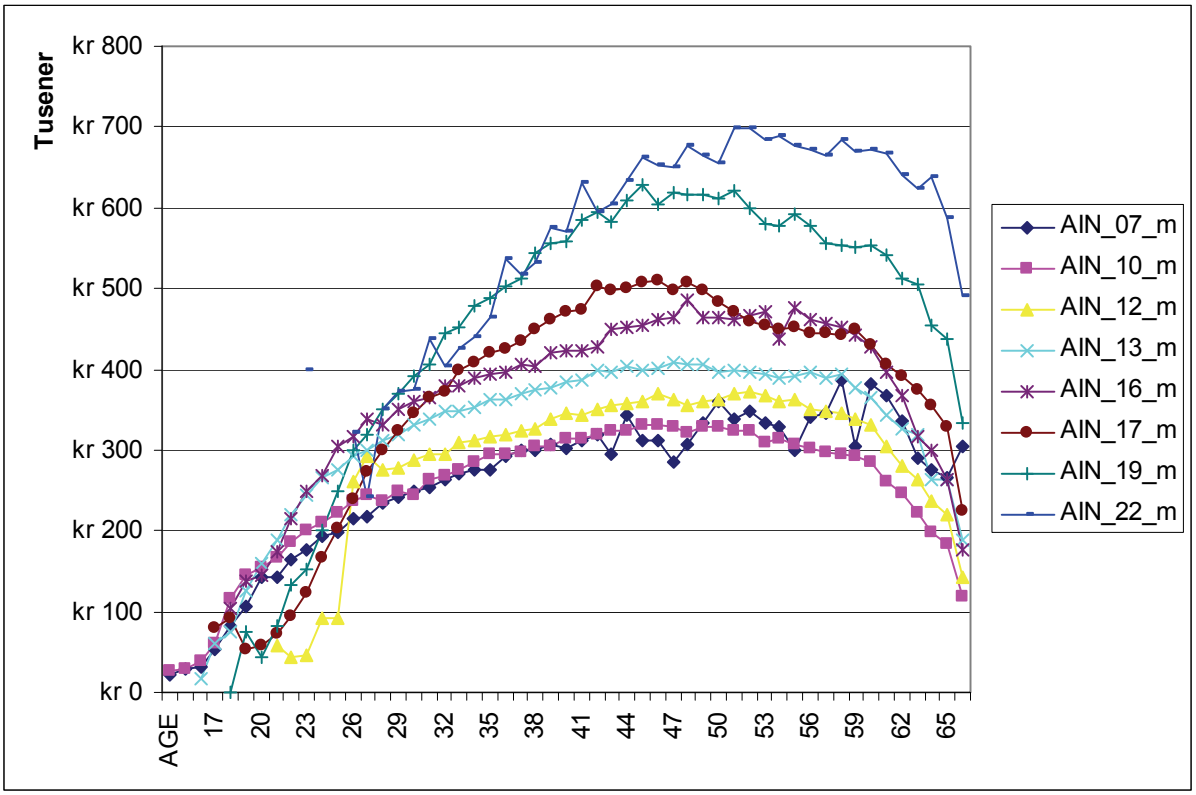


Figure 8: Annual incomes by educational level in 2006 (Female)

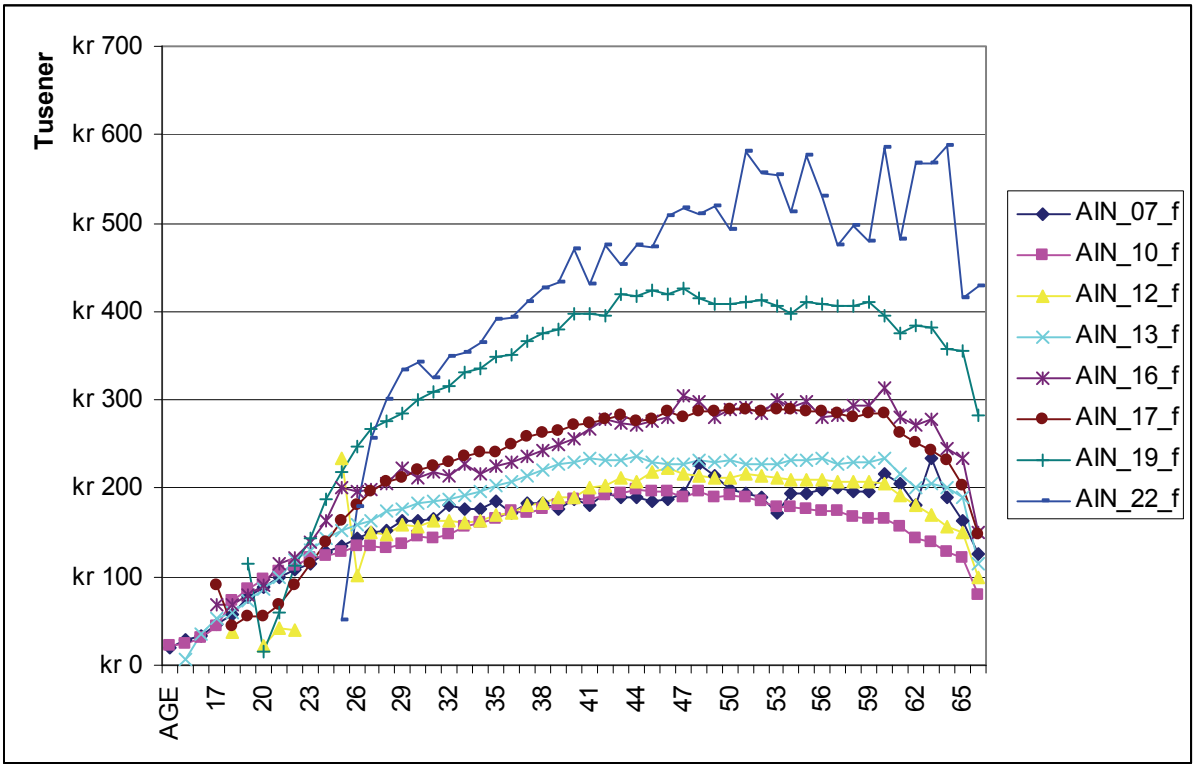


Figure 9: Lifetime labour incomes by educational level in 2006 (Male)

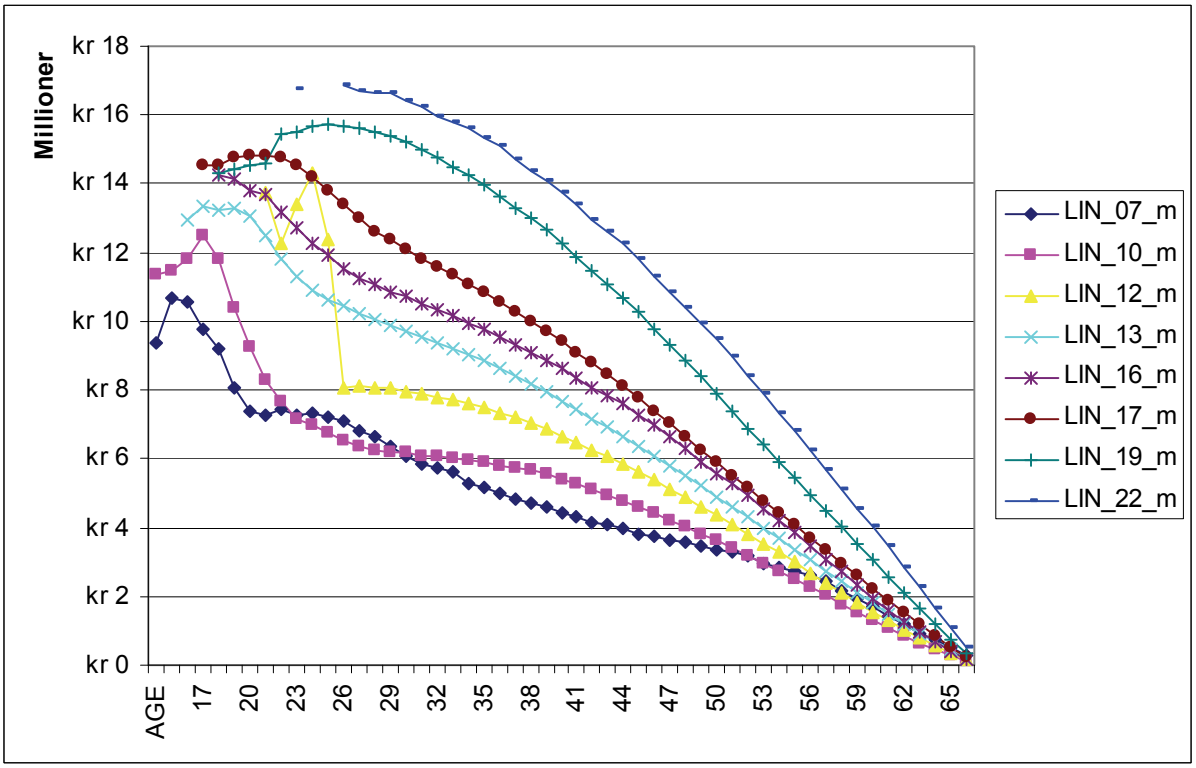
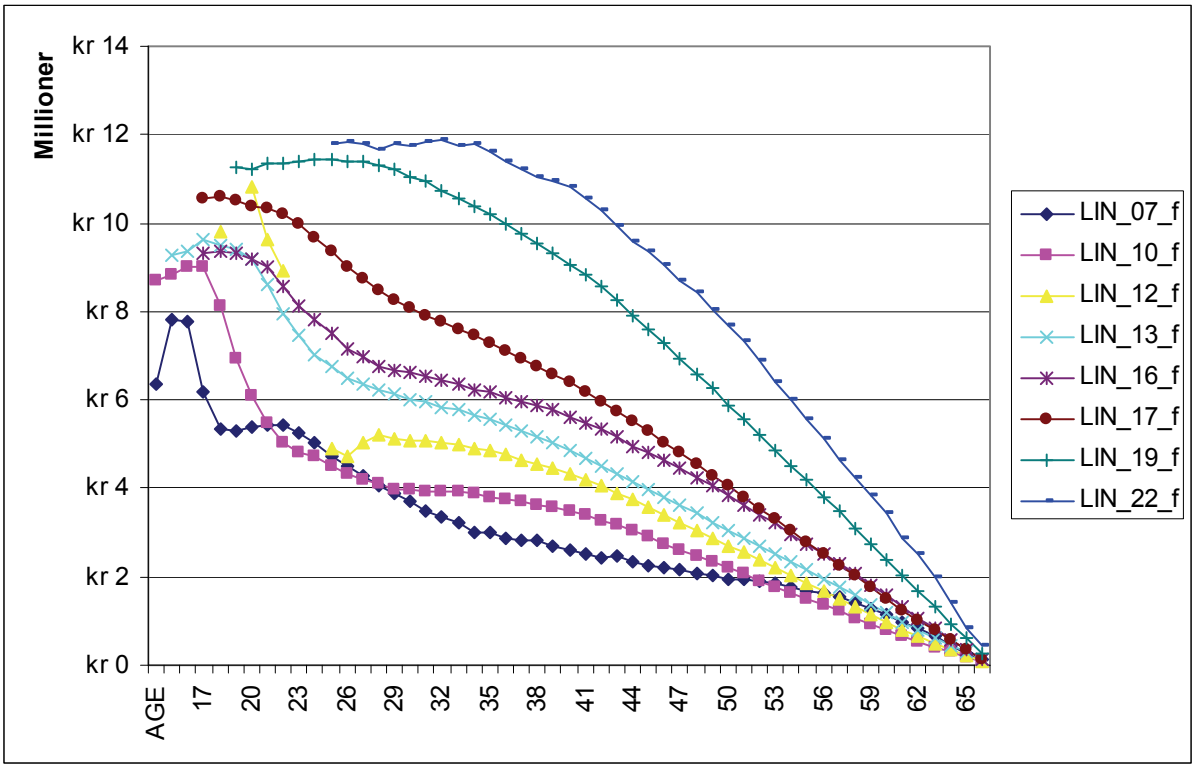


Figure 10: Lifetime labour incomes by educational level in 2006 (Female)



II. At any given discount rate, the shapes of the lifetime labour income curves critically depend on the age at which highest annual incomes enter the income streams of individuals' working life span. If annual incomes peak at older ages, then lifetime labour incomes will peak at older age cohorts.

III. The higher the discount rate, the lower the values of future incomes, and hence the earlier lifetime labour incomes peak.

5.6. Returns to education

The information on differences between lifetime labour incomes for cohorts with alternative educational levels is very useful for extrapolating the values created in investing in additional education. According to Jorgenson and Fraumeni (1989, 1992a, 1992b), the product of the education industry is investment in human capital, and the output of education is thus defined as additions to lifetime labour incomes due to additional education. Within this framework, the information presented above could be used to estimate investment in human capital and the output of education.

The following observations can be drawn based on the age-returns to education profiles (see Figure A47 to A86 in Appendix).

I. Regardless of gender, given an educational level, the higher the educational level one is to invest in, the higher the returns. In general, the earlier the age, the higher the returns since it could take some years to reap the full money benefits flowing from investments in higher education.

II. In terms of gender differences, the returns to male are in general larger than those to female, especially, at younger ages, and for those with final upper secondary ("13") or lower educational levels. At older ages and for those with post-secondary ("16") and higher educational levels, the differences are not significant.

Table 6: Lifetime labour income and return to education by educational level and gender (1000 NOK)

	Male		Female	
Educational level	Lifetime income	Return to education	Lifetime income	Return to education
Primary education	4804.46	-	3065.06	-
Lower secondary education	5227.60	423.14	3472.13	407.07
Upper secondary, basic	5808.21	580.61	3737.38	265.25
Upper secondary, final year	7040.98	1232.76	4662.13	924.75
Post-secondary non-tertiary education	7538.94	497.96	5018.68	356.56
First stage of tertiary education, undergraduate	8425.79	886.86	5761.85	743.17
First stage of tertiary education, graduate	10105.01	1679.21	7438.15	1676.30
Second stage of tertiary education, postgraduate	10538.55	433.54	8097.82	659.68

Average lifetime labour incomes and returns to education are reported in Table 6. The former is the average lifetime labour income across age and the latter is calculated as differences of lifetime labour incomes between two consecutive educational levels. The results show that the returns to education are not linear. The largest returns occur when one invests in graduate education ("19") from undergraduate level ("17"), with 1,679.21 thousands of NOK for male and 1,676.30 thousands of NOK for female. The second largest are when one achieves the final upper secondary education ("13") from basic upper secondary educational level ("12"), with 1,232.76 thousands of NOK for male and 924.75 thousands of NOK for female.

5.7. The stock of human capital

The objective of this study is to calculate the value of the human capital stock. Thus we apply the individual representative lifetime labour incomes presented above to total number of persons in each category classified by age, gender, educational level. In Table 7 we report the results that have been summed over all ages. Table 8 lists the corresponding share (in percentage) of human capital by educational level and gender.

The value of the Norwegian human capital stock in 2006 is estimated to be 15,260.69 billions of NOK in current prices as shown in Table 7.

Table 7: Norwegian human capital in 2006 by educational level and gender (billions of NOK)

Educational level	Male	Female	SUM
Primary education	262.48	129.01	391.49
Lower secondary education	1770.85	958.49	2729.34
Upper secondary, basic	552.83	403.18	956.01
Upper secondary, final year	3211.07	1606.85	4817.92
Post-secondary non-tertiary education	405.16	118.67	523.82
First stage of tertiary education, undergraduate	2068.31	2092.66	4160.97
First stage of tertiary education, graduate	1013.78	531.72	1545.50
Second stage of tertiary education, postgraduate	98.92	36.72	135.64
SUM	9383.39	5877.30	15260.69

Table 8: Norwegian human capital in 2006 by educational level and gender (percentage, %)

Educational level	Male	Female	SUM
Primary education	1.72	0.85	2.57
Lower secondary education	11.60	6.28	17.88
Upper secondary, basic	3.62	2.64	6.26
Upper secondary, final year	21.04	10.53	31.57
Post-secondary non-tertiary education	2.65	0.78	3.43
First stage of tertiary education, undergraduate	13.55	13.71	27.27
First stage of tertiary education, graduate	6.64	3.48	10.13
Second stage of tertiary education, postgraduate	0.65	0.24	0.89
SUM	61.49	38.51	100.00

According to Table 8, in terms of educational level the largest share of the human capital is embodied in those with final upper secondary education (“13”) and the second largest embodied in those with undergraduate education (“17”) for males. For females, however, the pattern is the opposite, i.e., those with undergraduate education (“17”) hold the largest human capital while those with final upper secondary education (“13”) have the second largest share. This is in accordance with the composition pattern of Norwegian labour force for male and female as displayed in Table 3 and 4.

For male and female together, the pattern is the same as shown for male only, which is easy to understand because the human capital for males accounts for over 60% of the total value of the human capital in 2006.

To compare the human capital stock with its physical capital counterpart, we apply the Norwegian fixed assets (market producers) in 2006 that is 2,532.24 billions of NOK in current prices. The comparison between human capital and physical capital indicates that the former is approximately 6 times as large as the latter.

5.8. Sensitivity analysis

The estimates of human capital stock presented above are subject to a number of assumptions. The annual income growth rate and the annual discount rate are set to be 2.5% and 3.5%, respectively, as used in Ervik, et al. (2003). In order to assess the sensitivity of the human capital estimates to these parameters, a number of alternative estimates are obtained by using alternative income growth rates and discount rates. The results are listed in Table 9.

In the upper panel of Table 9, the annual discount rate is fixed at 3.5% and we test the impact on the value of the human capital stock of alternative annual income growth rate ranging from 0 to 5.5%. While in the lower panel of Table 9, the annual income growth rate is fixed at 2.5%, we test the impact on the value of the human capital stock of alternative annual discount rate ranging from 0 to 6.5%.

The main conclusion is that one percent increase in annual income growth rate (annual discount rate) with annual discount rate (annual income growth rate) fixed will lead to from 6.36 to 18.83 percent increase (24.12 to 10.87 percent decrease) in the stock of human capital. The marginal increases (decreases) depend on the departure, and are increasing (decreasing) when annual income growth rate (annual discount rate) increases.

Table 9: Results from sensitivity analysis

Annual discount rate (%)	Annual income growth rate (%)	Human capital in 2006 (billions of NOK)	Percent change (%)
3.5	0	10949.64	-
3.5	0.5	11646.33	6.36
3.5	1.5	13266.78	13.91
3.5	**2.5**	**15260.69**	**15.03**
3.5	3.5	17736.93	16.23
3.5	4.5	20840.53	17.50
3.5	5.5	24765.61	18.83
0	2.5	27556.22	-
1.5	2.5	20909.20	-24.12
2.5	2.5	17736.93	-15.17
3.5	**2.5**	**15260.69**	**-13.96**
4.5	2.5	13301.14	-12.84
5.5	2.5	11730.01	-11.81
6.5	2.5	10454.49	-10.87

6. Concluding remarks and possible future developments

By applying the lifetime labour income approach, this paper measures the human capital stock in 2006 for Norway based on a register-based employment data set. Assuming annual income growth rate and discount rate being 2.5% and 3.5%, respectively, the calculated value of the human capital is 15,260.69 billions of NOK in current prices, approximately 6 times as large as that of physical capital in 2006. However, the result is sensitive to the choice of two key parameters: annual income growth rate and discount rate.

A snapshot of the Norwegian human capital stock in 2006 with very detailed information on the composition pattern of the human capital stock including labour participation rates, school enrolment rates, employment rates, annual income and lifetime income thus computed, distributed by age, sex and educational attainment, is reported.

Next we plan to apply the lifetime labour income approach employed in this paper to further calculate the Norwegian human capital stock for other years (2000-2007). Moreover, we try to construct an accumulation account for human capital, where changes of the human capital stock can be allocated among the human capital flows in each year. The objective is to find the factors behind the evolution of the human capital in these years, based on which, some policy suggestions can be drawn.

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Appendix

Figure A1: Labour participation rates for those with primary education in 2006.

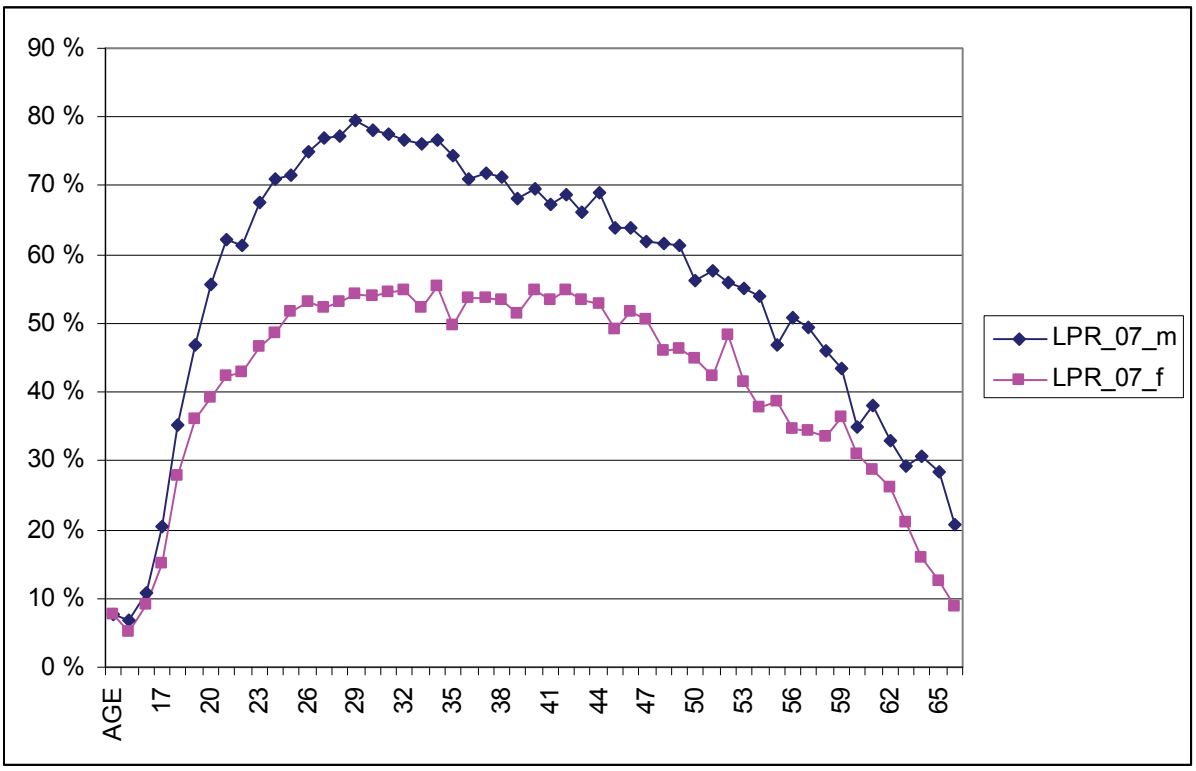

Figure A2: Labour participation rates for those with lower secondary education in 2006.

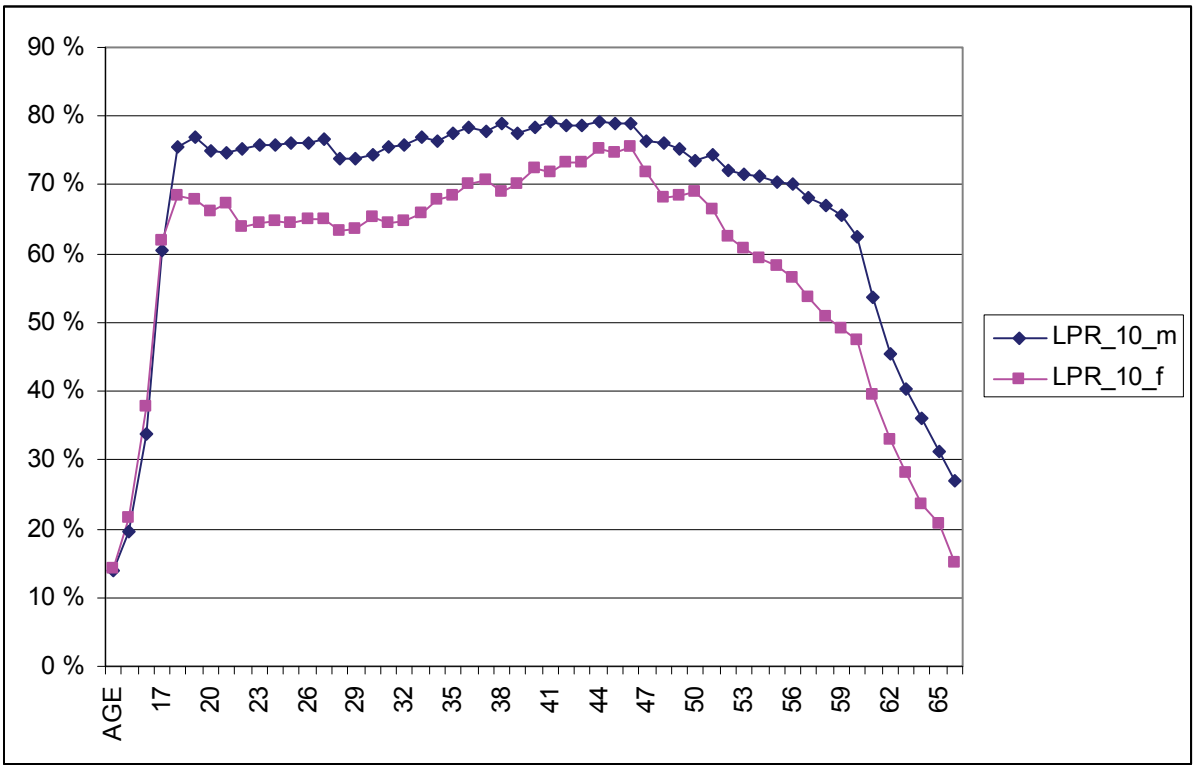

Figure A3: Labour participation rates for those with basic upper secondary education in 2006.

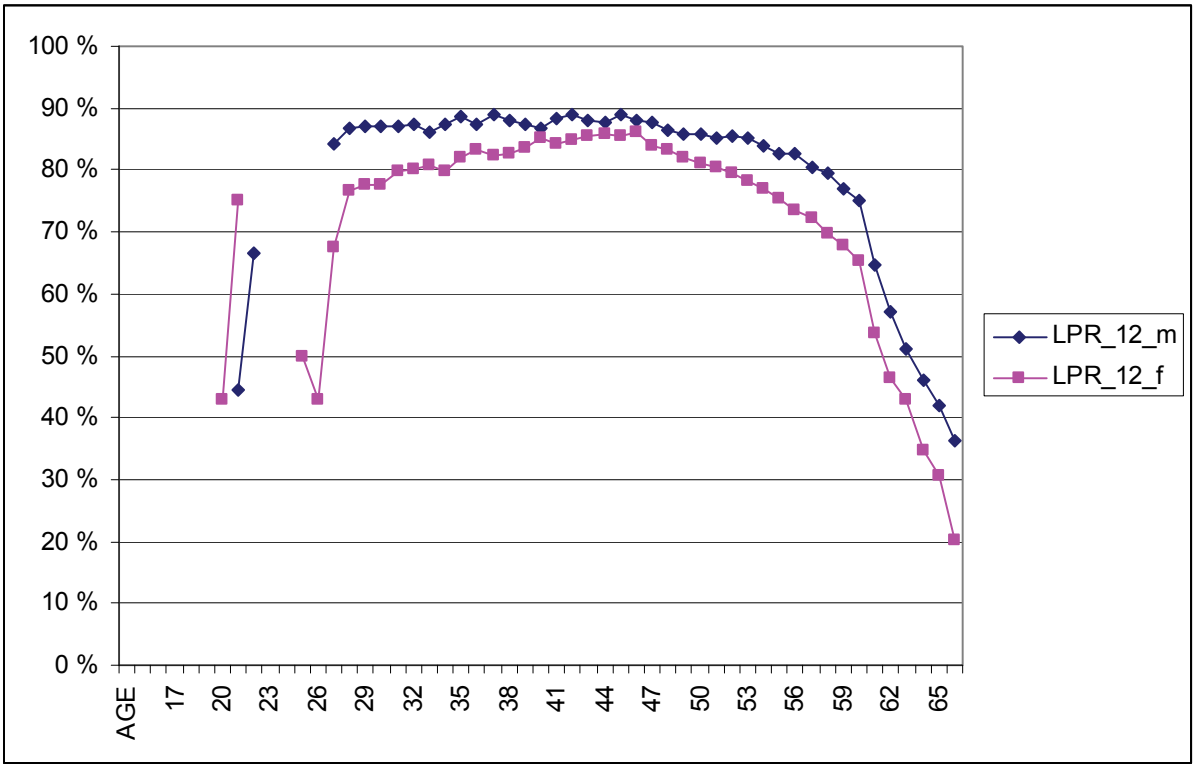

Figure A4: Labour participation rates for those with final upper secondary education in 2006.

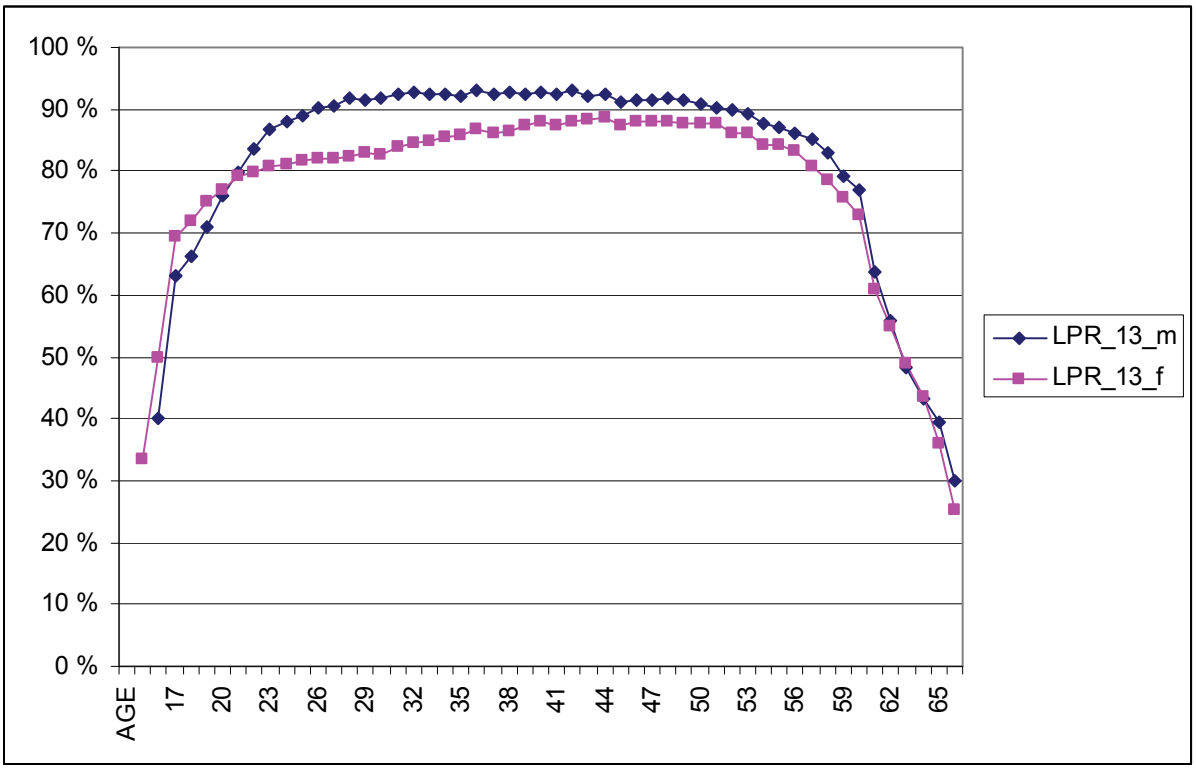

Figure A5: Labour participation rates for those with post-secondary education in 2006.

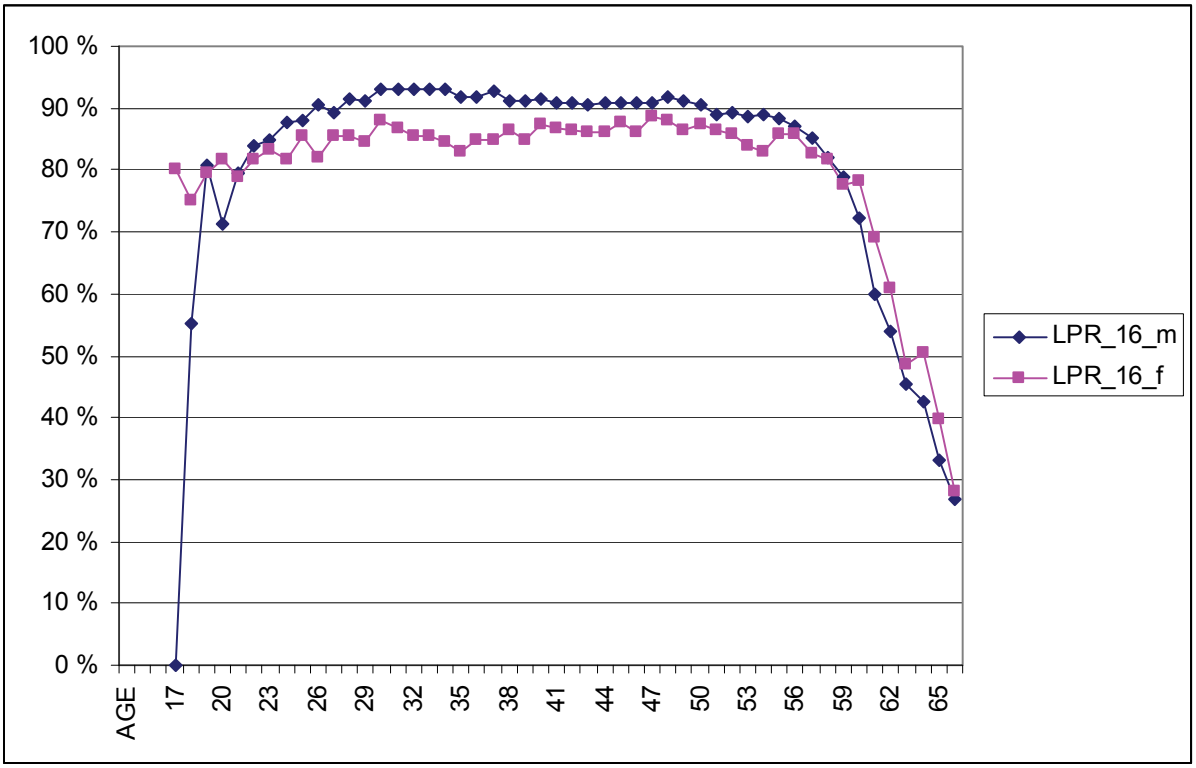

Figure A6: Labour participation rates for those with undergraduate education in 2006.

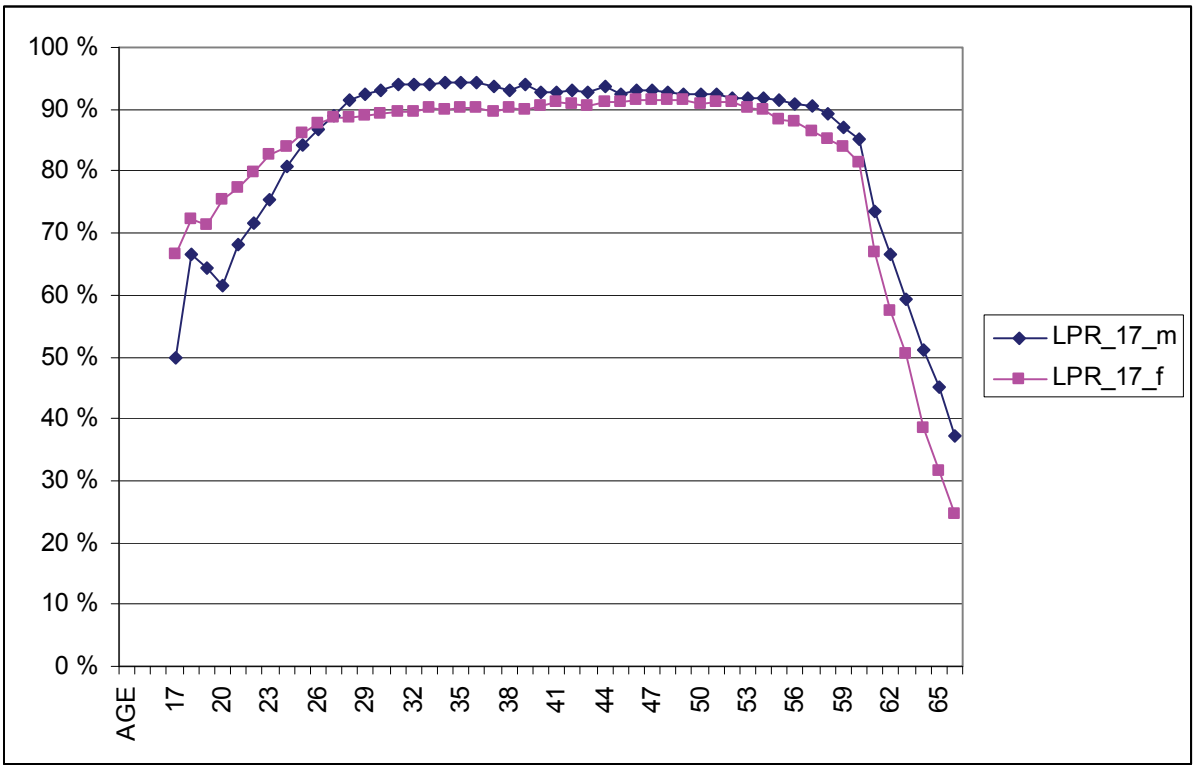

Figure A7: Labour participation rates for those with graduate education in 2006.

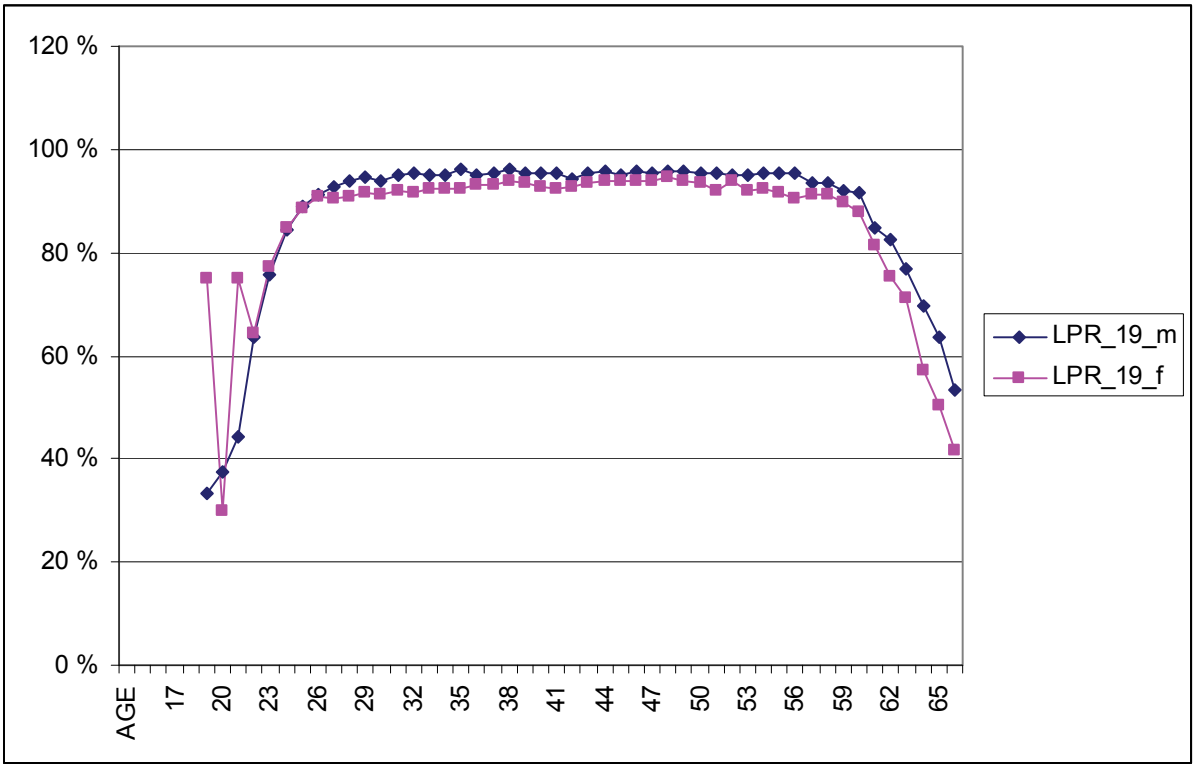

Figure A8: Labour participation rates for those with postgraduate education in 2006.

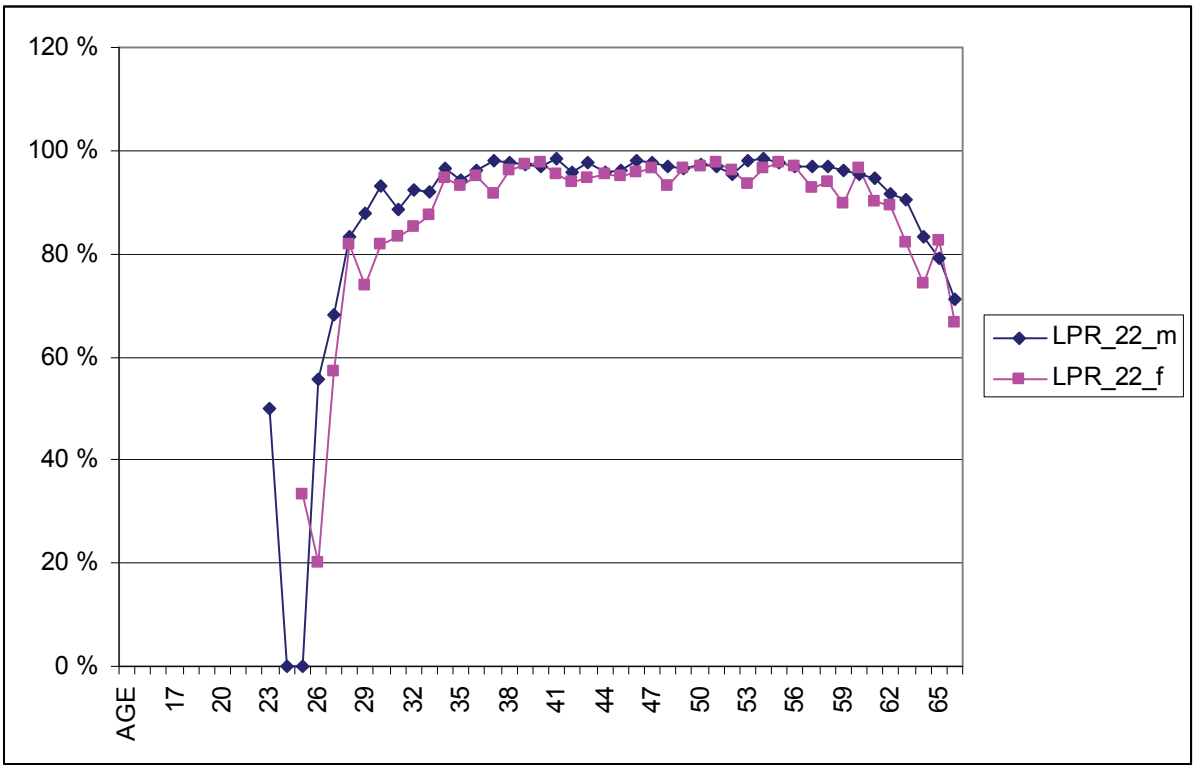

Figure A9: School enrolment rates for those with primary education in 2006 (Male).

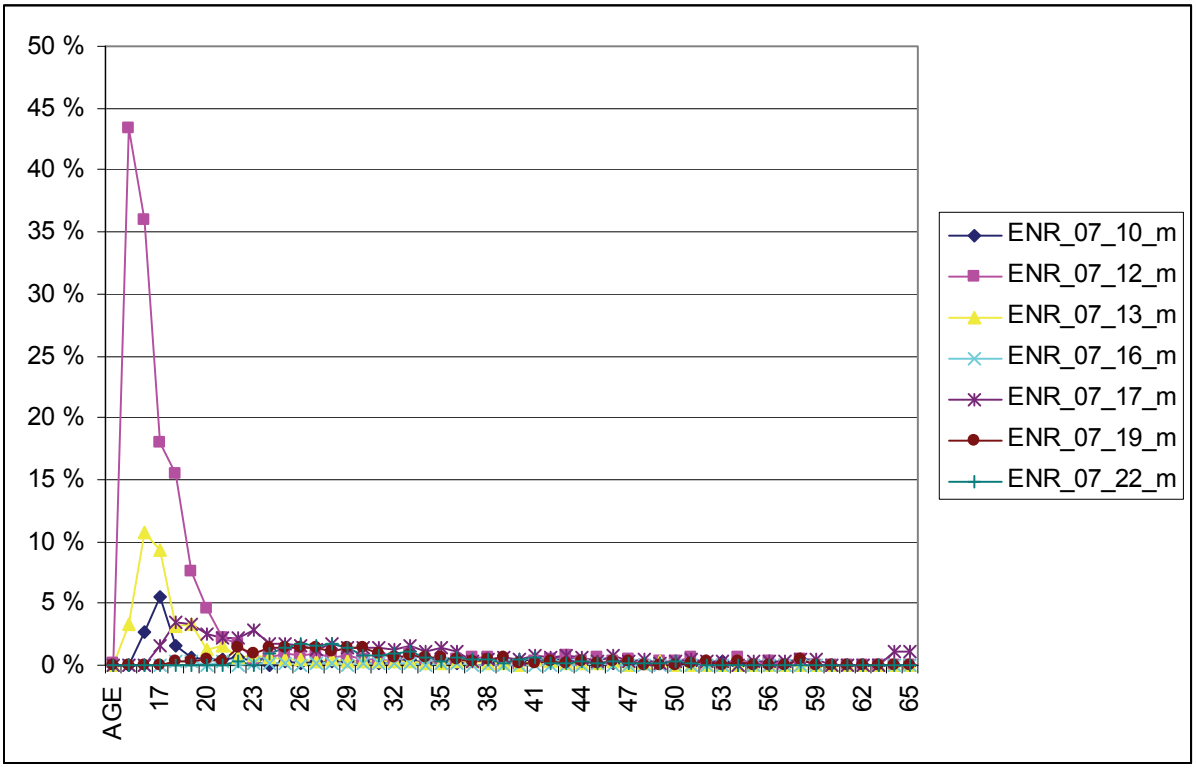

Figure A10: School enrolment rates for those with primary education in 2006 (Female).

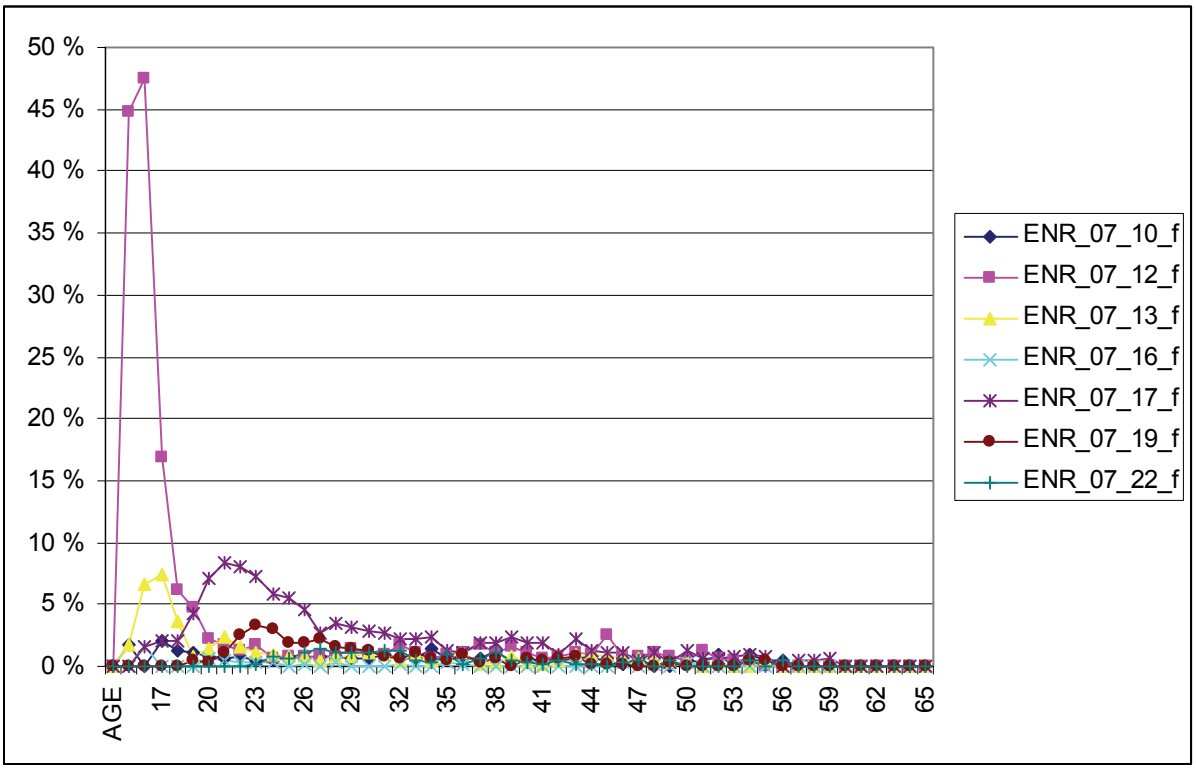

Figure A11: School enrolment rates for those with lower secondary education in 2006 (Male).

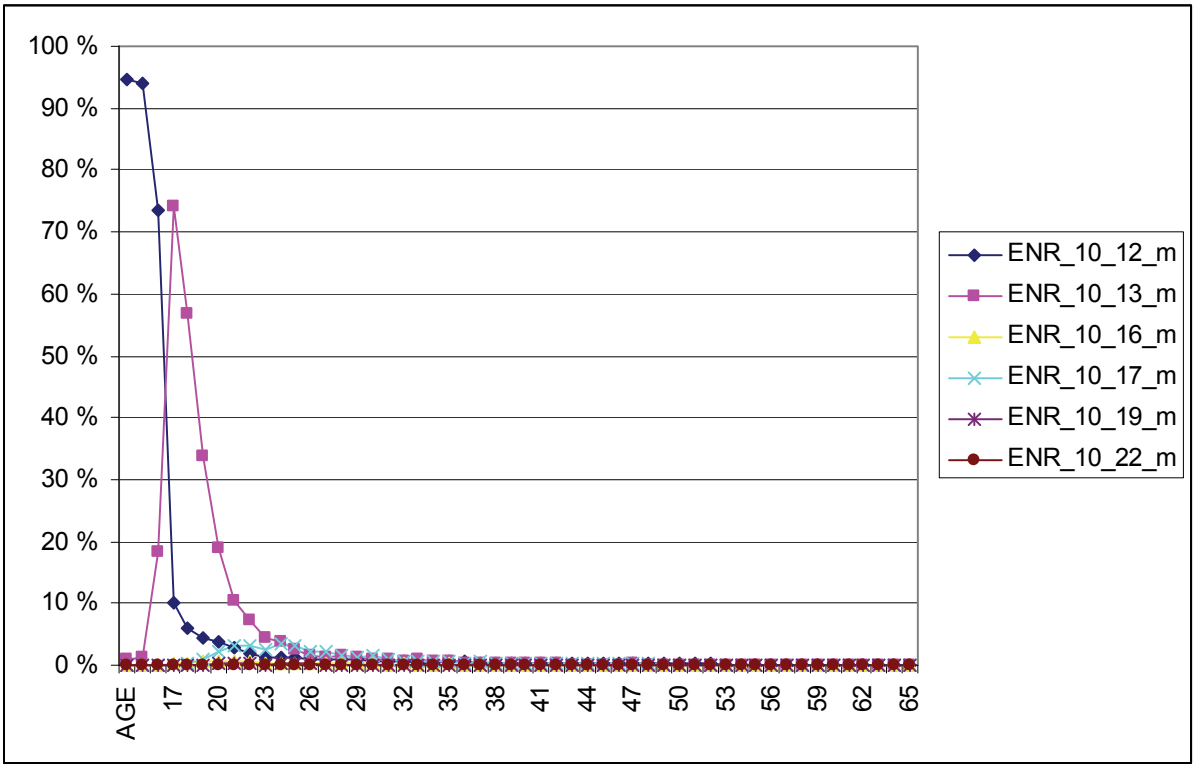

Figure A12: School enrolment rates for those with lower secondary education in 2006 (Female).

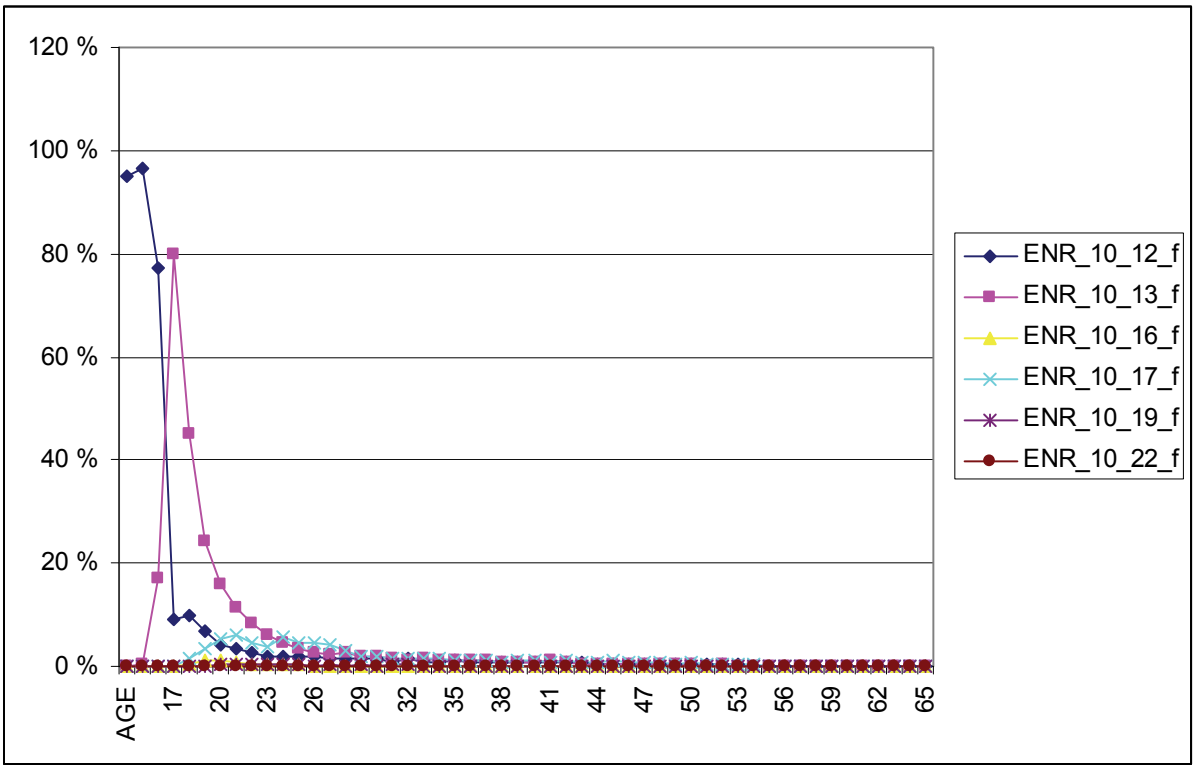

Figure A13: School enrolment rates for those with basic upper secondary education in 2006 (Male).

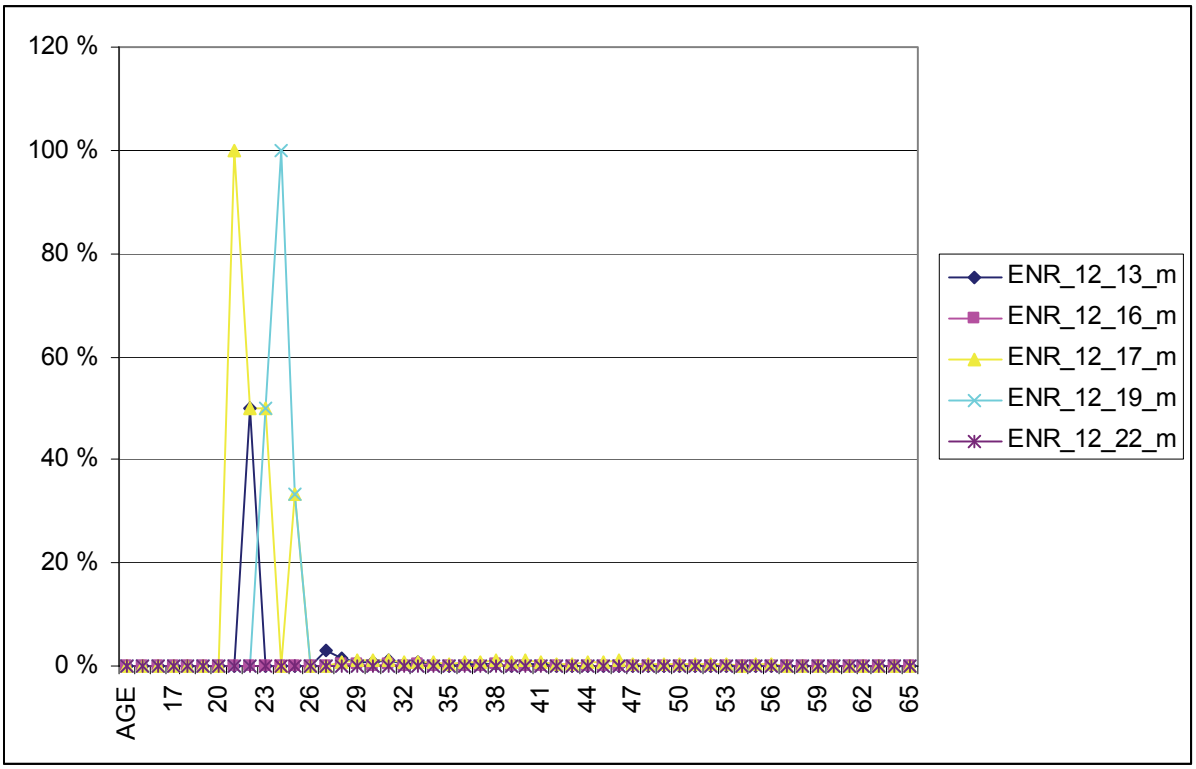

Figure A14: School enrolment rates for those with basic upper secondary education in 2006 (Female).

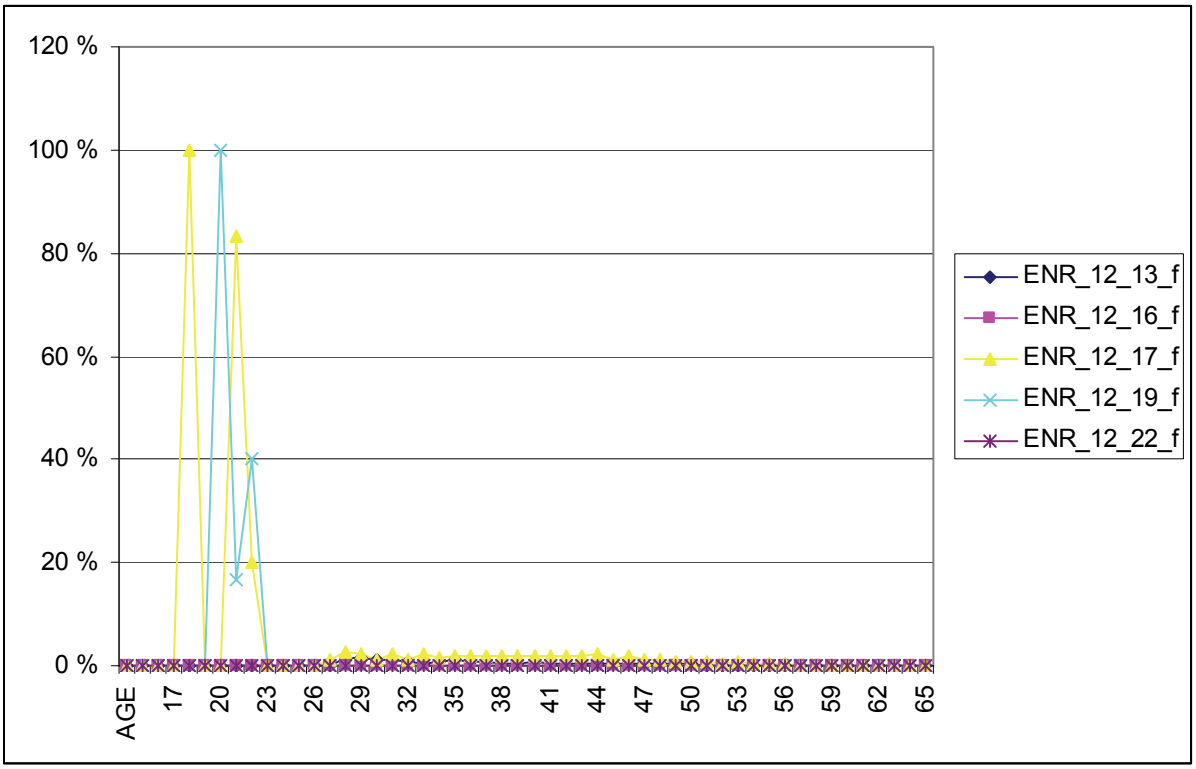

Figure A15: School enrolment rates for those with final upper secondary education studying at graduate educational level in 2006.

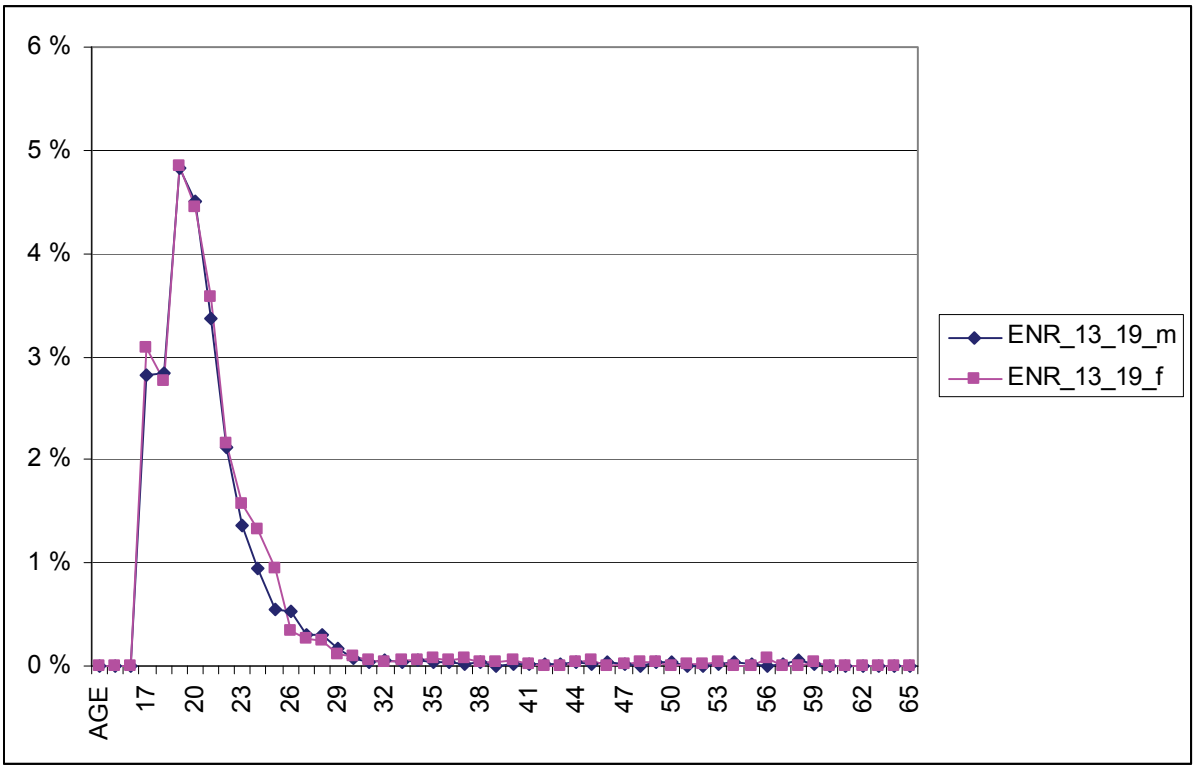

Figure A16: School enrolment rates for those with final upper secondary education studying at postgraduate educational level in 2006.

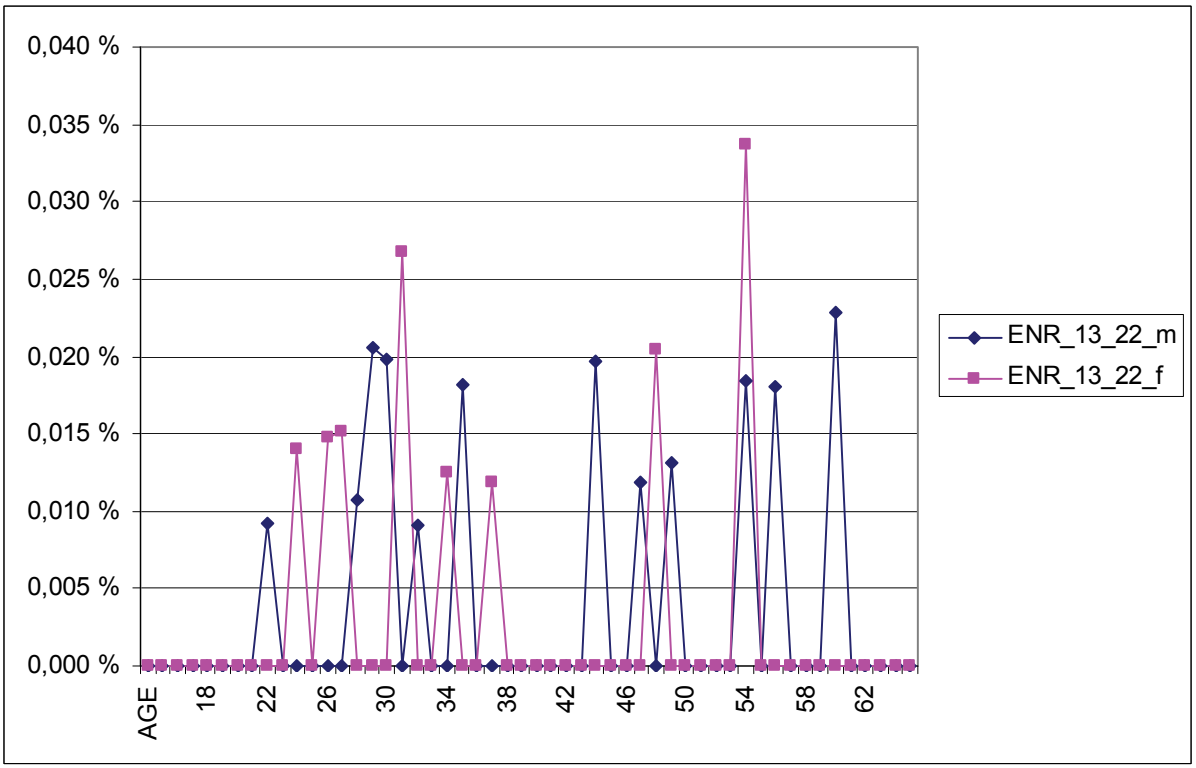

Figure A17: School enrolment rates for those with post-secondary education studying at undergraduate educational level in 2006.

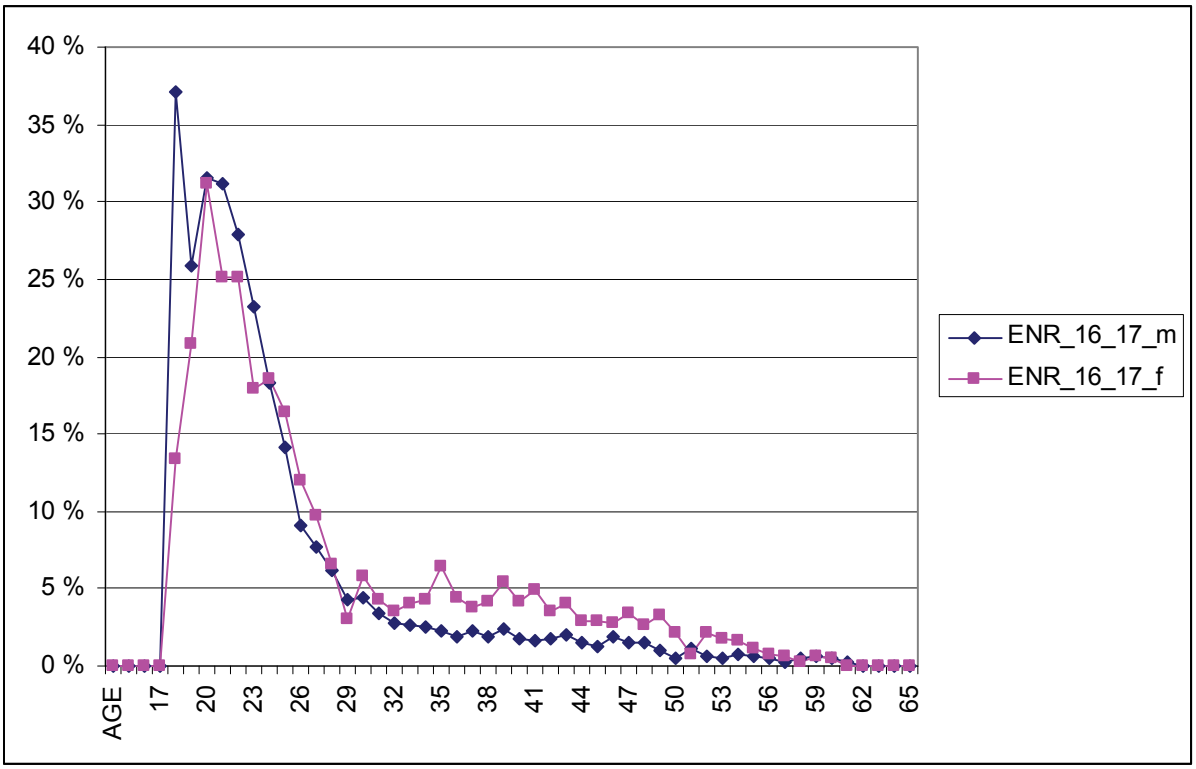

Figure A18: School enrolment rates for those with post-secondary education studying at graduate educational level in 2006.

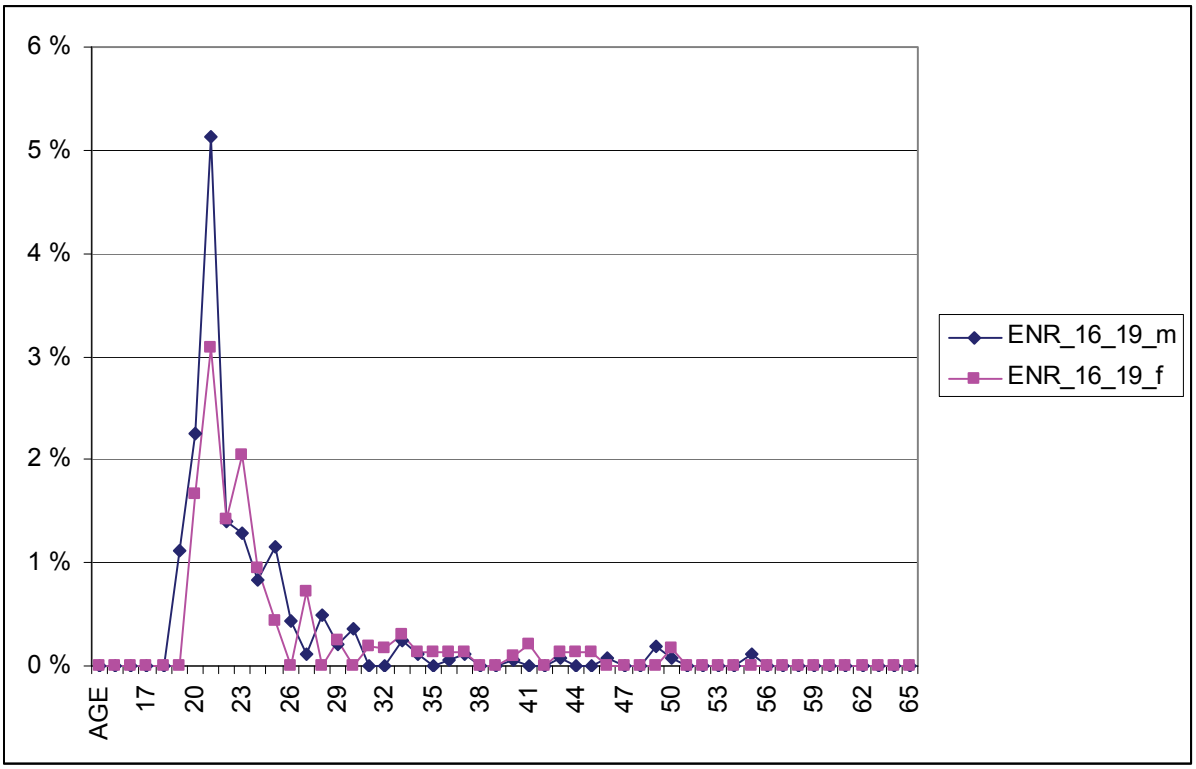

Figure A19: School enrolment rates for those with post-secondary education studying at postgraduate educational level in 2006.

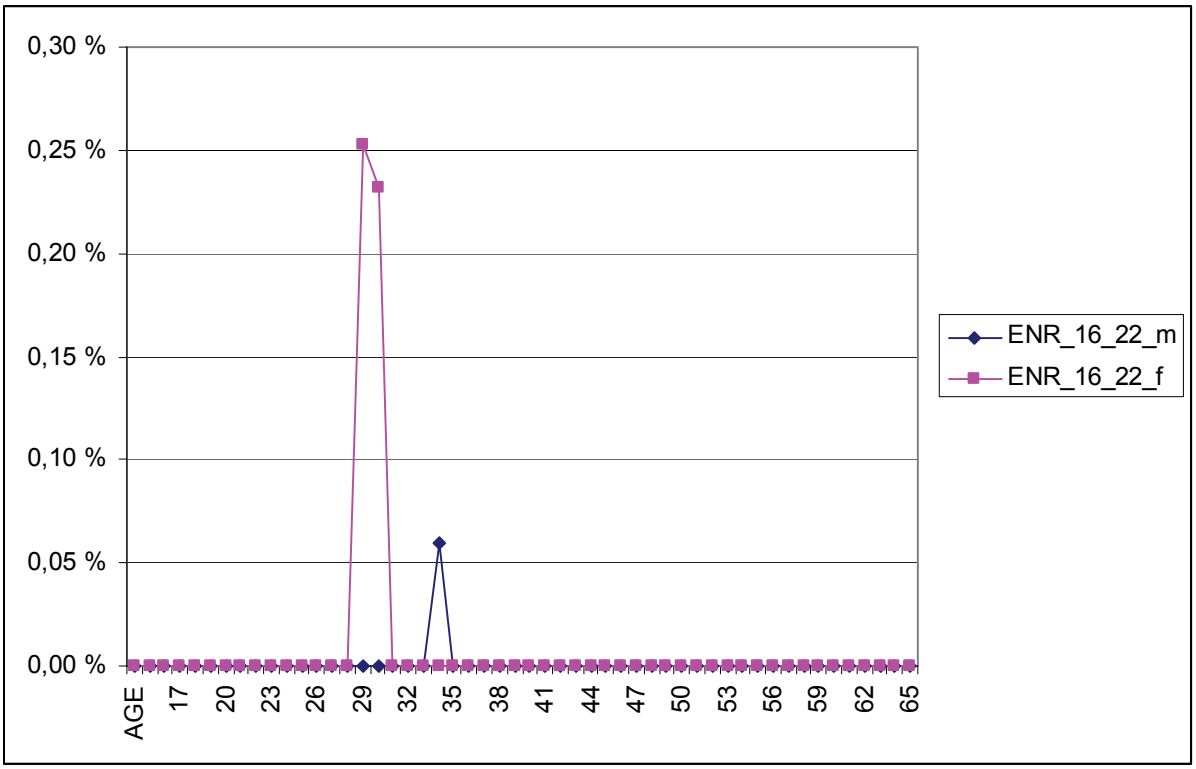

Figure A20: School enrolment rates for those with undergraduate educational level studying at graduate educational level in 2006.

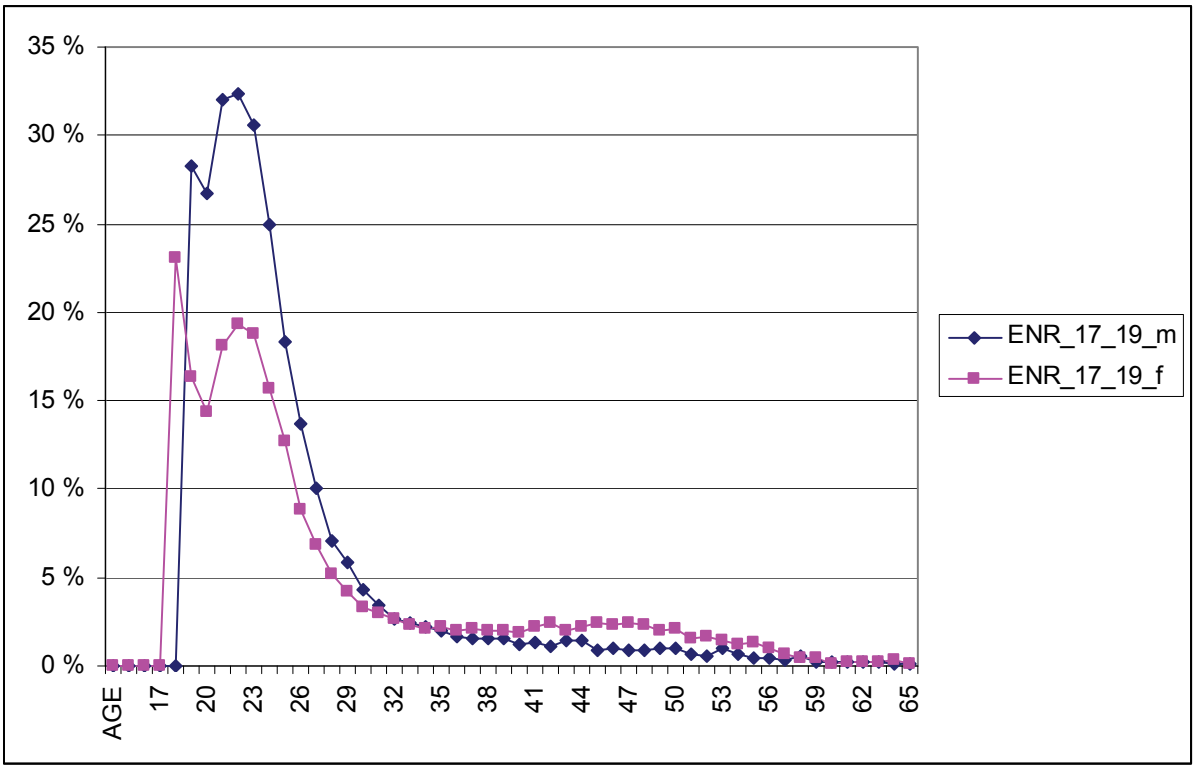

Figure A21: School enrolment rates for those with undergraduate educational level studying at postgraduate educational level in 2006.

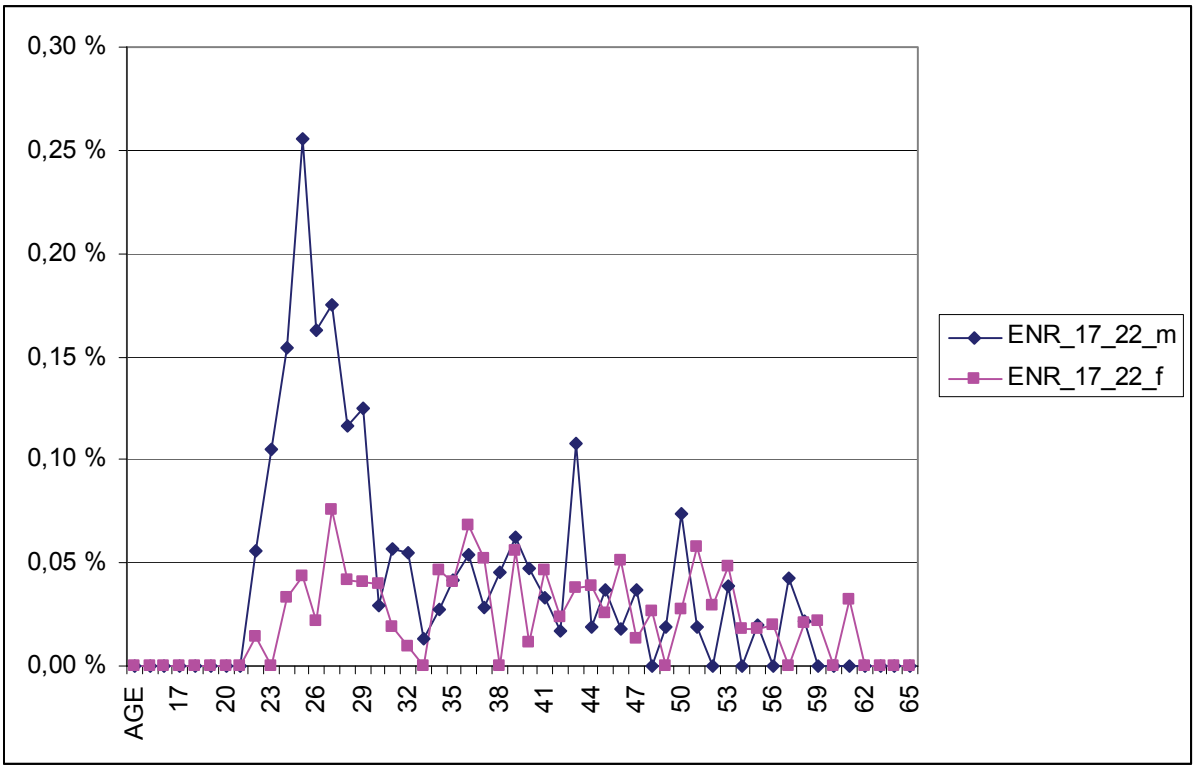

Figure A22: School enrolment rates for those with graduate educational level studying at postgraduate educational level in 2006.

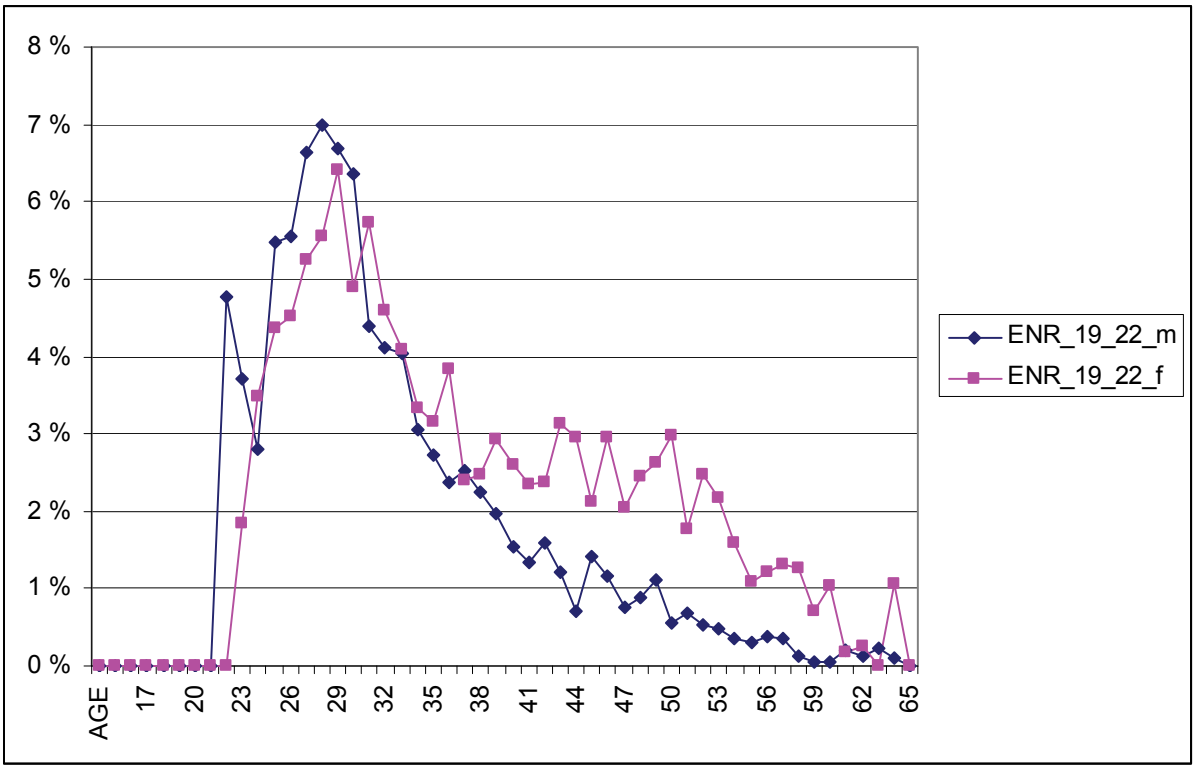

Figure A23: Employment rates for those with primary educational level in 2006.

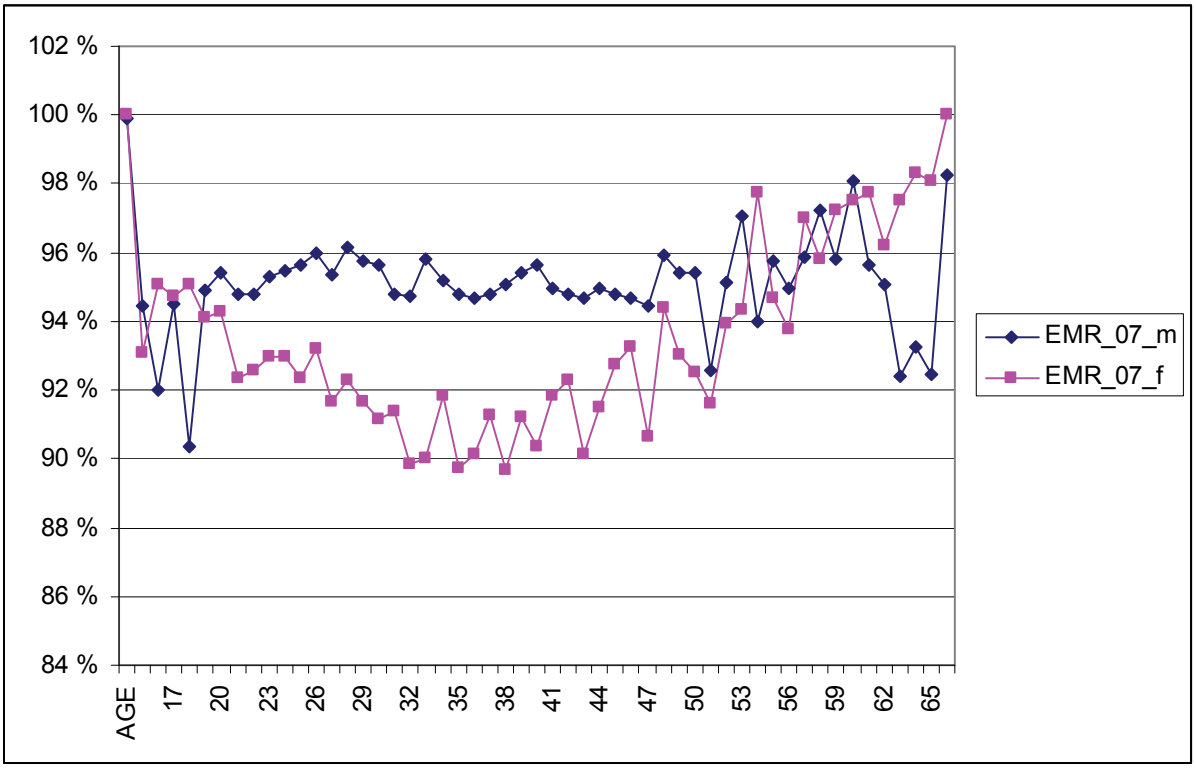

Figure A24: Employment rates for those with lower secondary educational level in 2006.

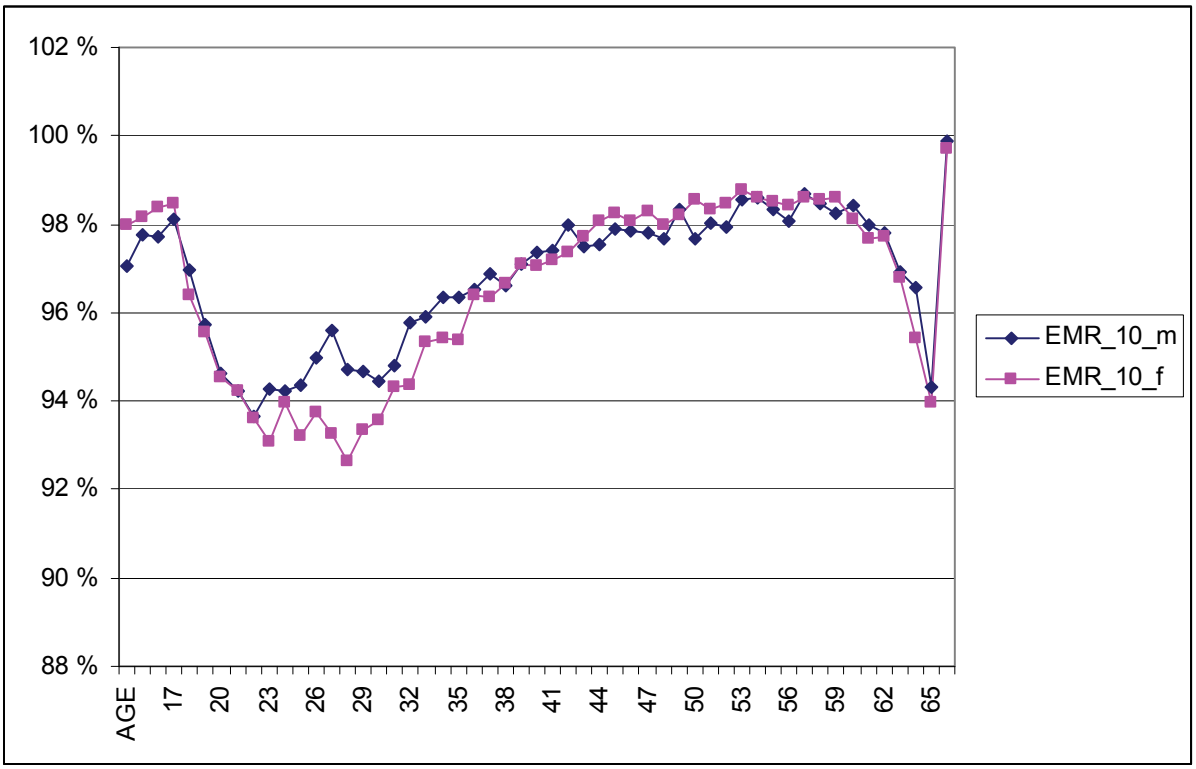

Figure A25: Employment rates for those with basic upper secondary educational level in 2006.

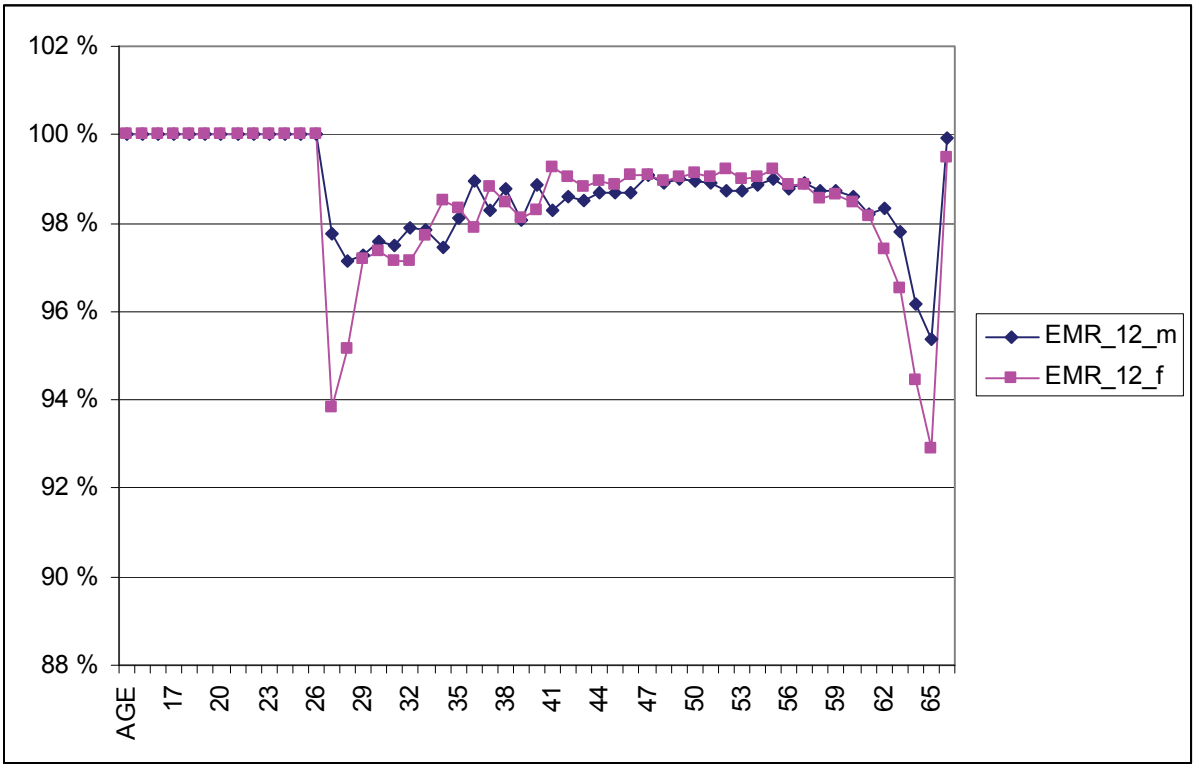

Figure A26: Employment rates for those with final upper secondary educational level in 2006.

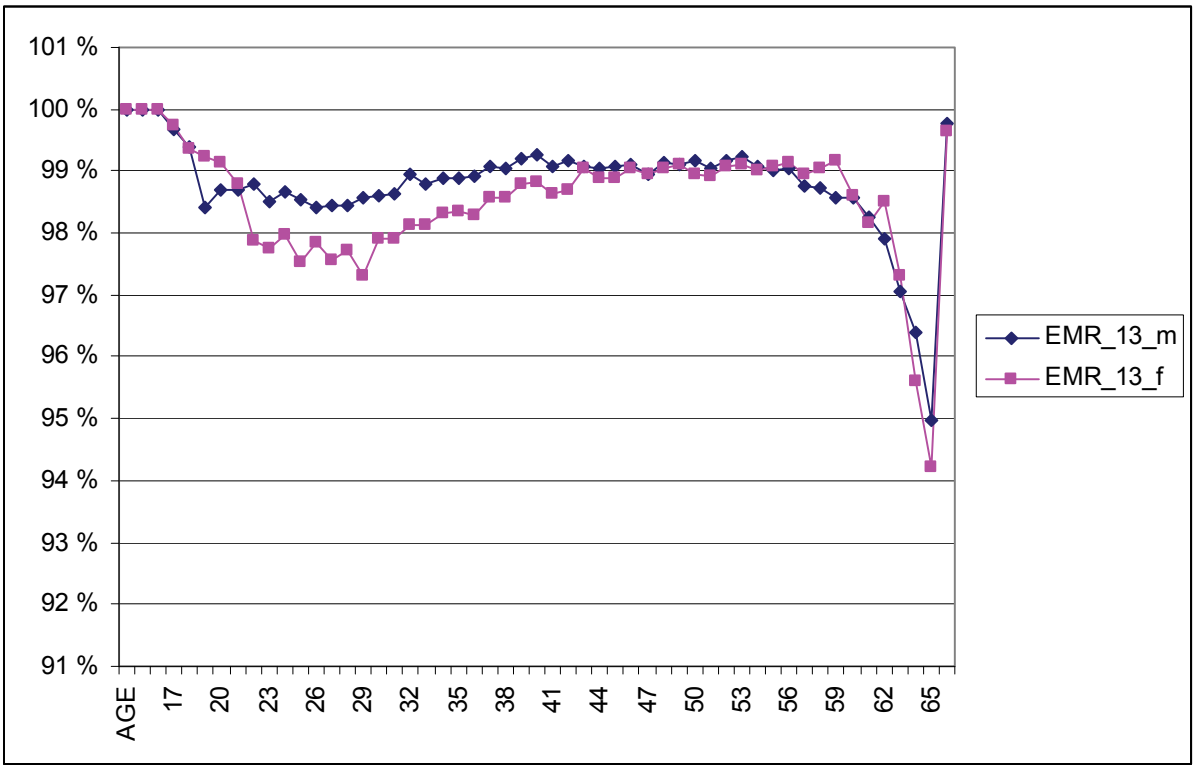

Figure A27: Employment rates for those with post-secondary non-tertiary educational level in 2006.

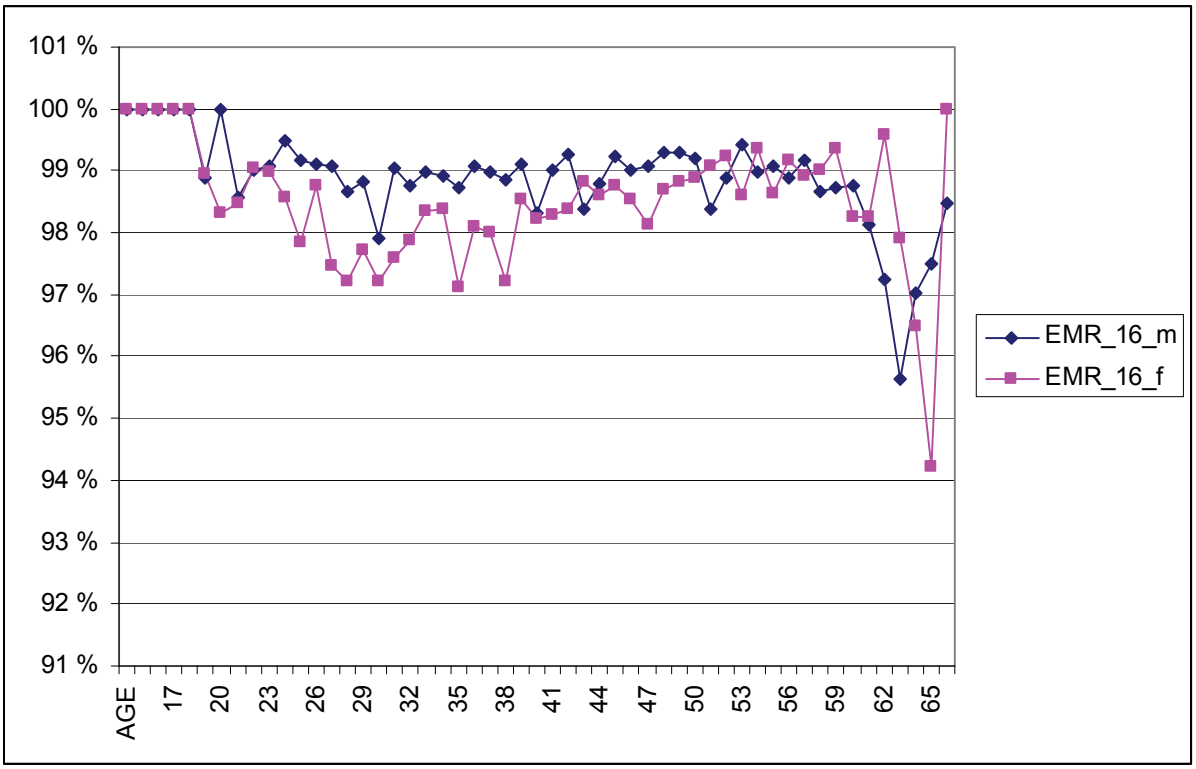

Figure A28: Employment rates for those with undergraduate educational level in 2006.

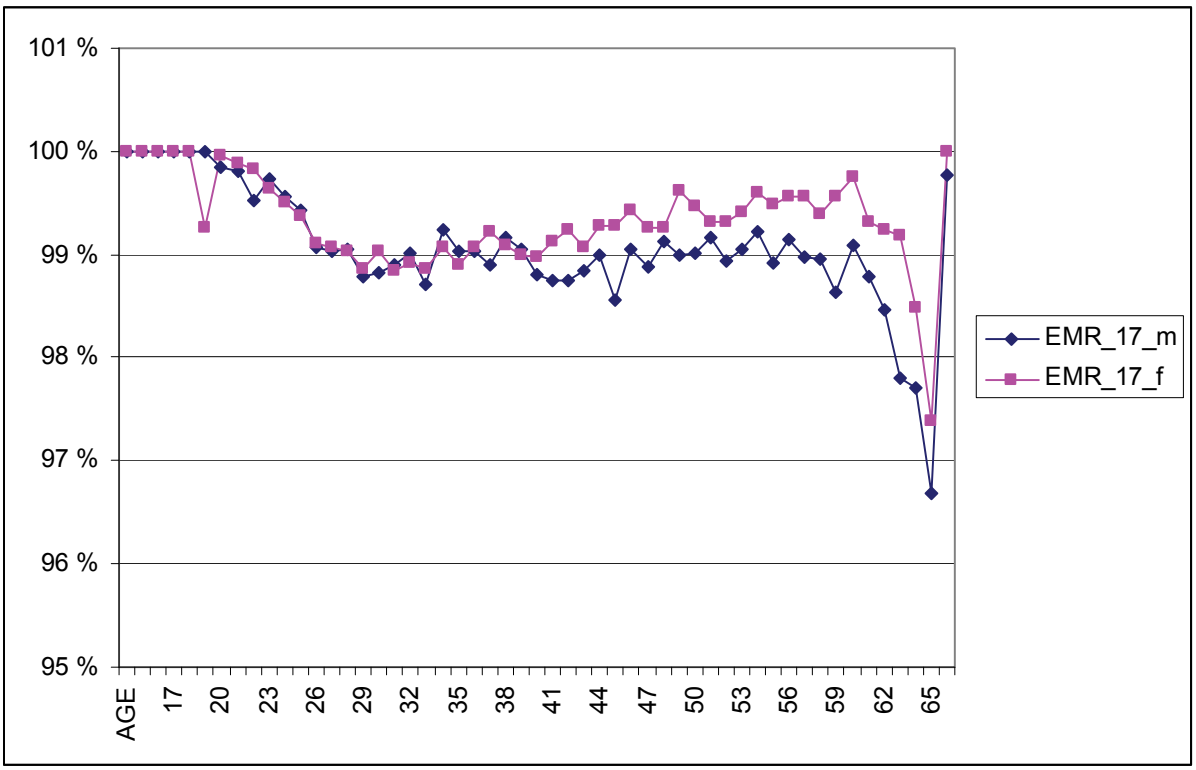

Figure A29: Employment rates for those with graduate educational level in 2006.

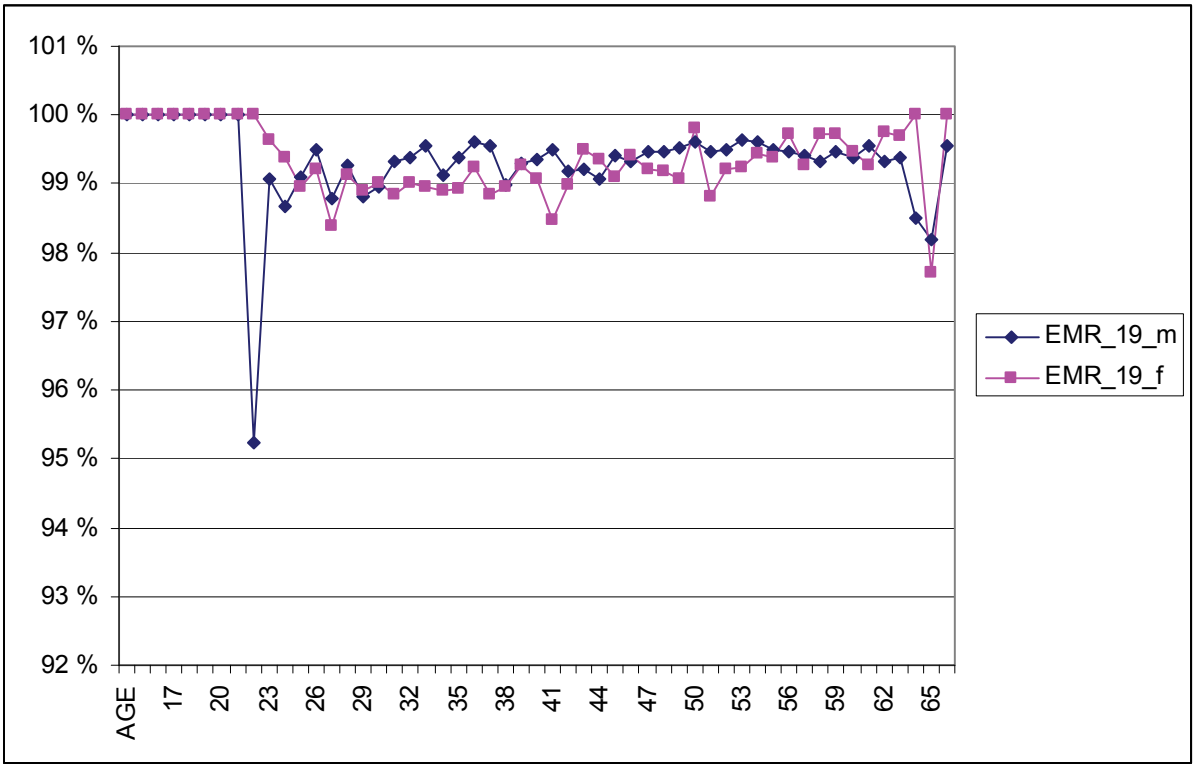

Figure A30: Employment rates for those with postgraduate educational level in 2006.

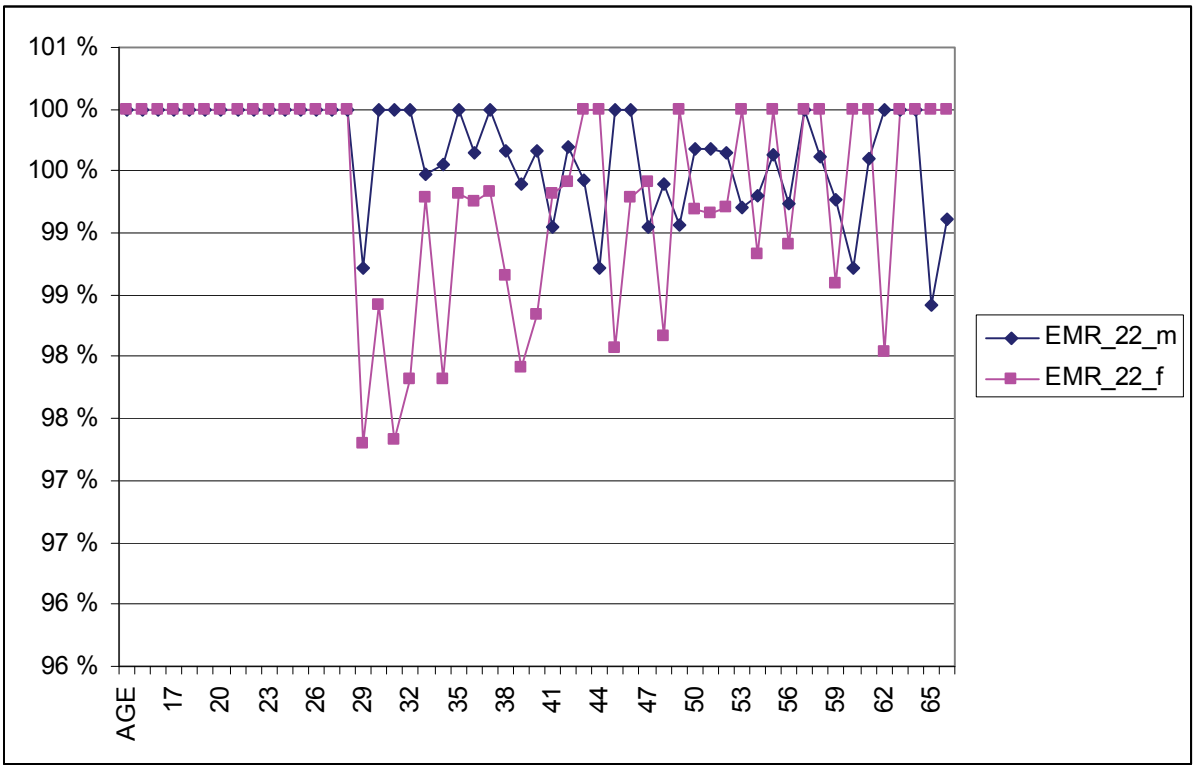

Figure A31: Annual incomes for those with primary educational level in 2006.

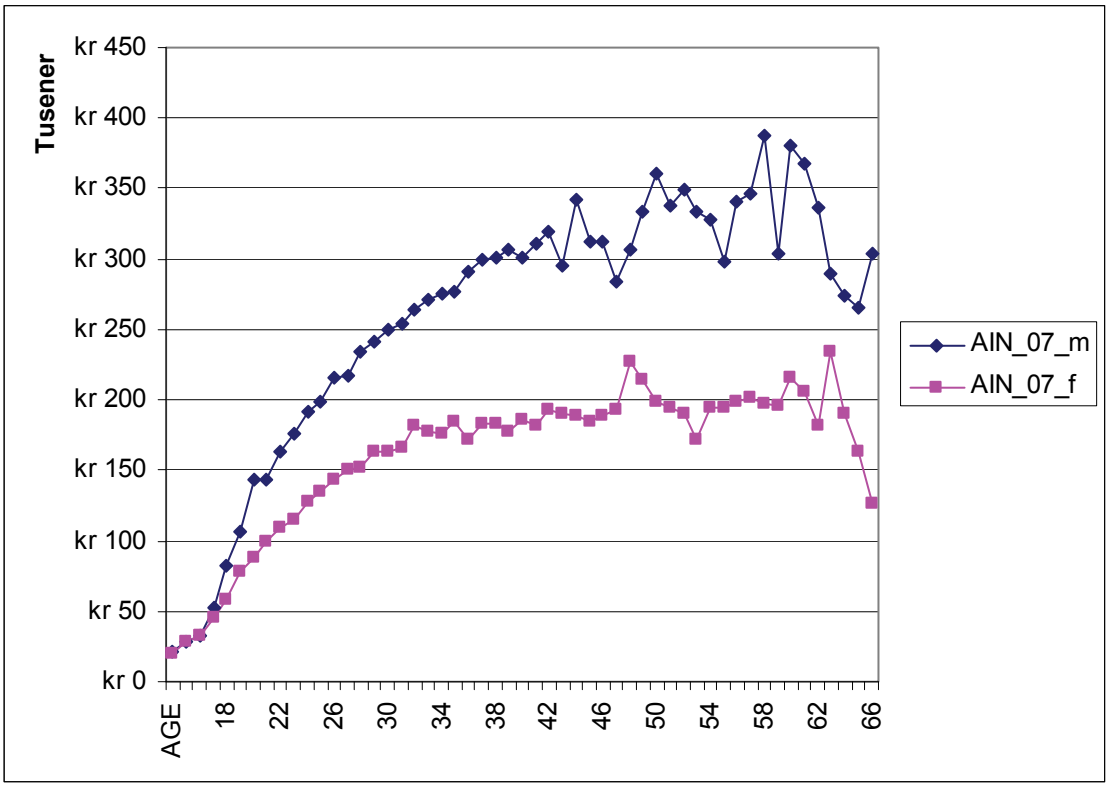

Figure A32: Annual incomes for those with lower secondary educational level in 2006.

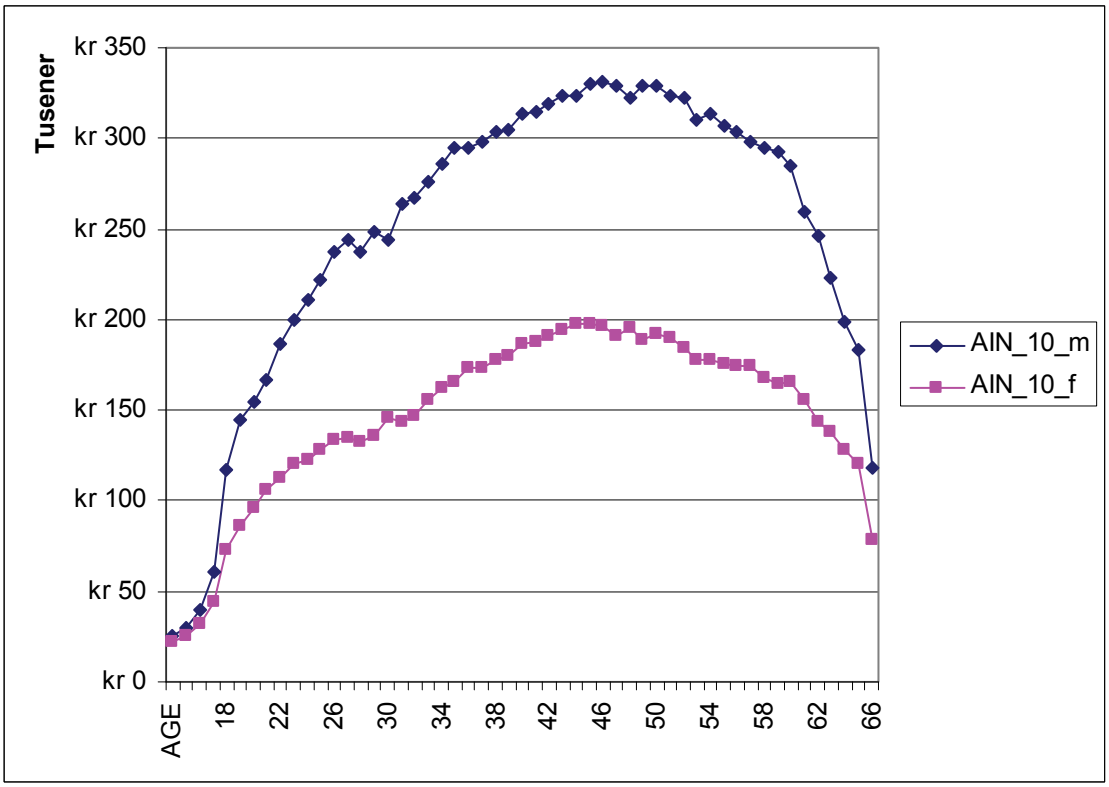

Figure A33: Annual incomes for those with basic upper secondary educational level in 2006.

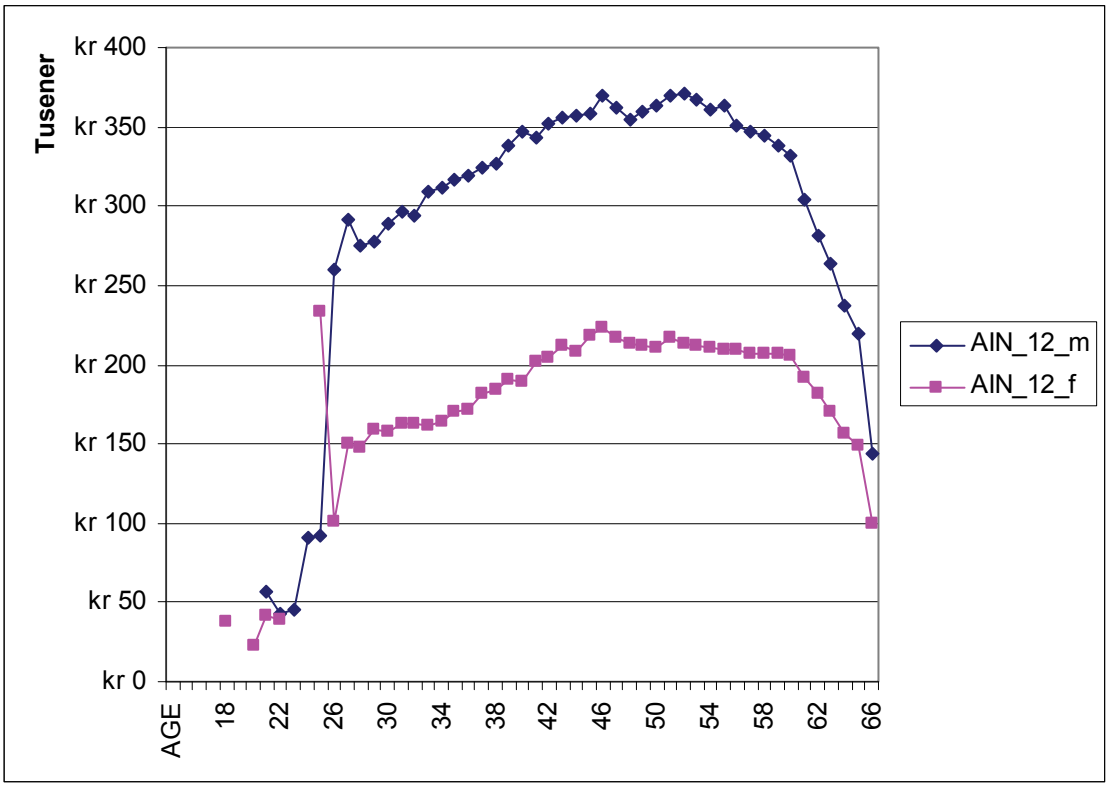

Figure A34: Annual incomes for those with final upper secondary educational level in 2006.

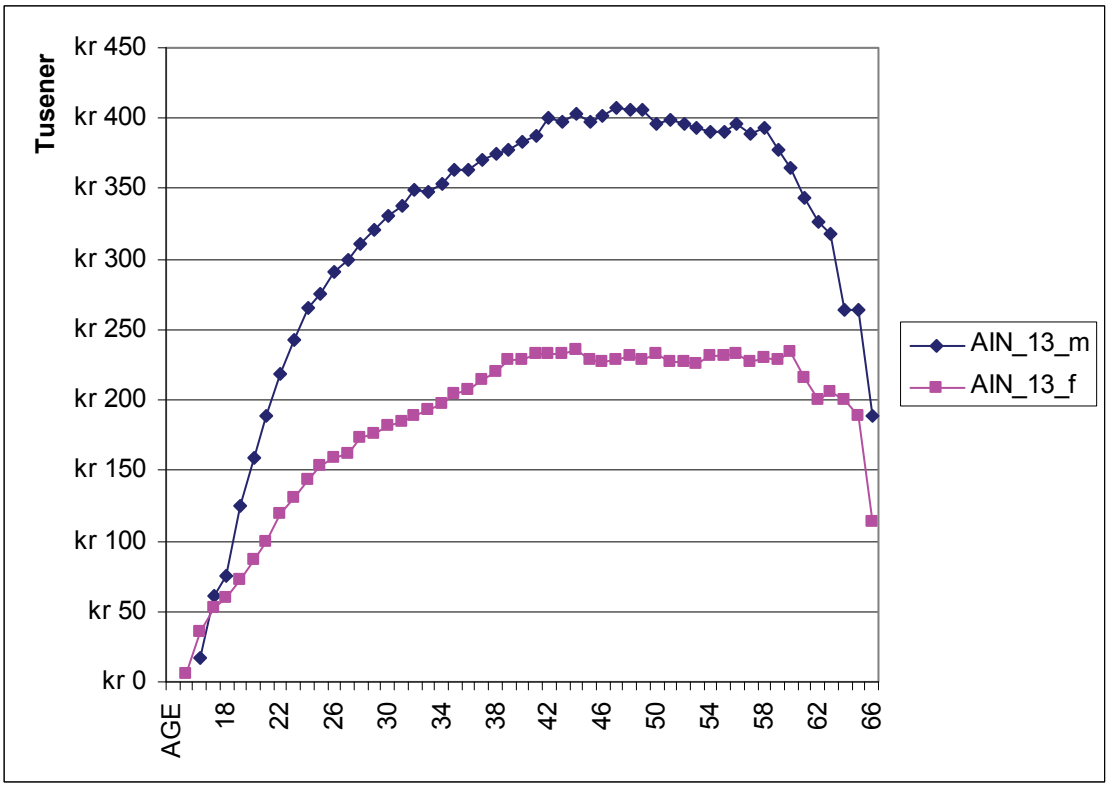

Figure A35: Annual incomes for those with post-secondary educational level in 2006.

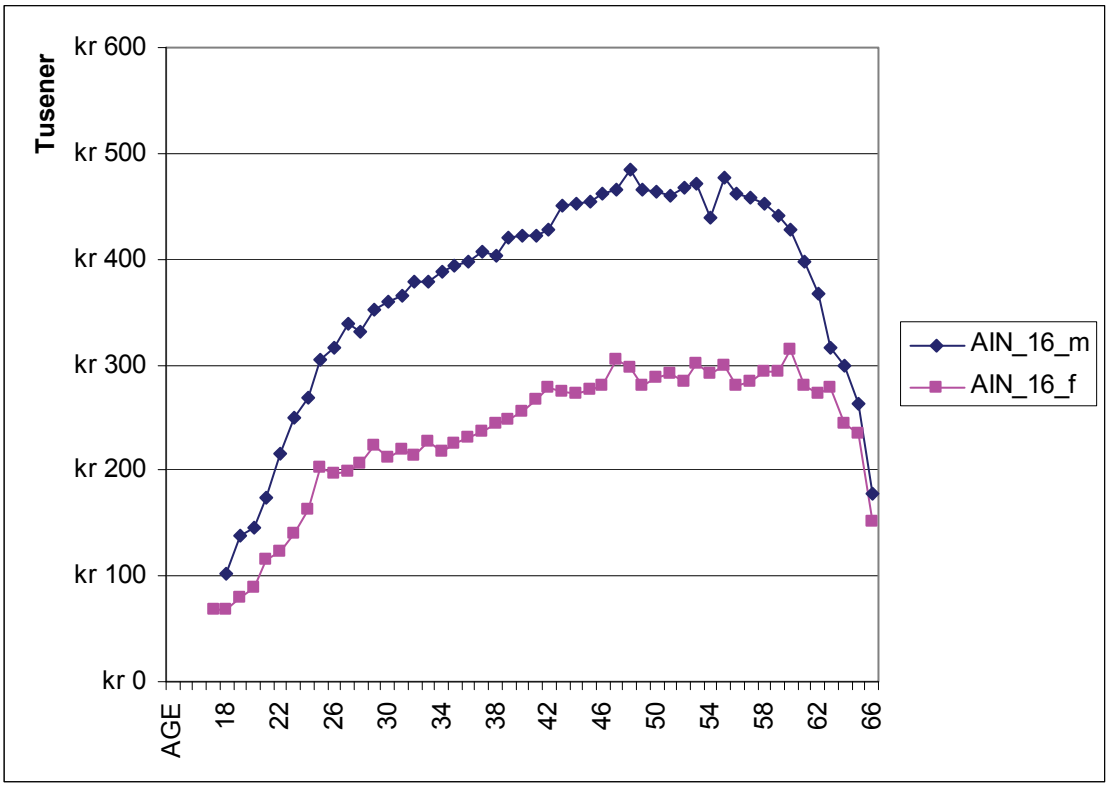

Figure A36: Annual incomes for those with undergraduate educational level in 2006.

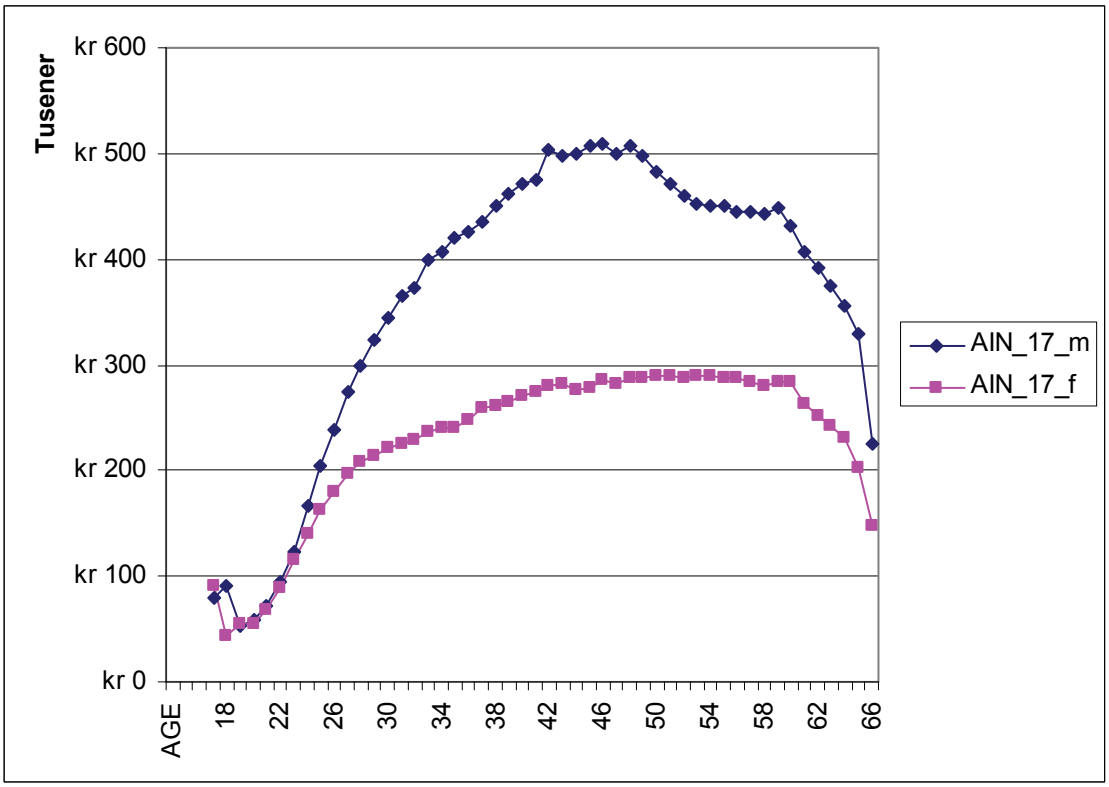

Figure A37: Annual incomes for those with graduate educational level in 2006.

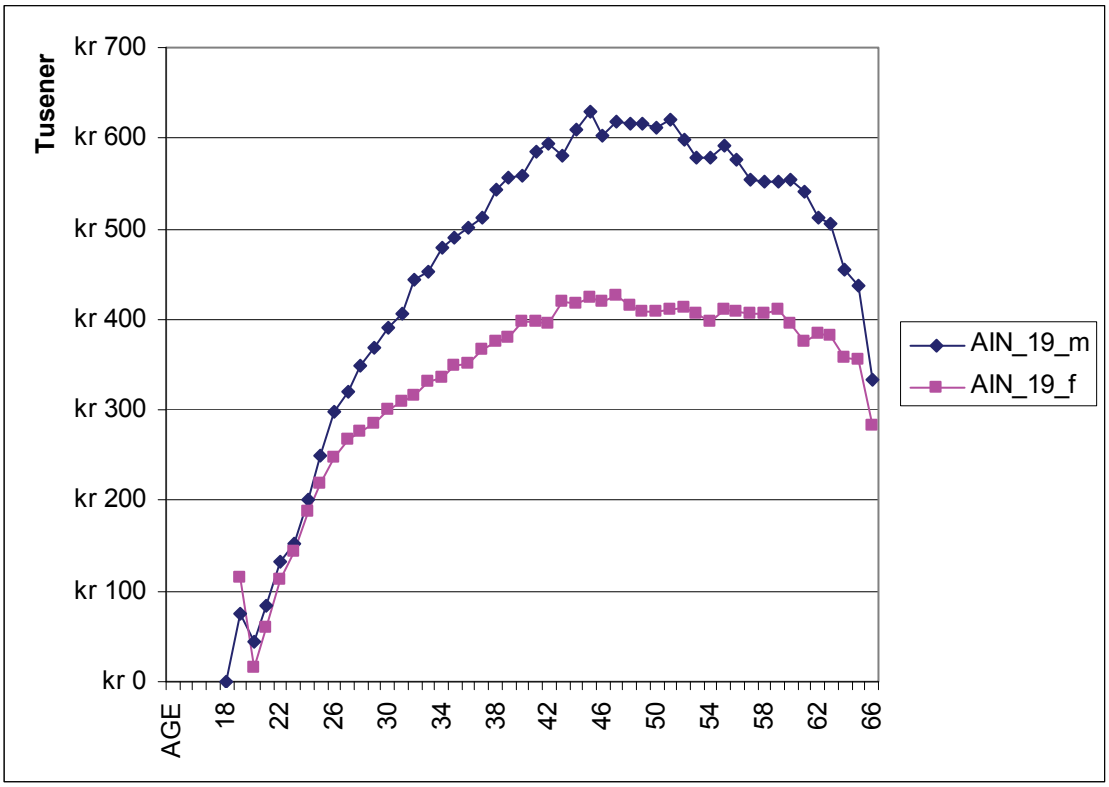

Figure A38: Annual incomes for those with postgraduate educational level in 2006.

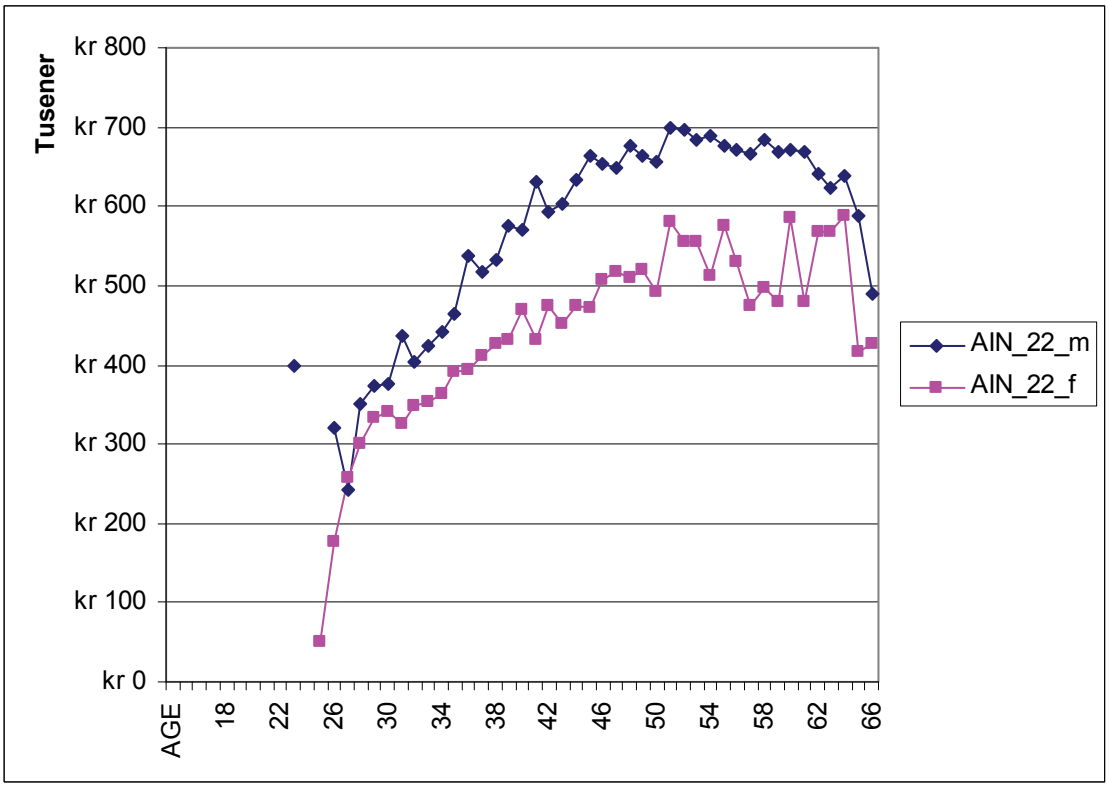

Figure A39: Lifetime incomes for those with primary educational level in 2006.

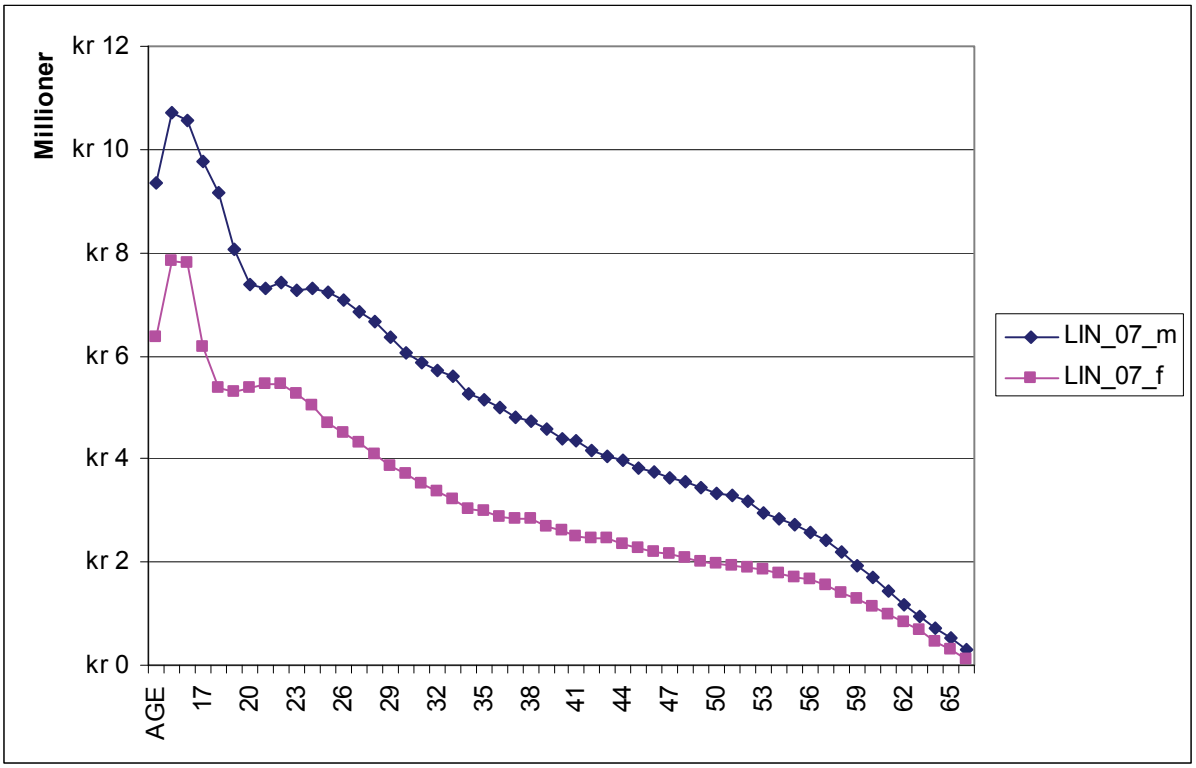

Figure A40: Lifetime incomes for those with lower secondary educational level in 2006.

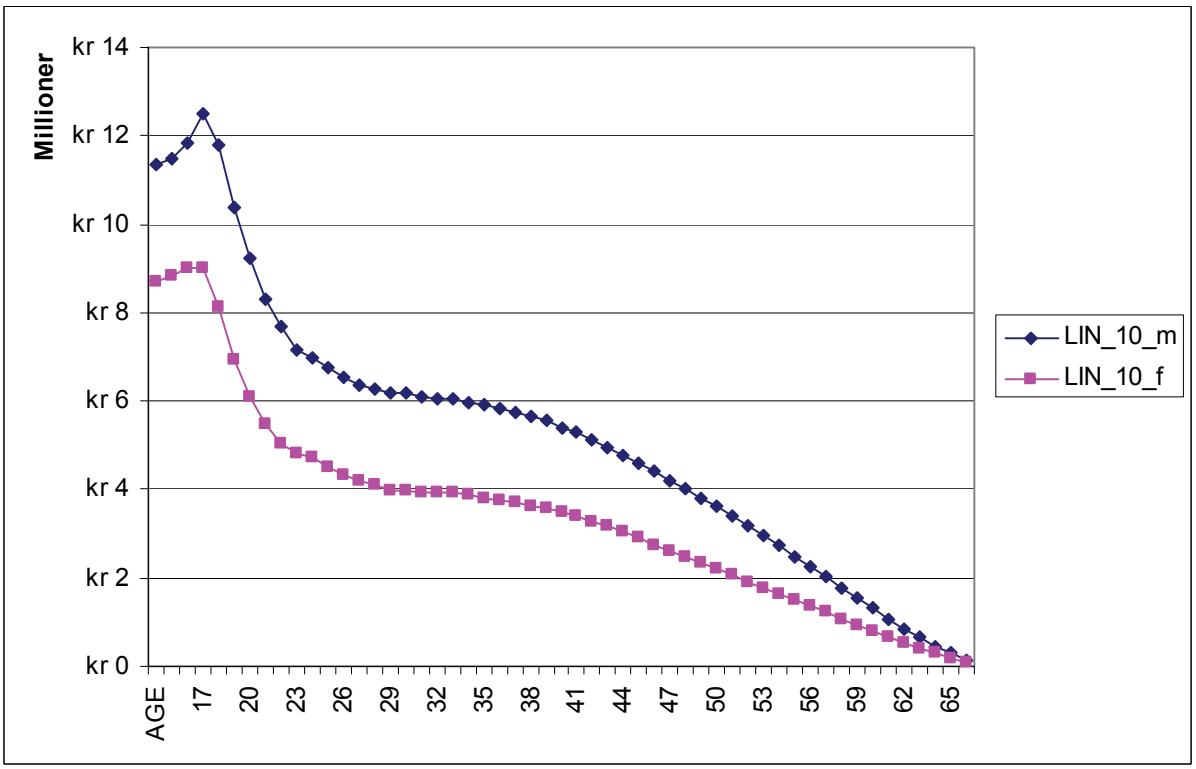

Figure A41: Lifetime incomes for those with basic upper secondary educational level in 2006.

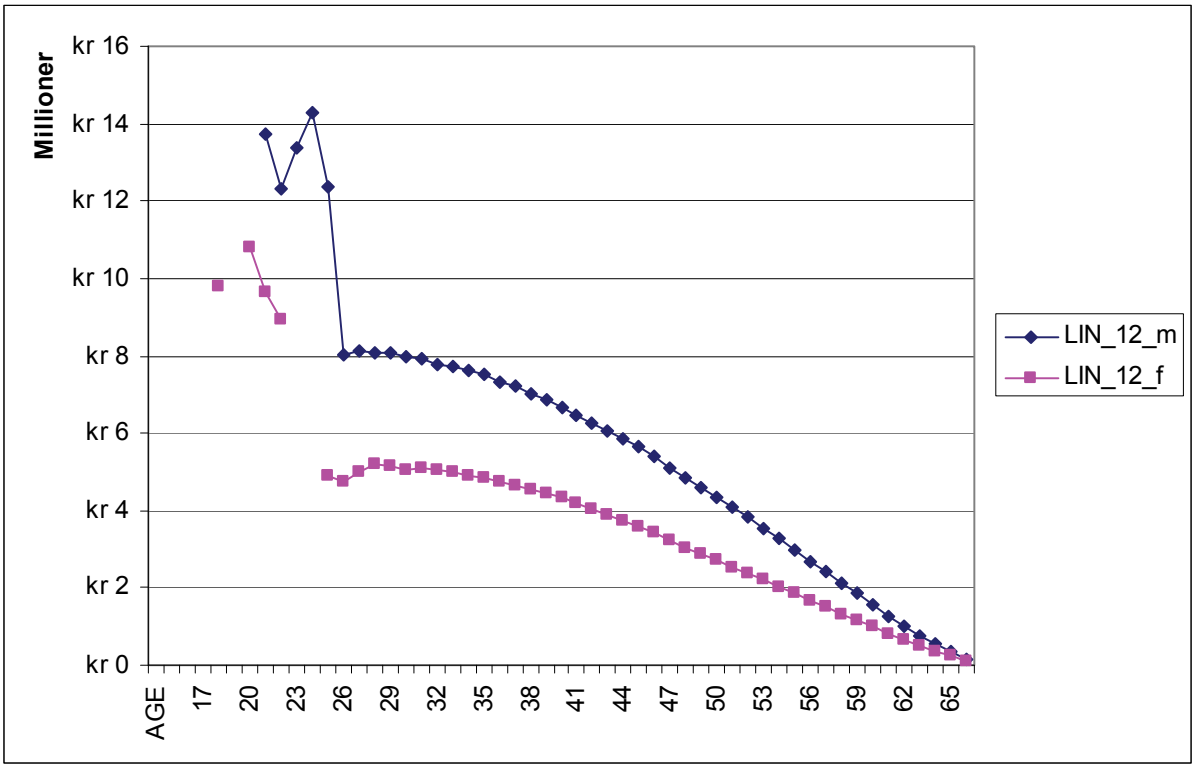

Figure A42: Lifetime incomes for those with final upper secondary educational level in 2006.

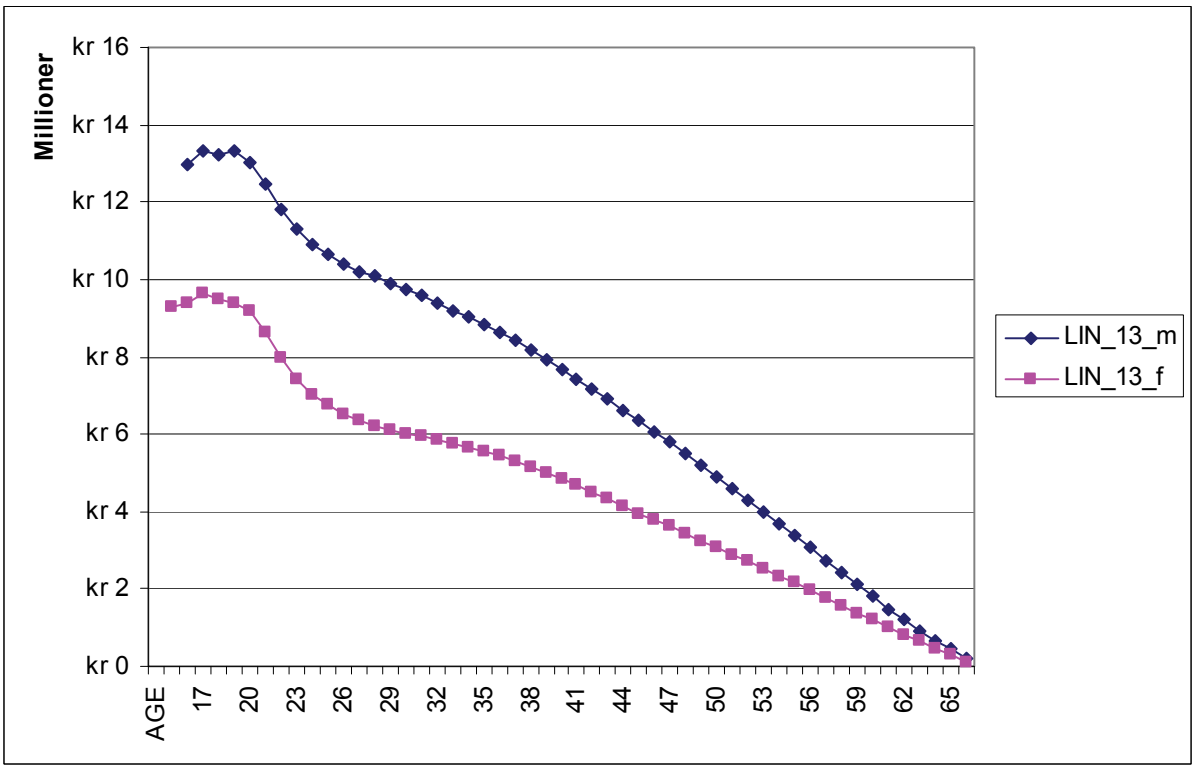

Figure A43: Lifetime incomes for those with post-secondary educational level in 2006.

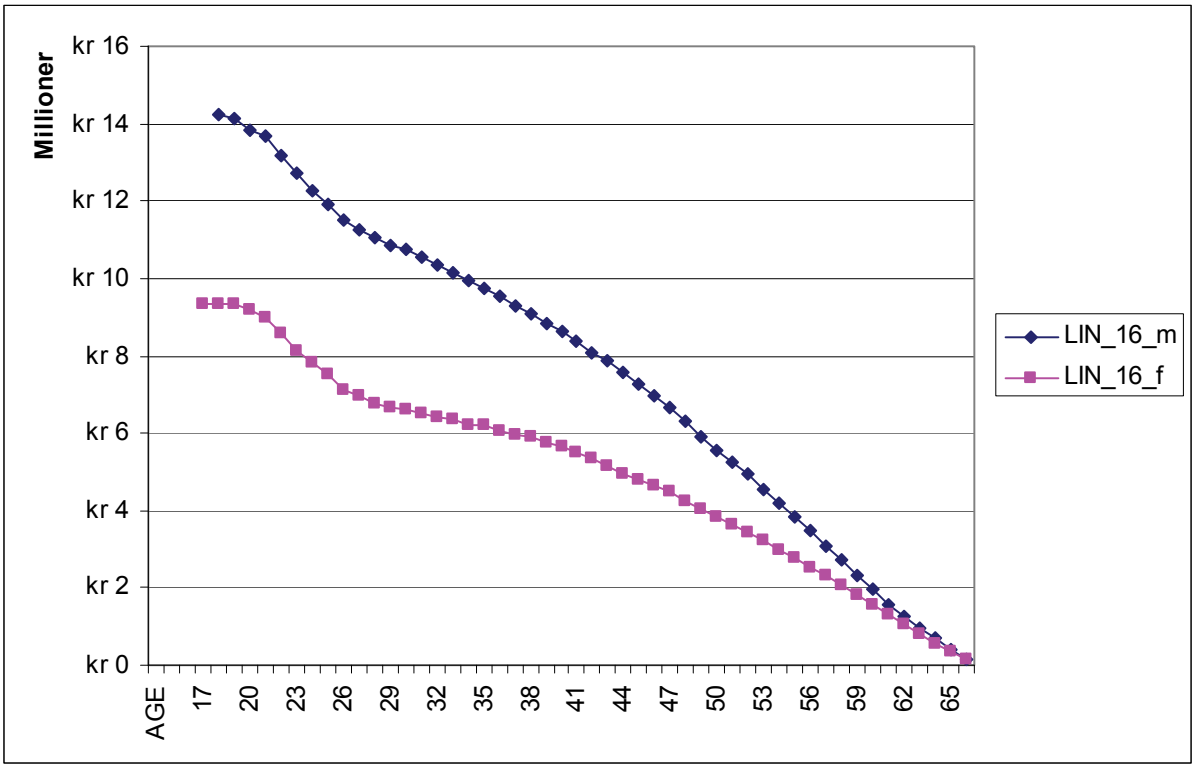

Figure A44: Lifetime incomes for those with undergraduate educational level in 2006.

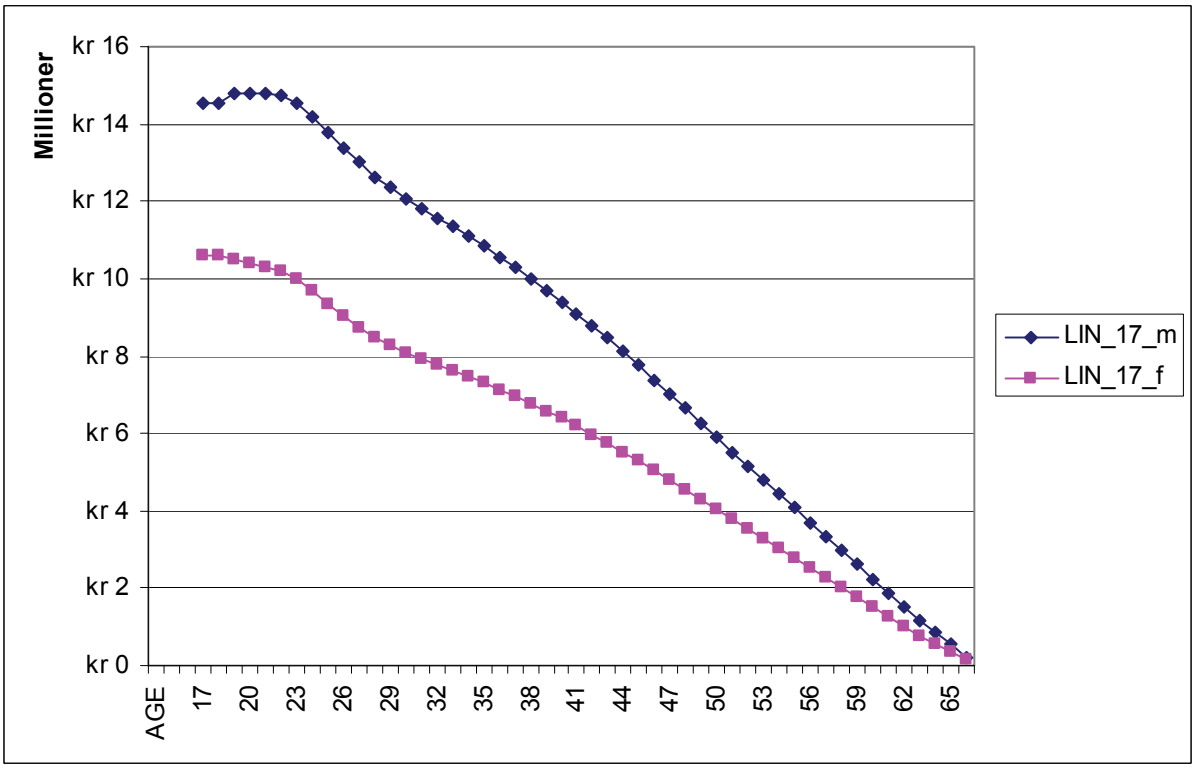

Figure A45: Lifetime incomes for those with graduate educational level in 2006.

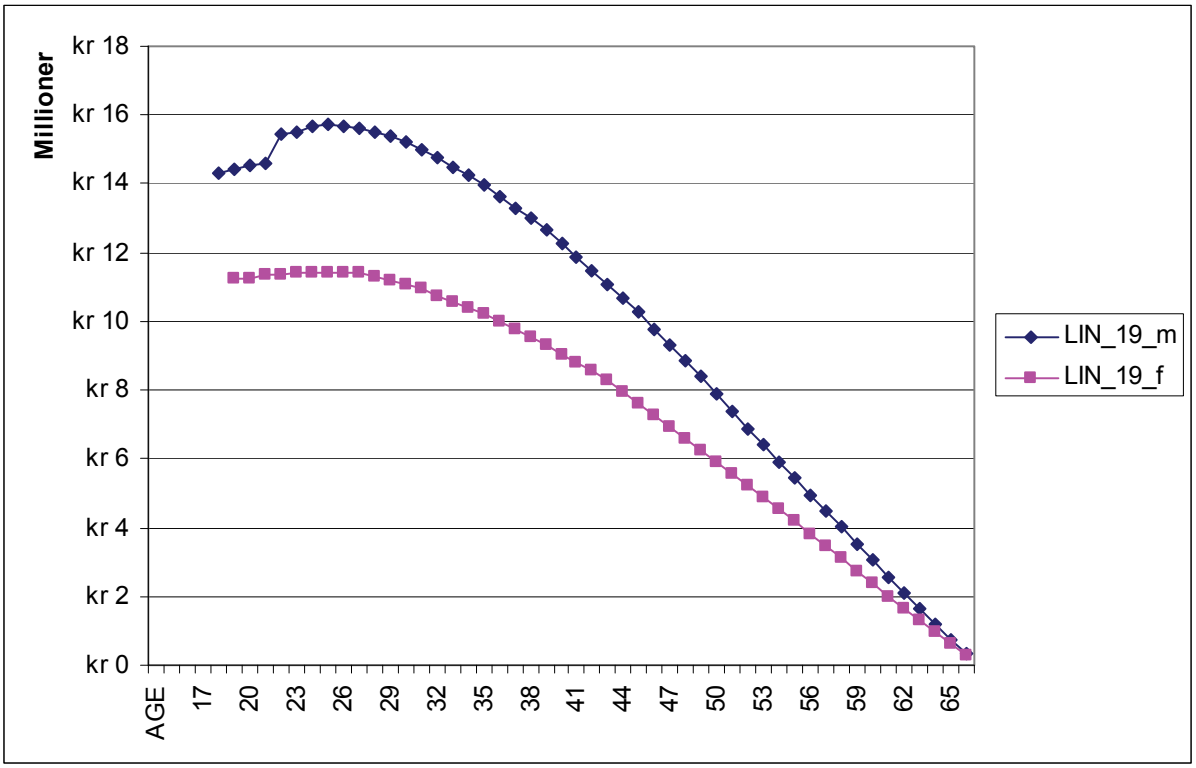

Figure A46: Lifetime incomes for those with postgraduate educational level in 2006.

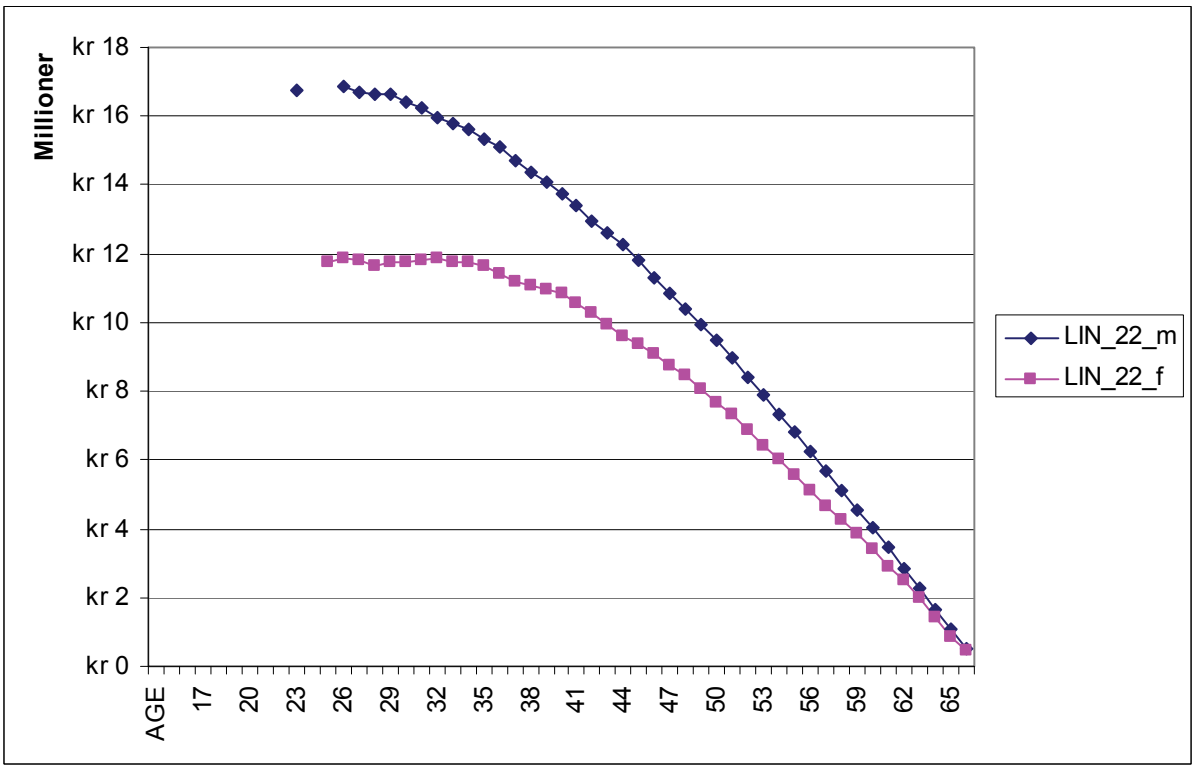

Figure A47: Returns to higher educational levels from primary education in 2006 (Male).

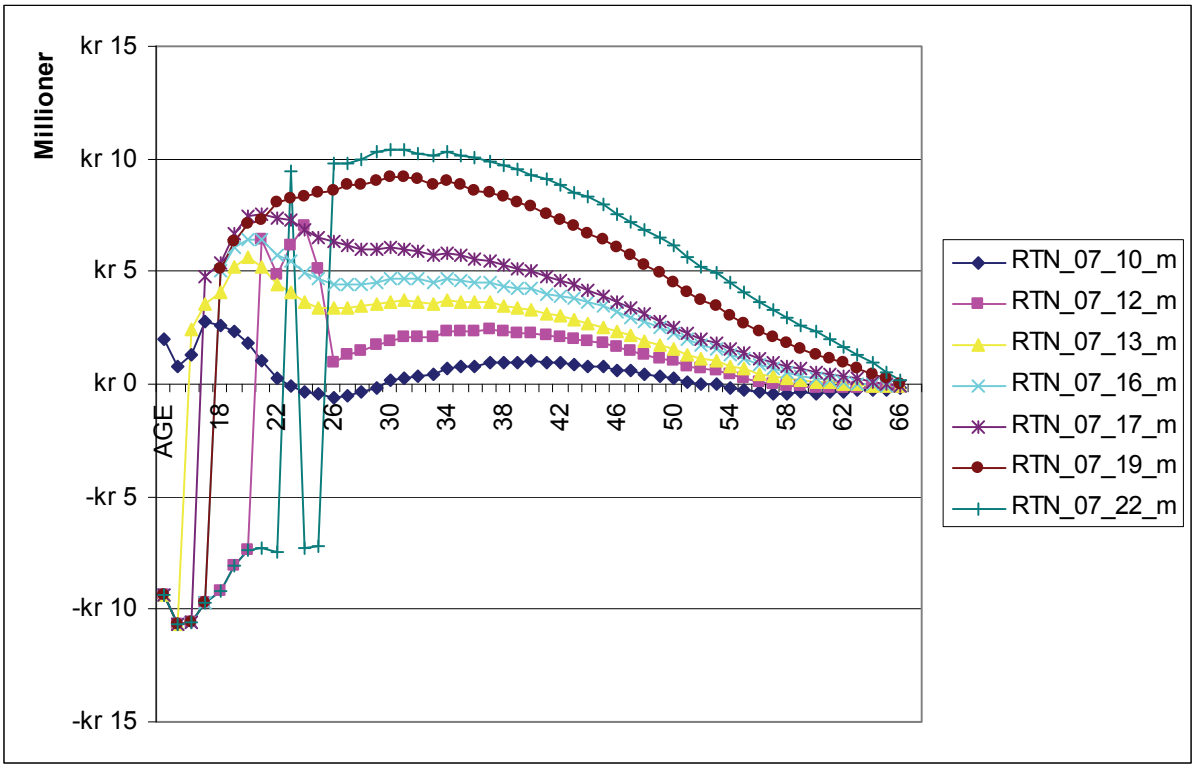

Figure A48: Returns to higher educational levels from primary education in 2006 (Female).

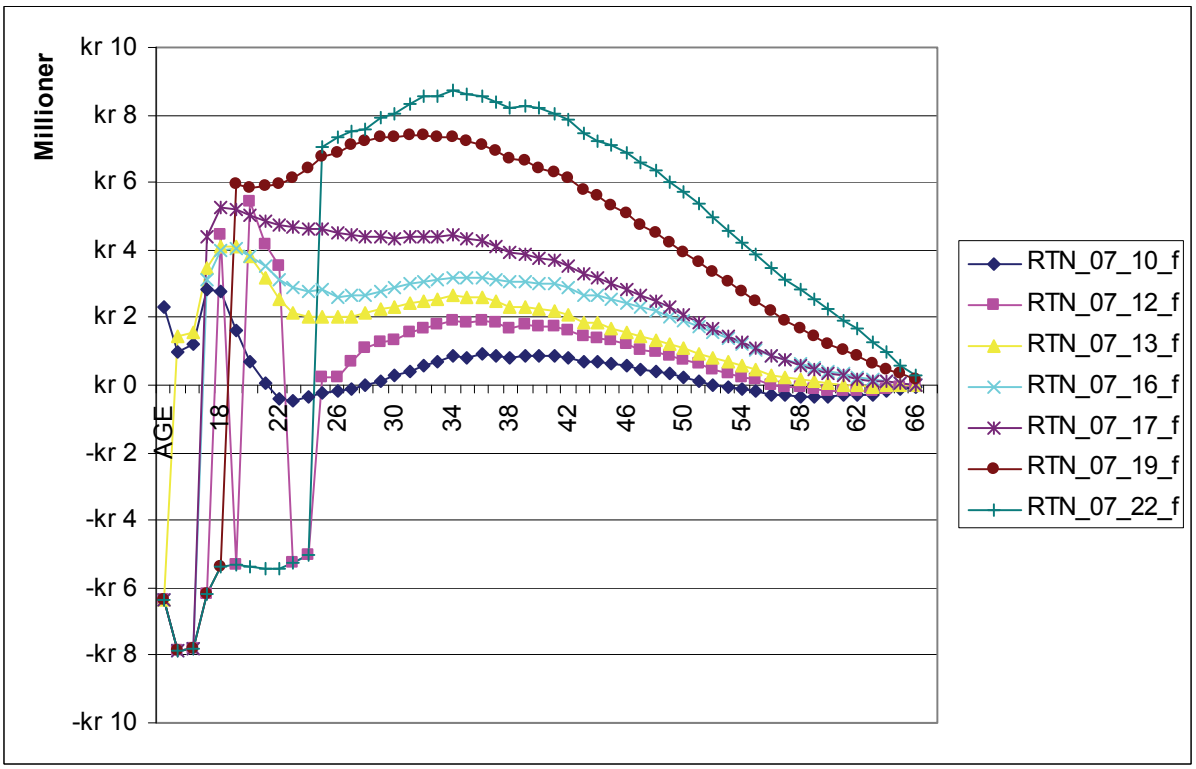

Figure A49: Returns to higher educational levels from lower secondary education in 2006 (Male).

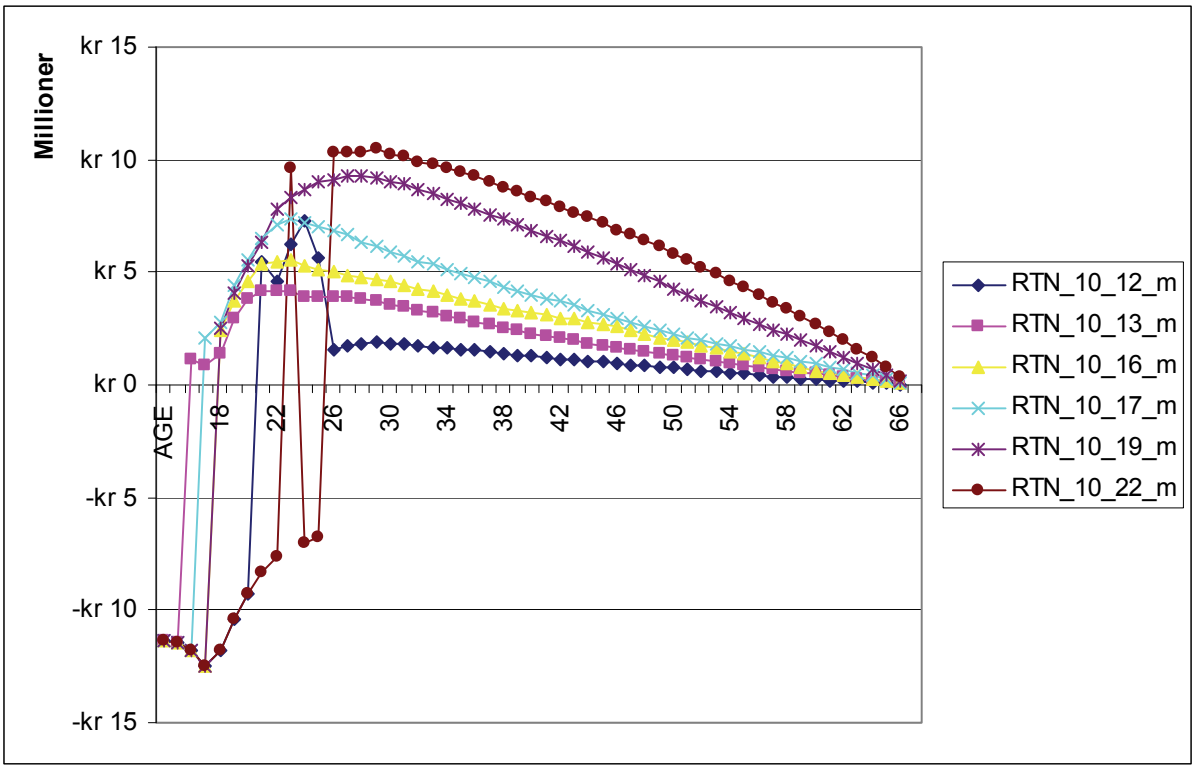

Figure A50: Returns to higher educational levels from lower secondary education in 2006 (Female).

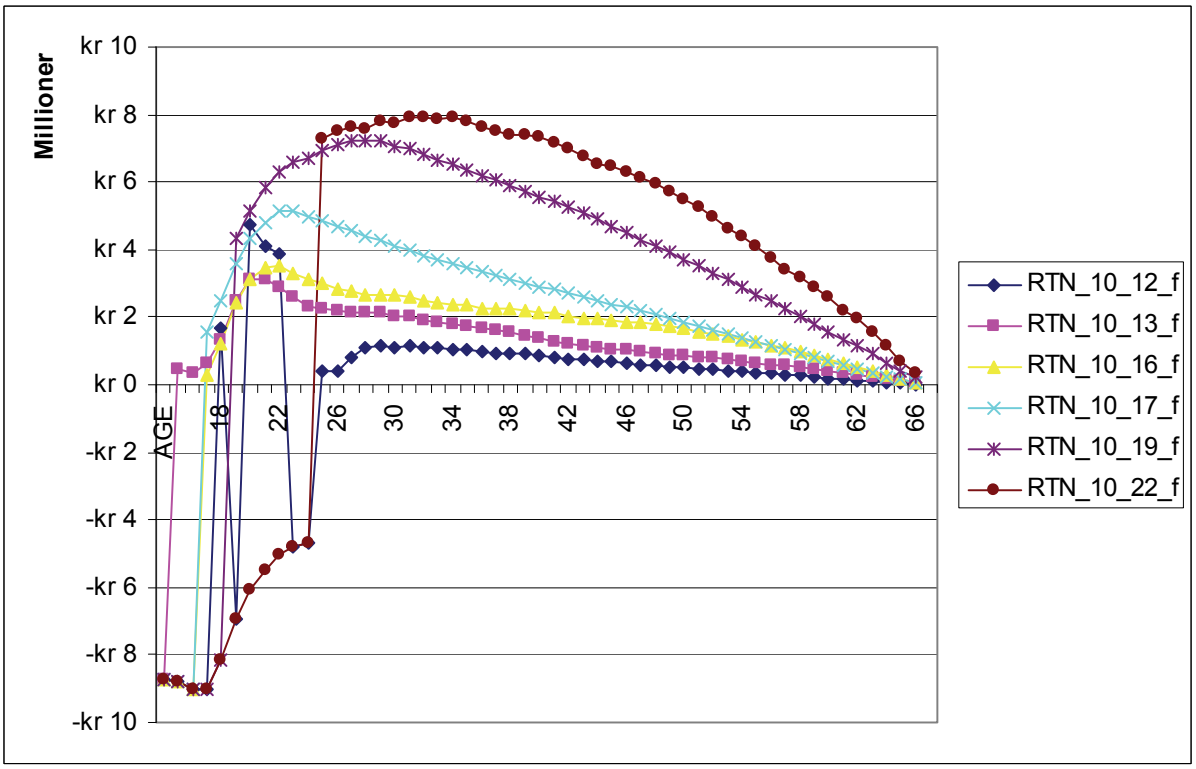

Figure A51: Returns to higher educational levels from basic upper secondary education in 2006 (Male).

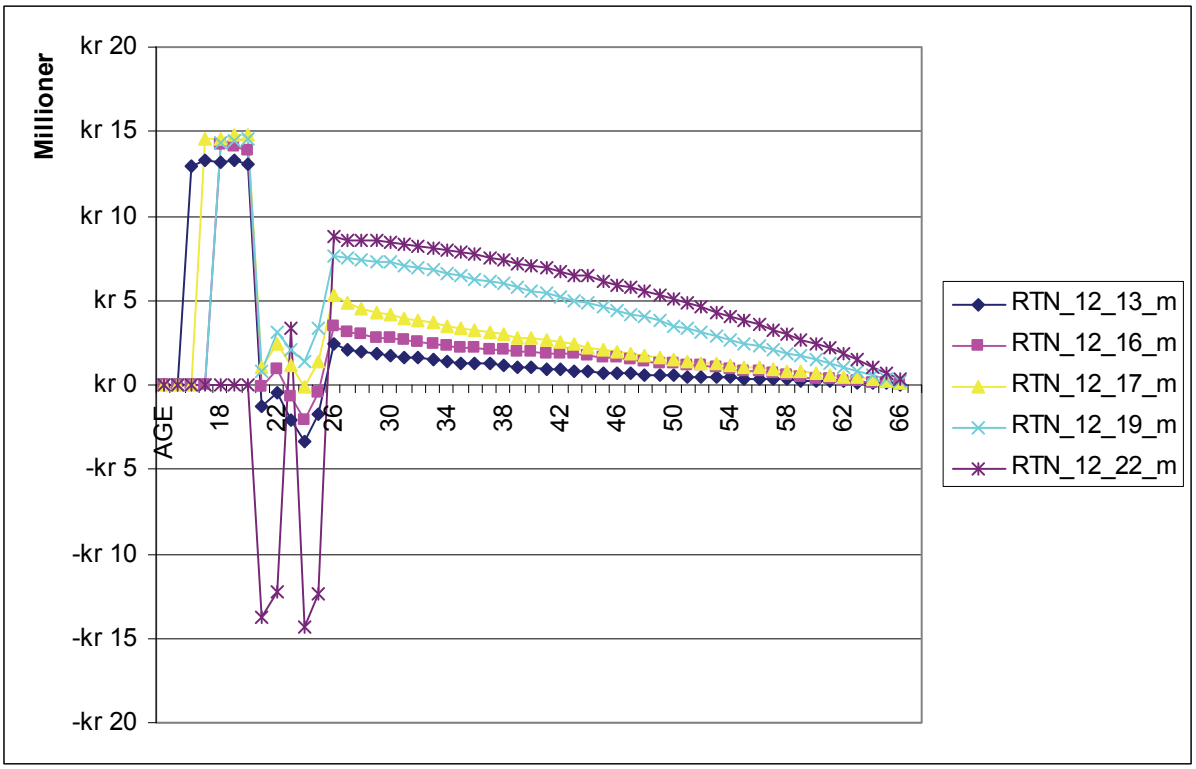

Figure A52: Returns to higher educational levels from basic upper secondary education in 2006 (Female).

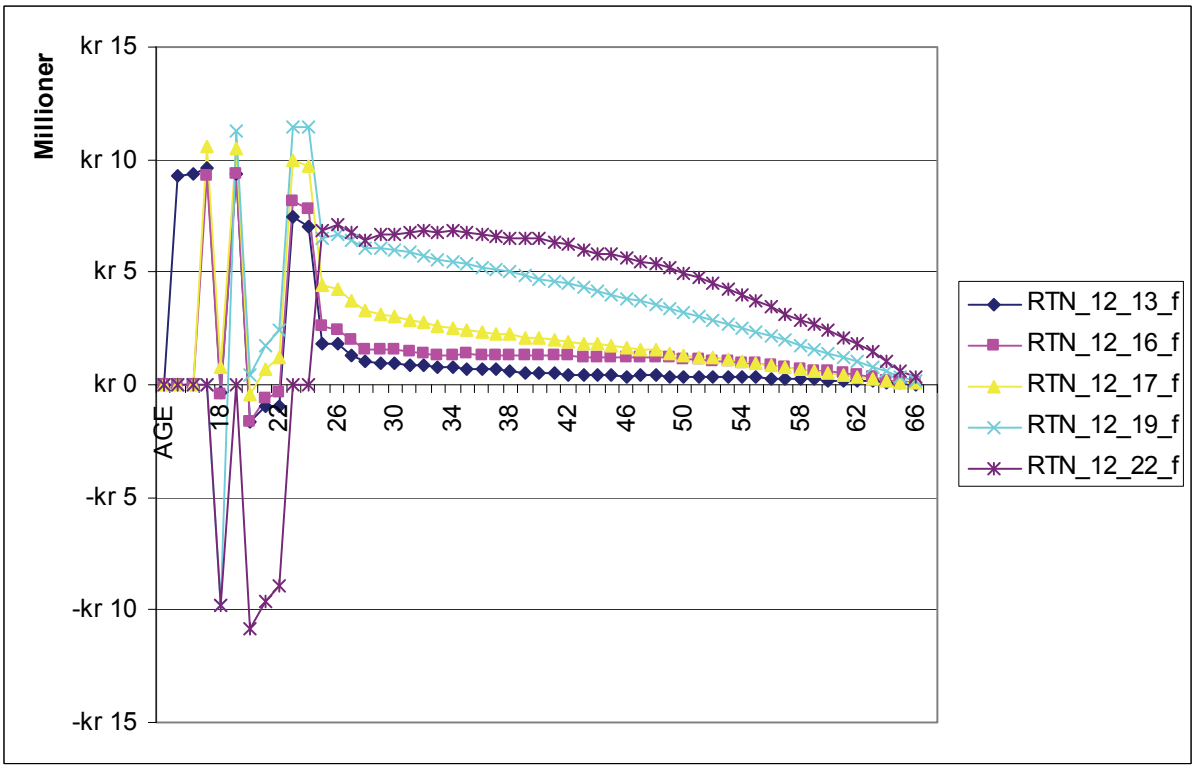

Figure A53: Returns to higher educational levels from final upper secondary education in 2006 (Male).

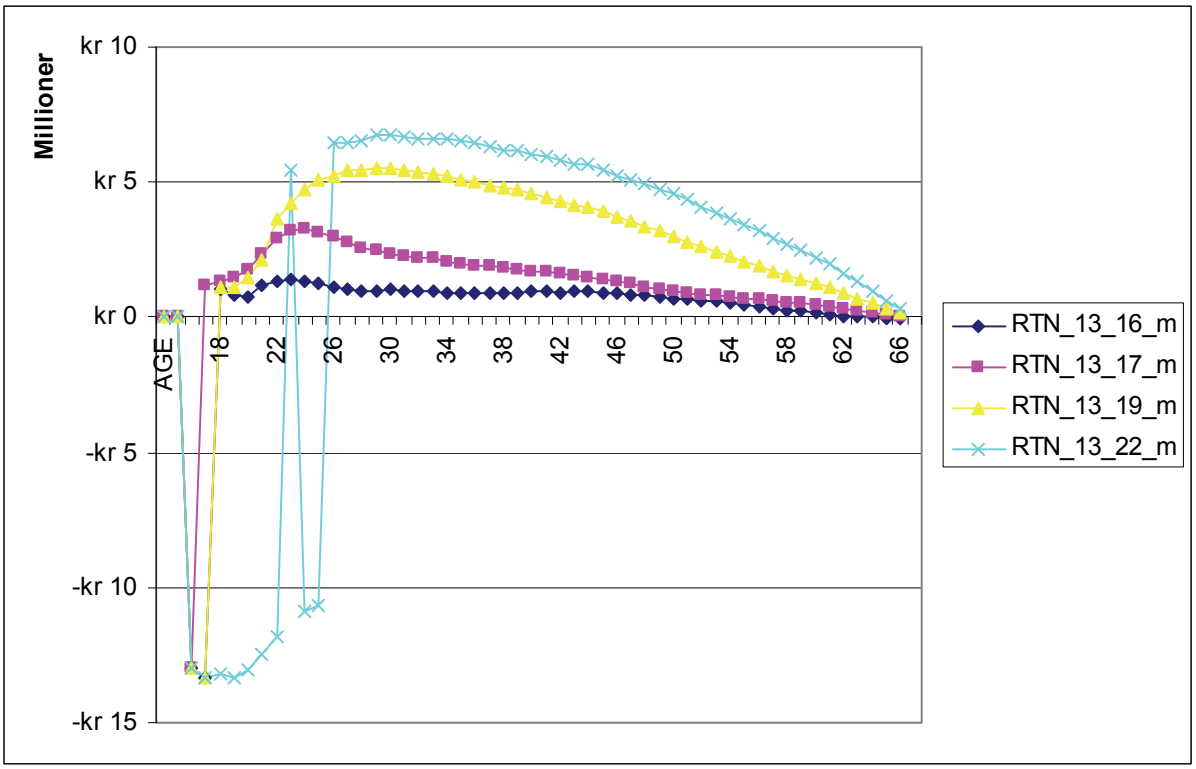

Figure A54: Returns to higher educational levels from final upper secondary education in 2006 (Female).

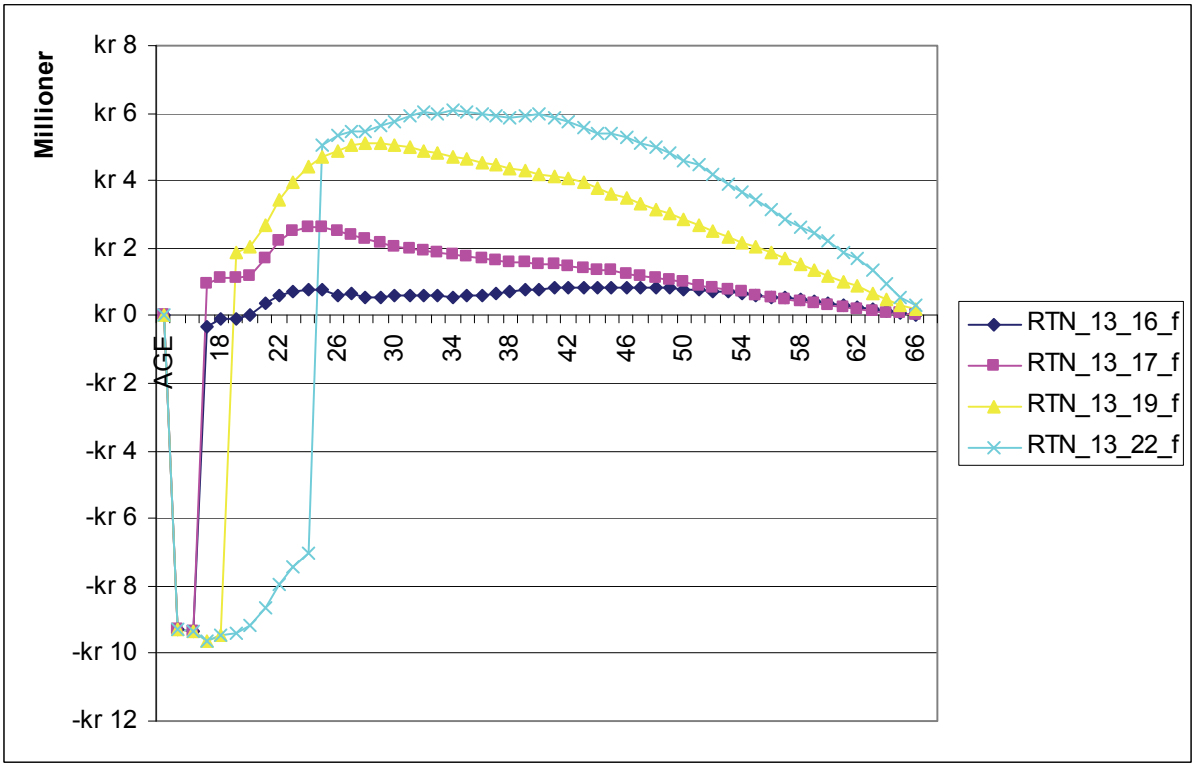

Figure A55: Returns to higher educational levels from post-secondary education in 2006 (Male).

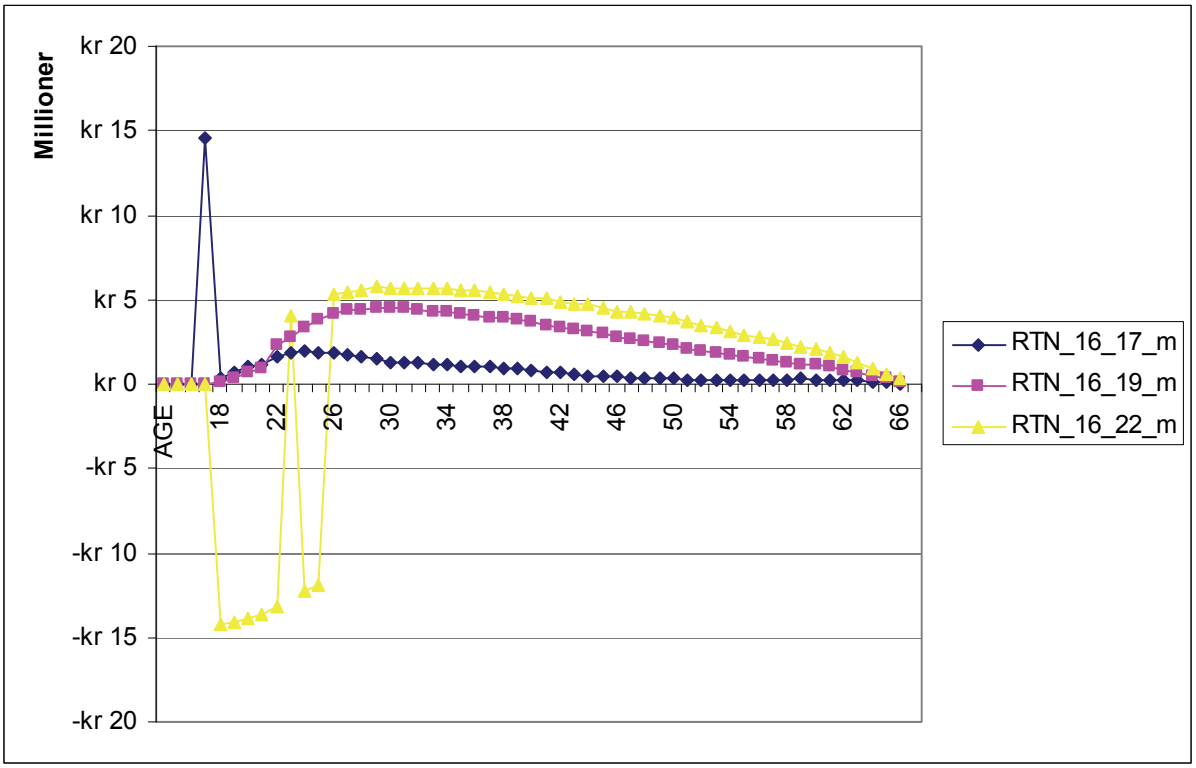

Figure A56: Returns to higher educational levels from post-secondary education in 2006 (Female).

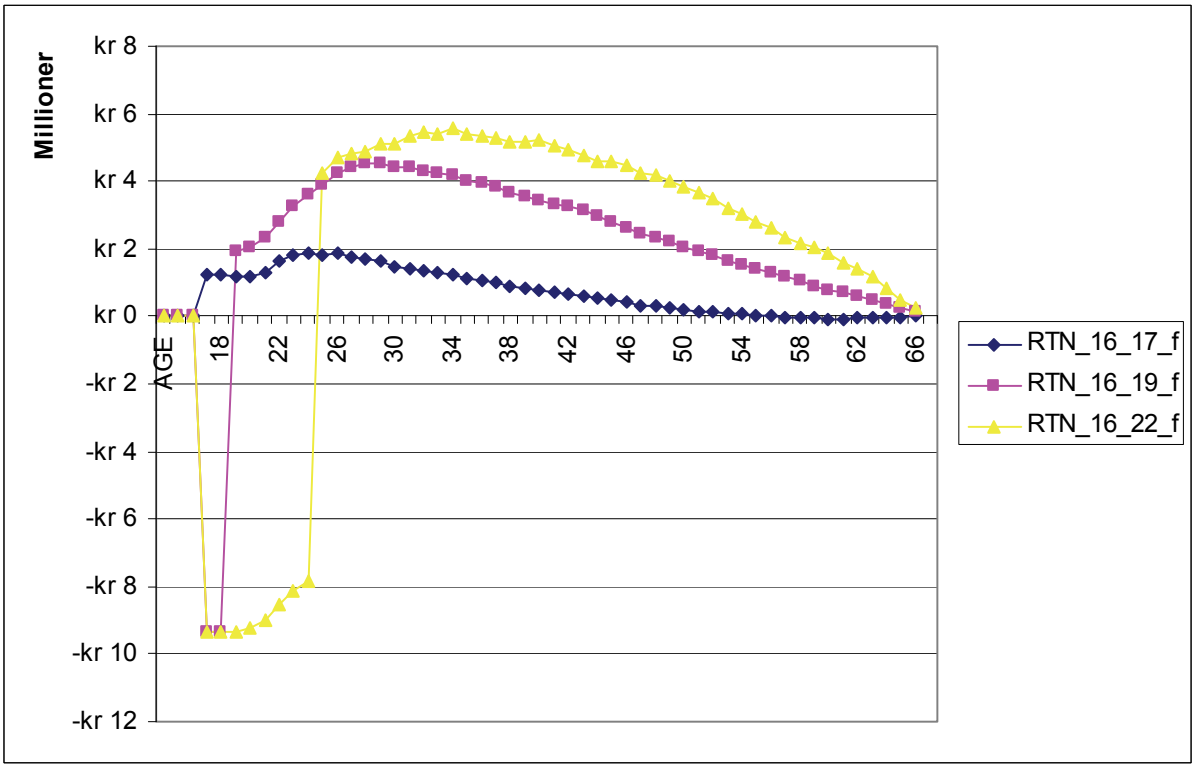

Figure A57: Returns to higher educational levels from undergraduate education in 2006 (Male).

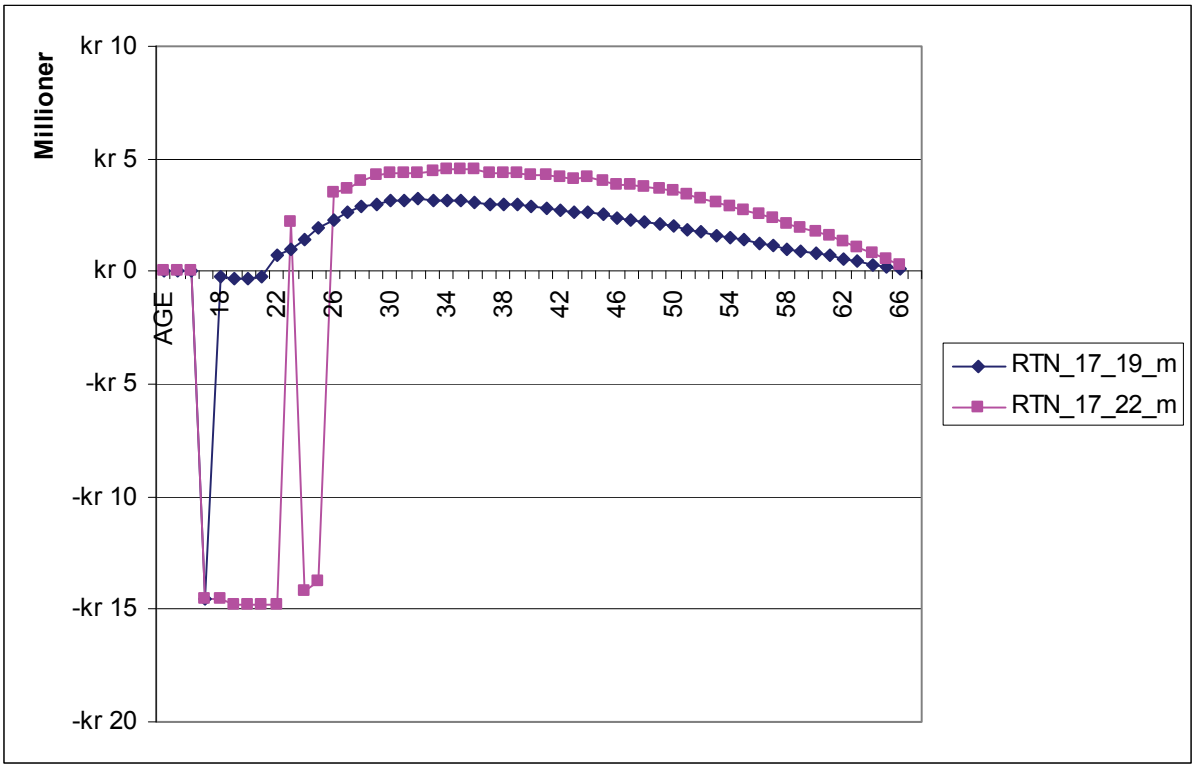

Figure A58: Returns to higher educational levels from undergraduate education in 2006 (Female).

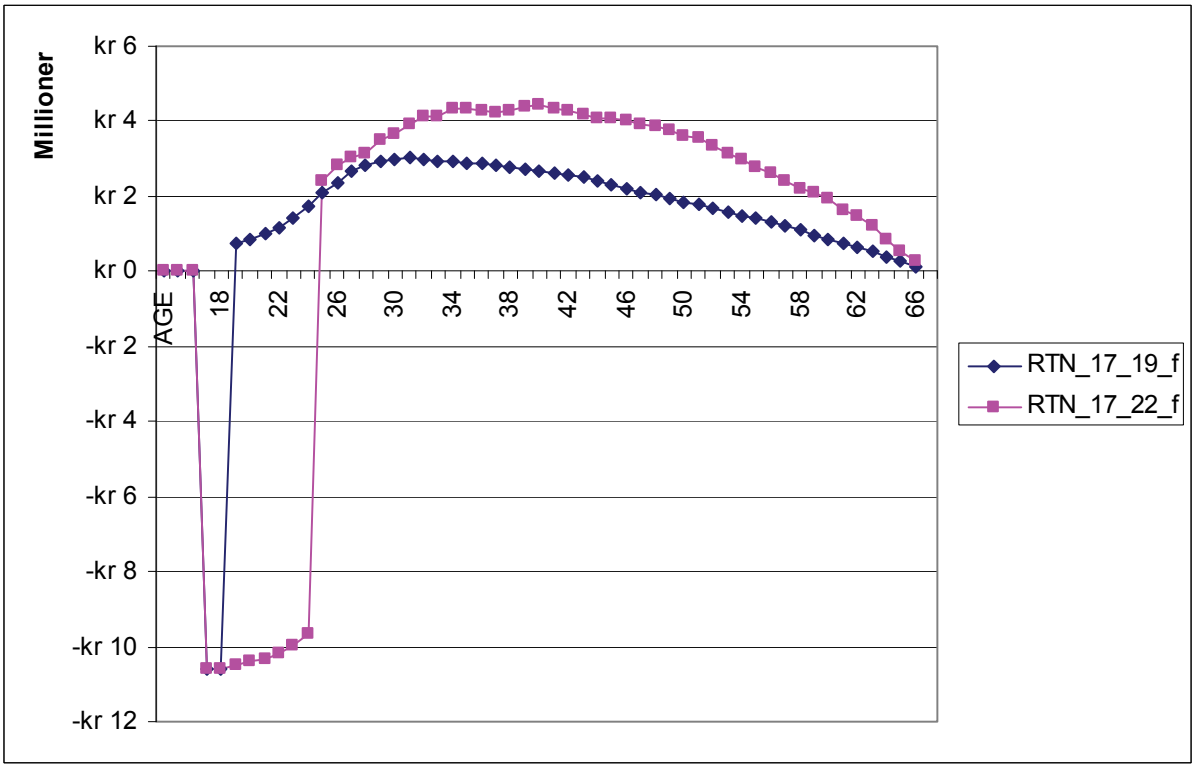

Figure A59: Returns to higher educational level from graduate education in 2006.

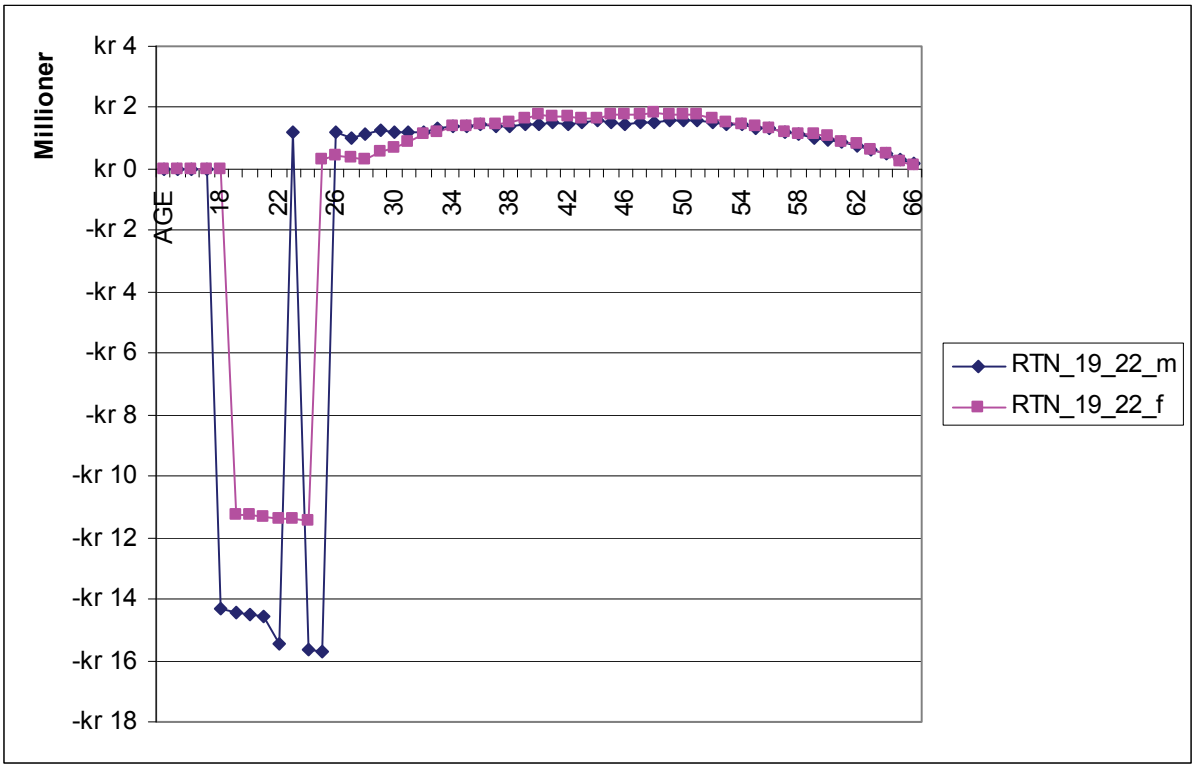

Figure A60: Returns to lower secondary education from primary education in 2006.

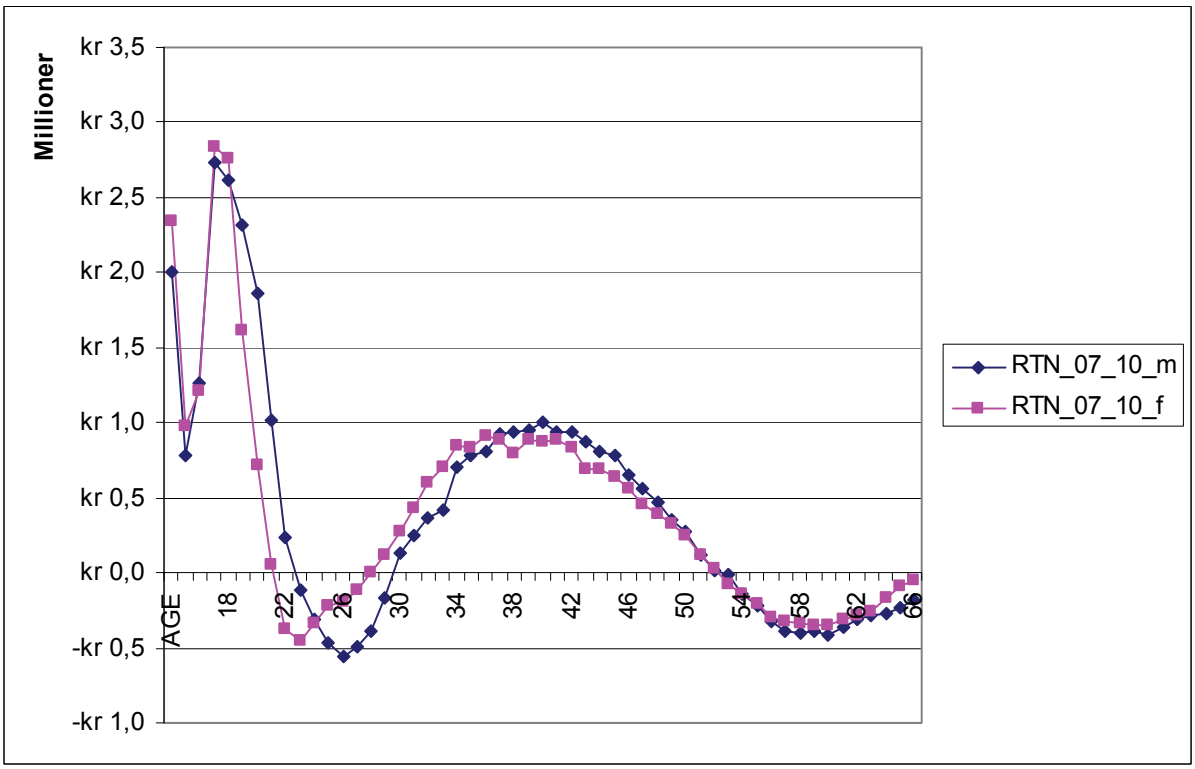

Figure A61: Returns to basic upper secondary education from primary education in 2006.

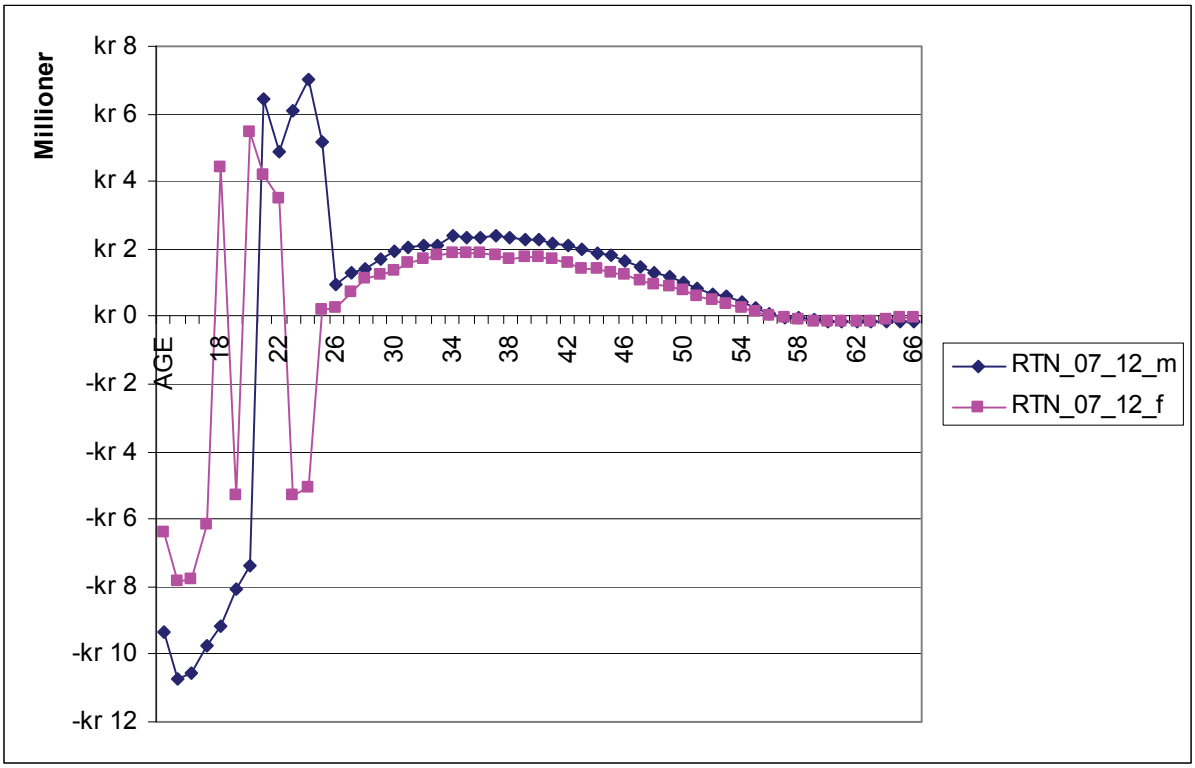

Figure A62: Returns to final upper secondary education from primary education in 2006.

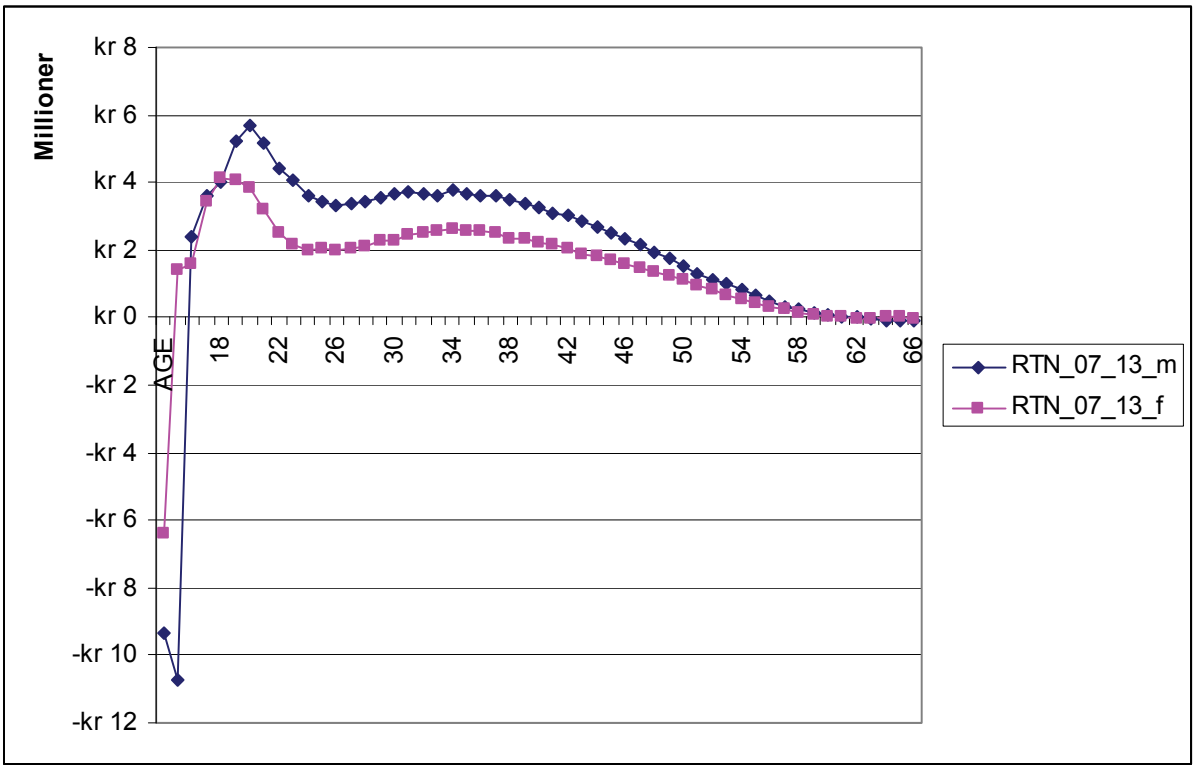

Figure A63: Returns to post-secondary education from primary education in 2006.

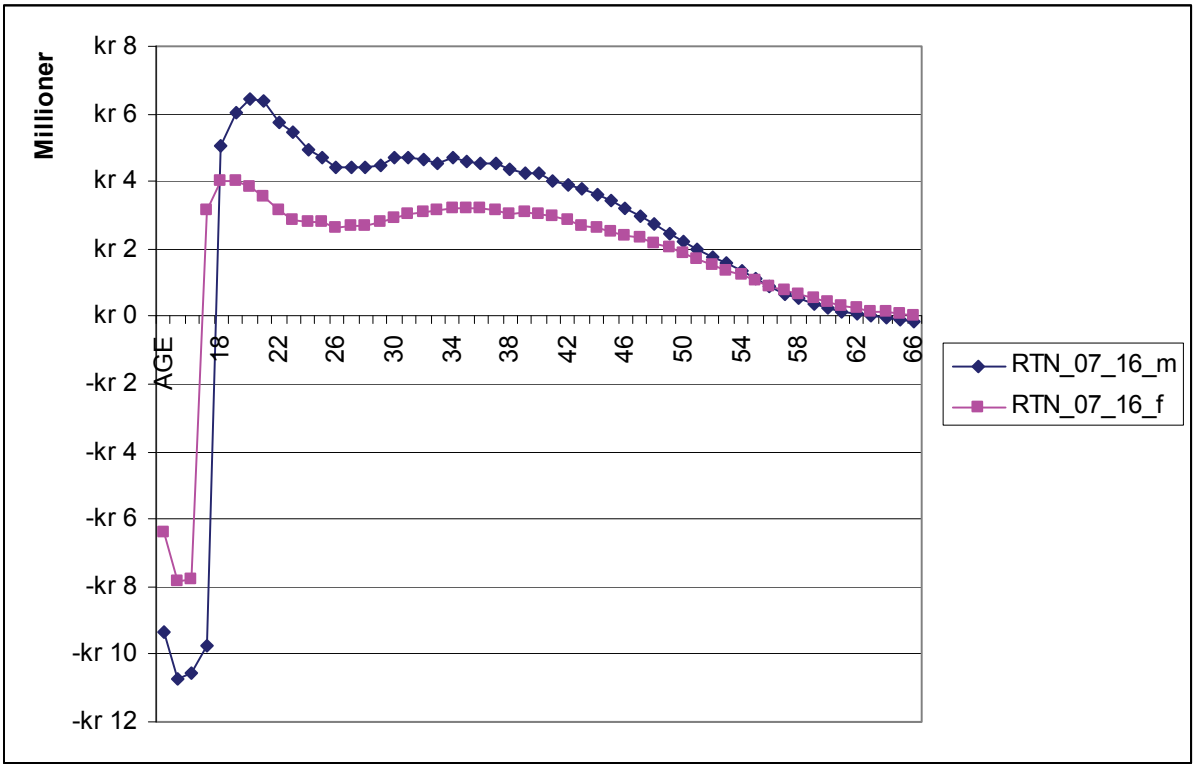

Figure A64: Returns to undergraduate education from primary education in 2006.

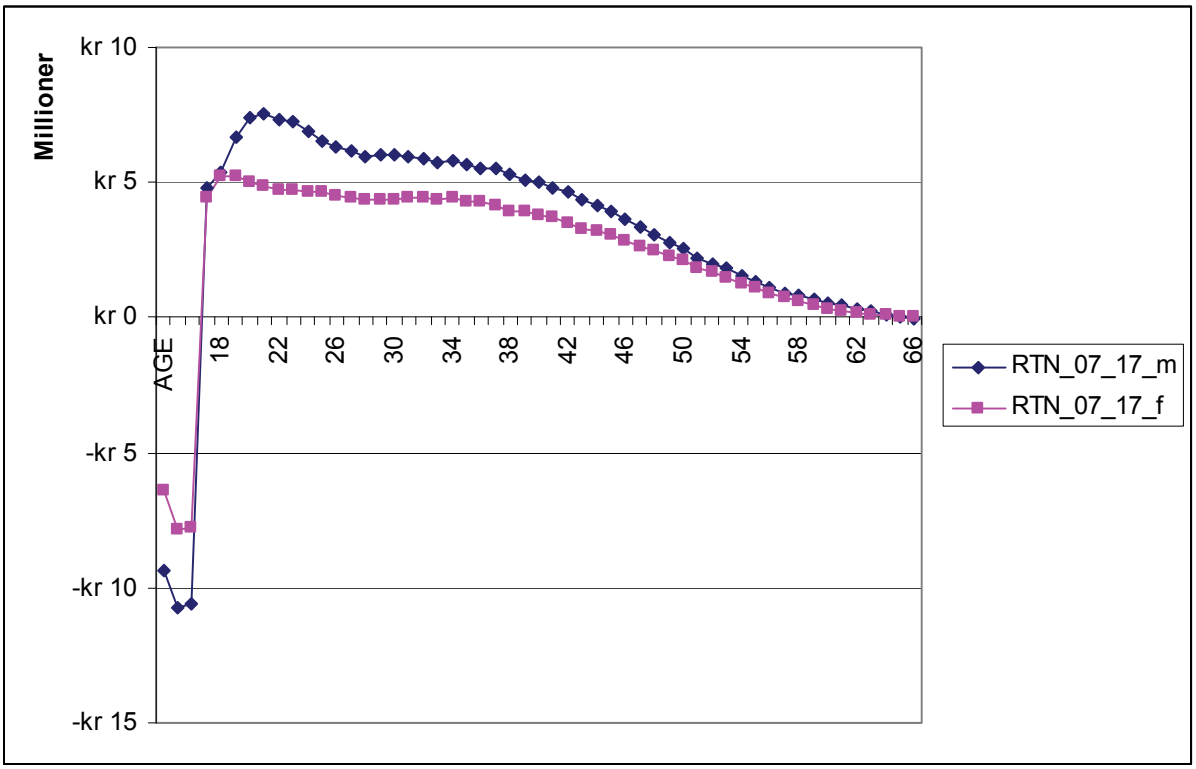

Figure A65: Returns to graduate education from primary education in 2006.

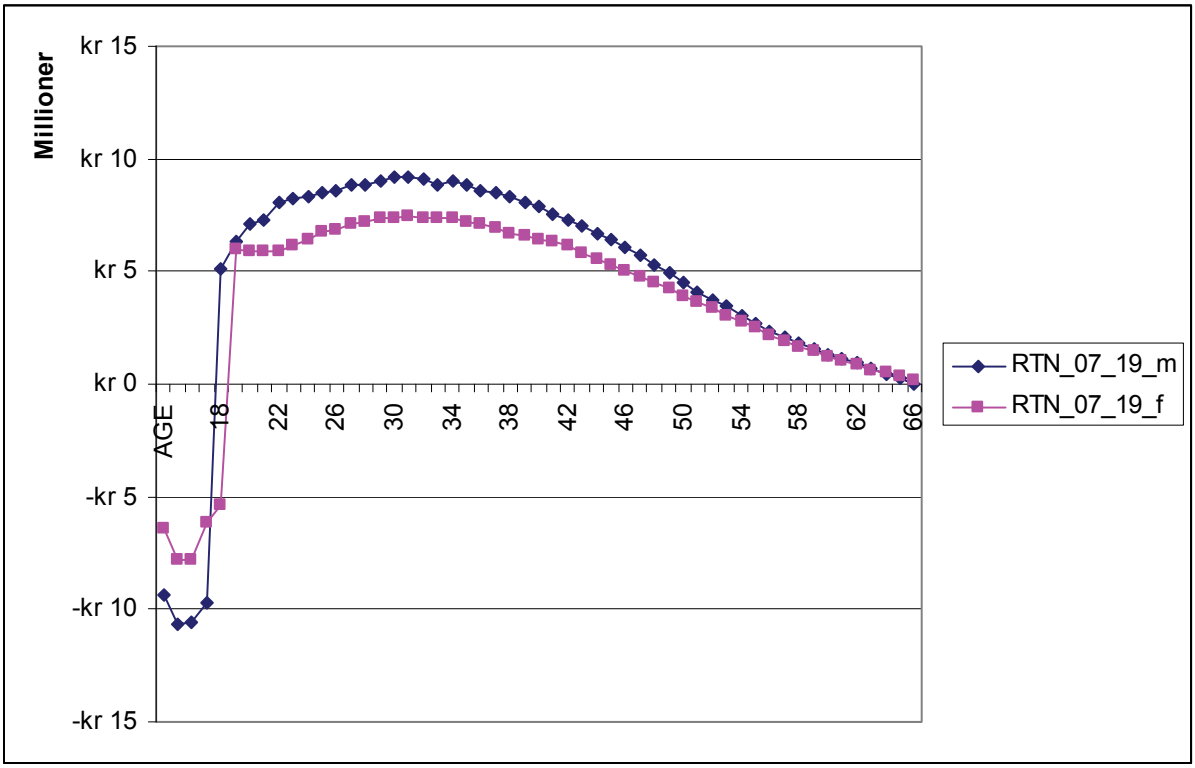

Figure A66: Returns to postgraduate education from primary education in 2006.

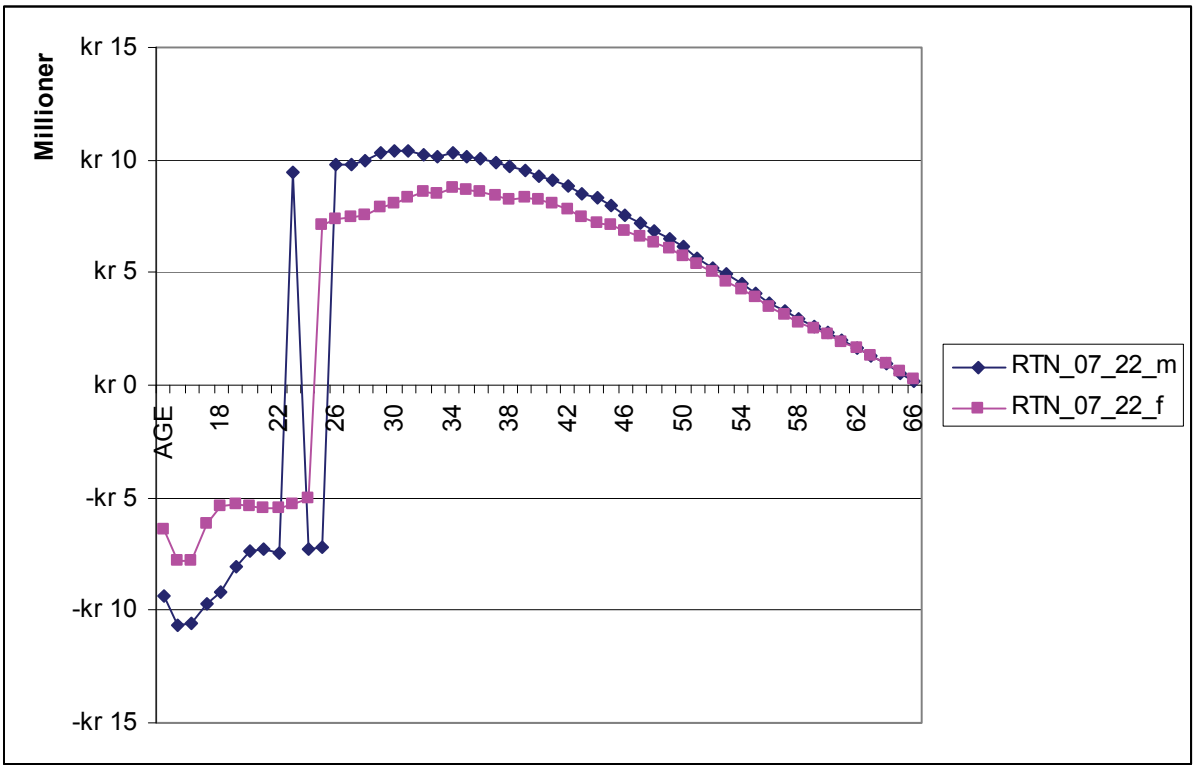

Figure A67: Returns to basic upper secondary education from lower secondary education in 2006.

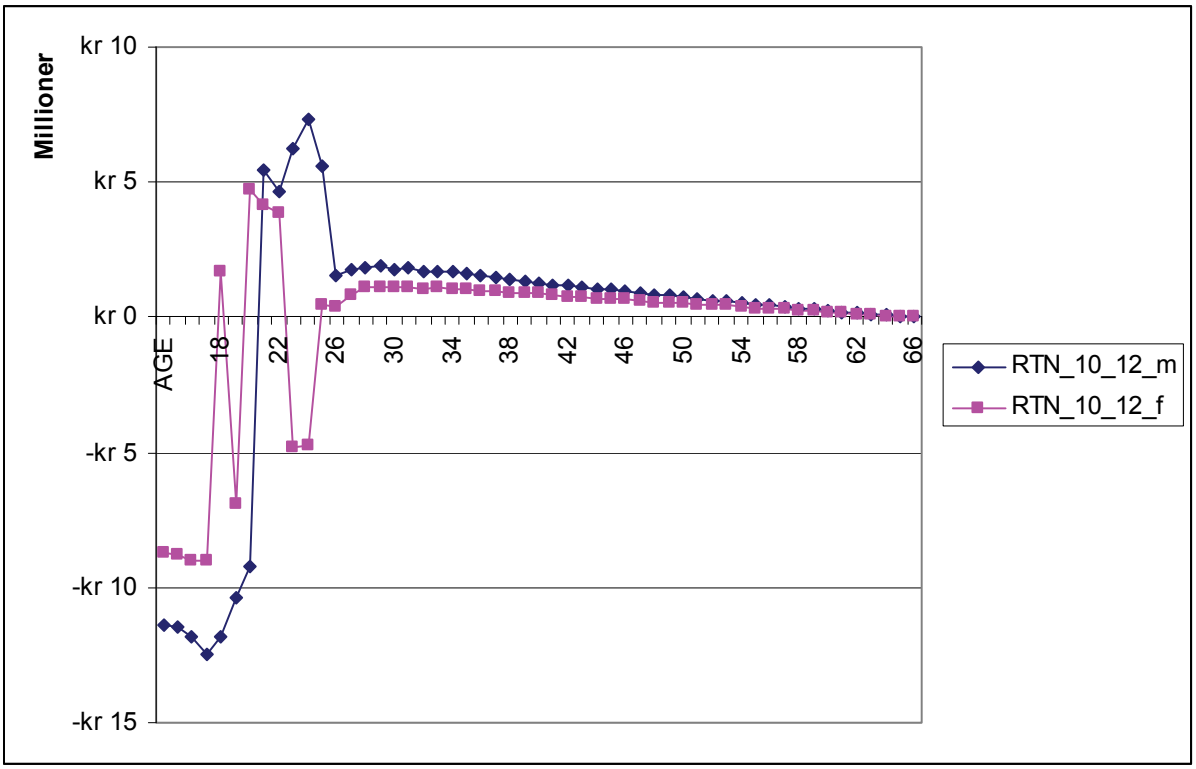

Figure A68: Returns to final upper secondary education from lower secondary education in 2006.

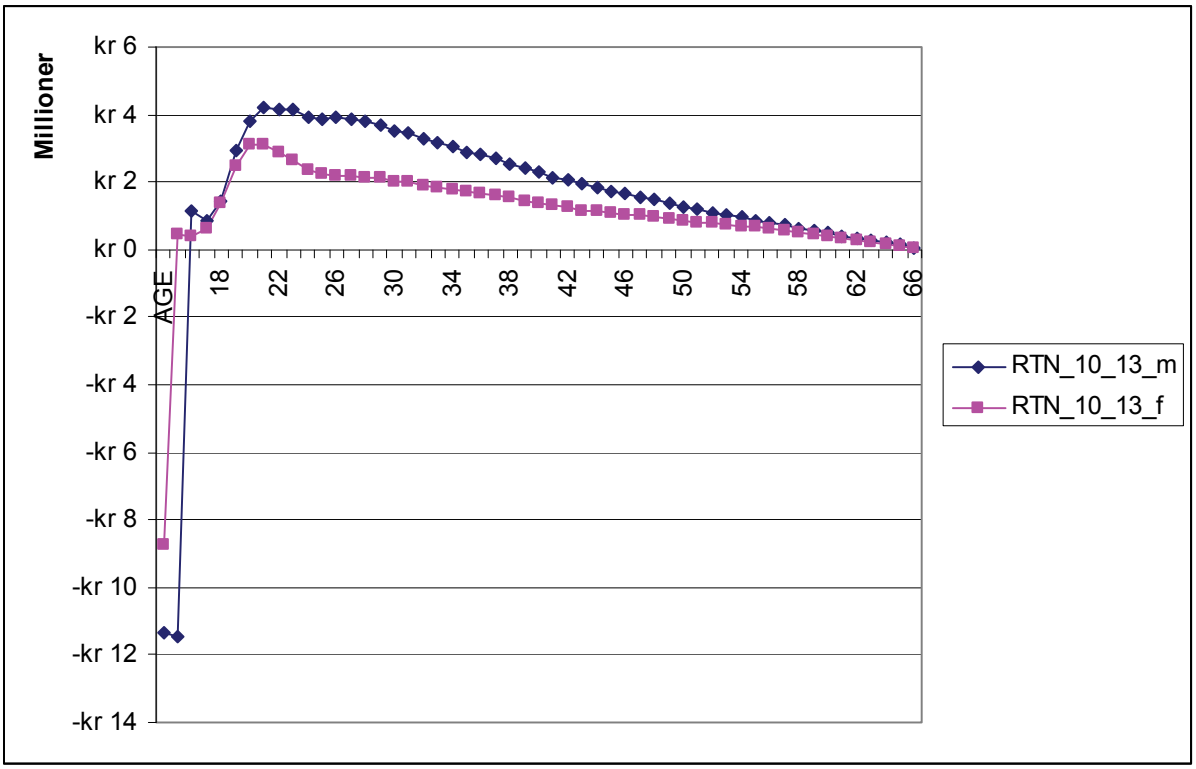

Figure A69: Returns to post-secondary education from lower secondary education in 2006.

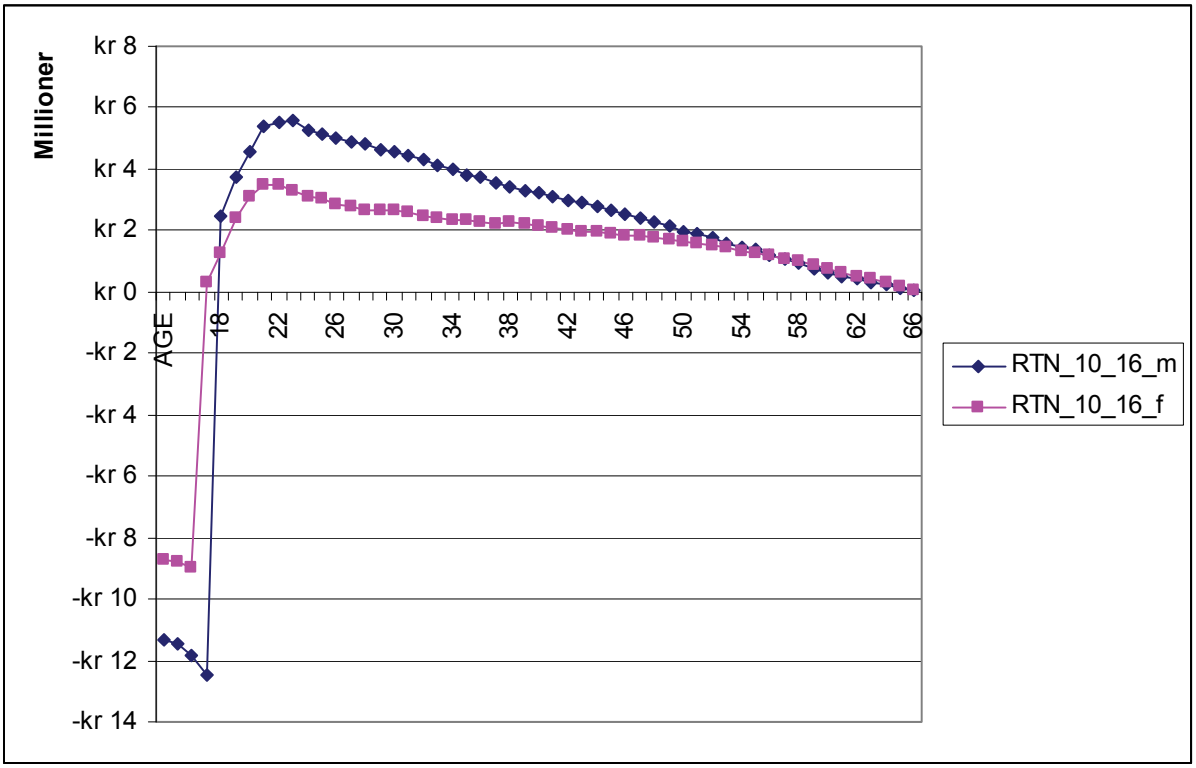

Figure A70: Returns to undergraduate education from lower secondary education in 2006.

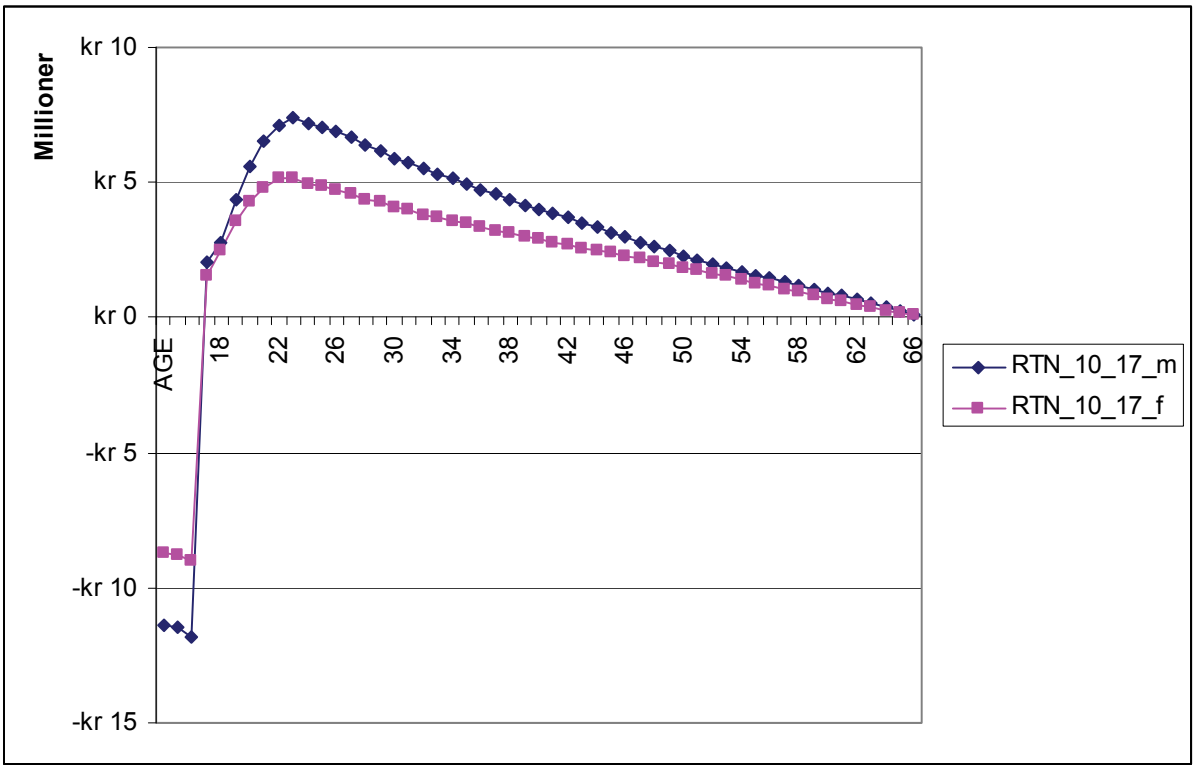

Figure A71: Returns to graduate education from lower secondary education in 2006.

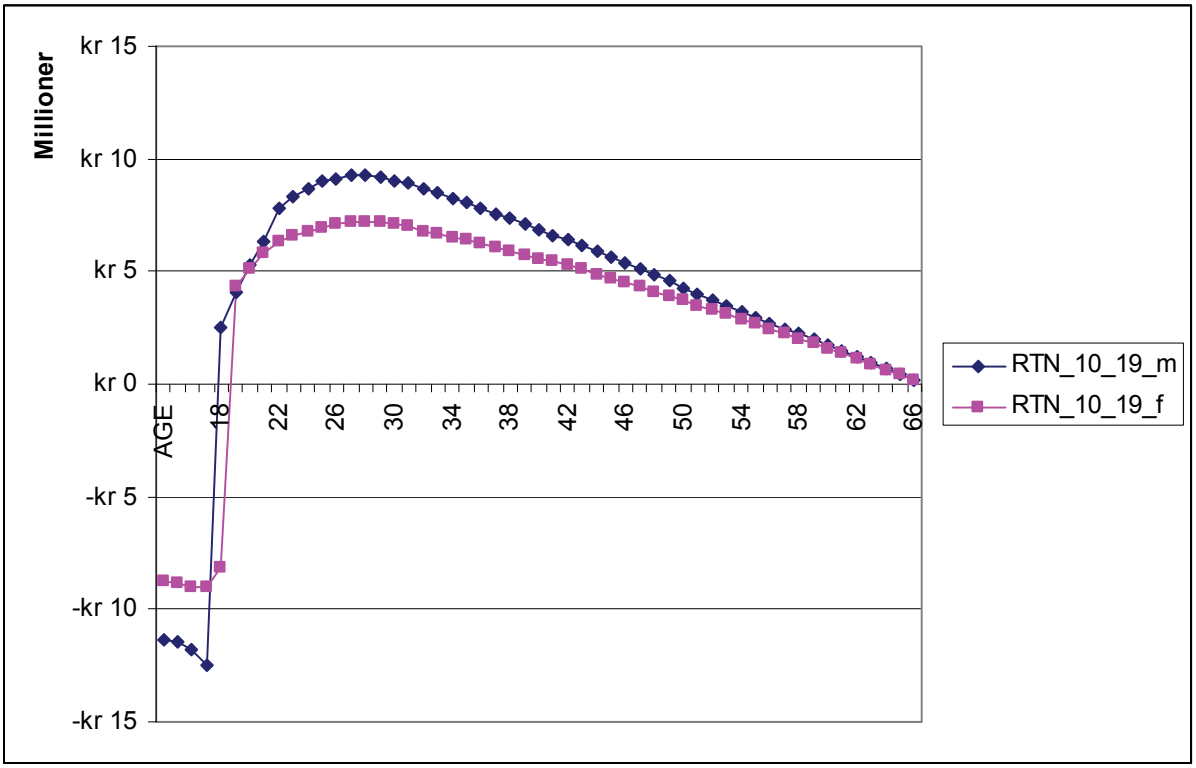

Figure A72: Returns to postgraduate education from lower secondary education in 2006.

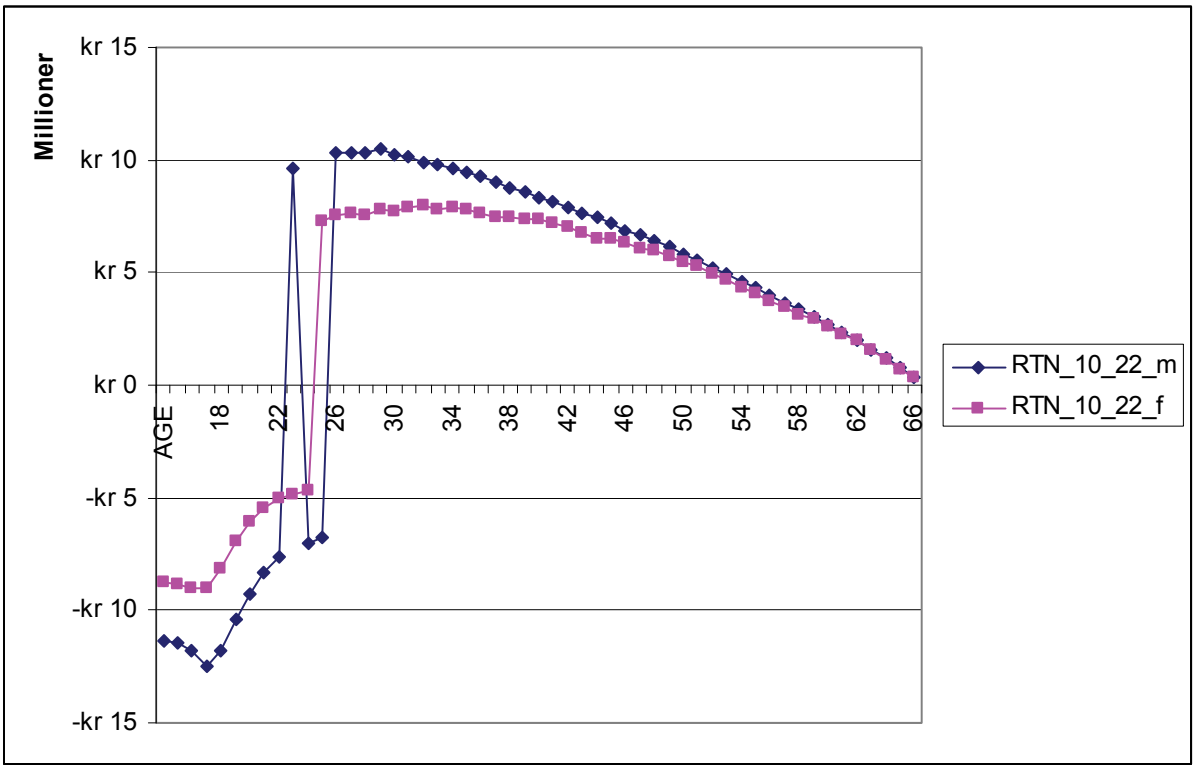

Figure A73: Returns to final upper secondary education from basic upper secondary education in 2006.

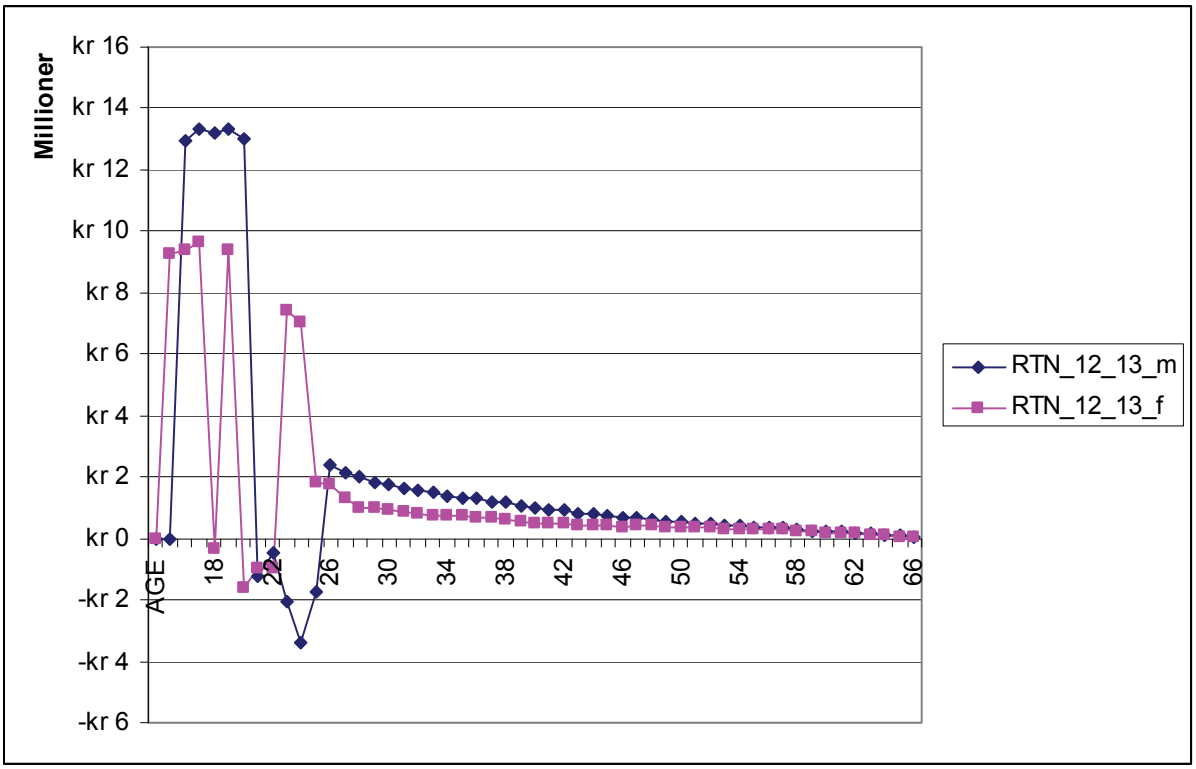

Figure A74: Returns to post-secondary education from basic upper secondary education in 2006.

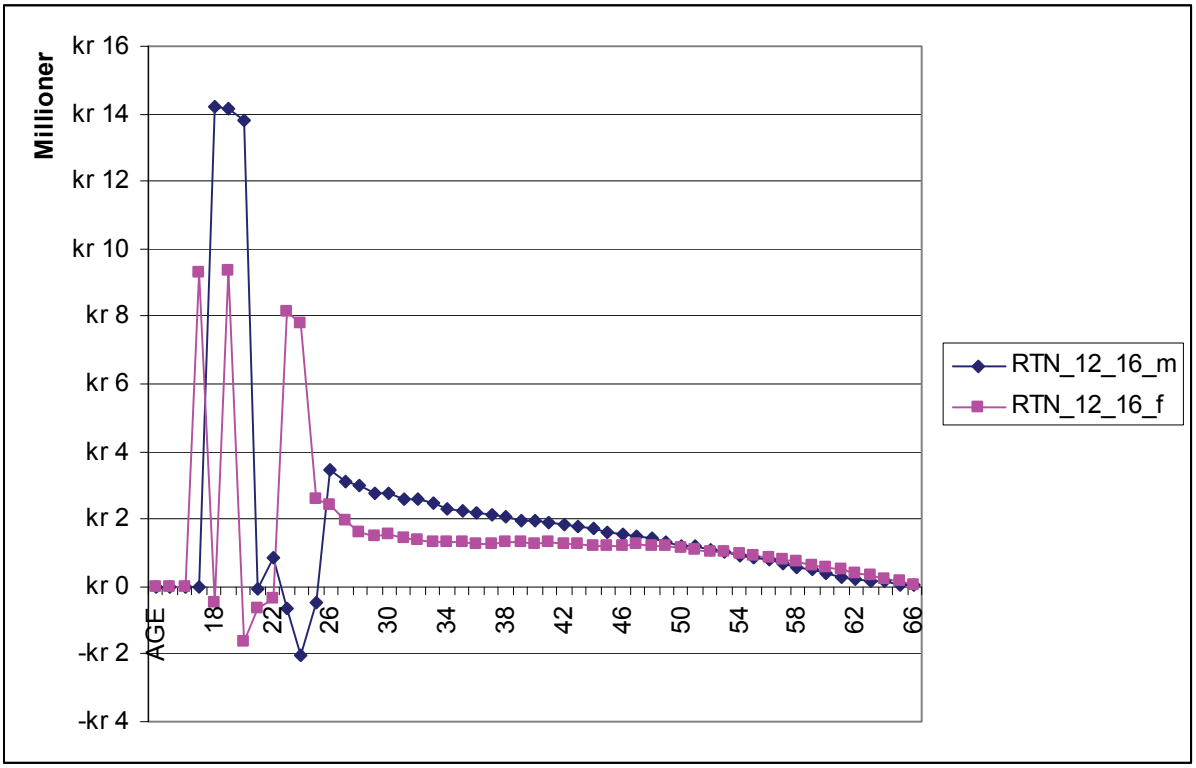

Figure A75: Returns to undergraduate education from basic upper secondary education in 2006.

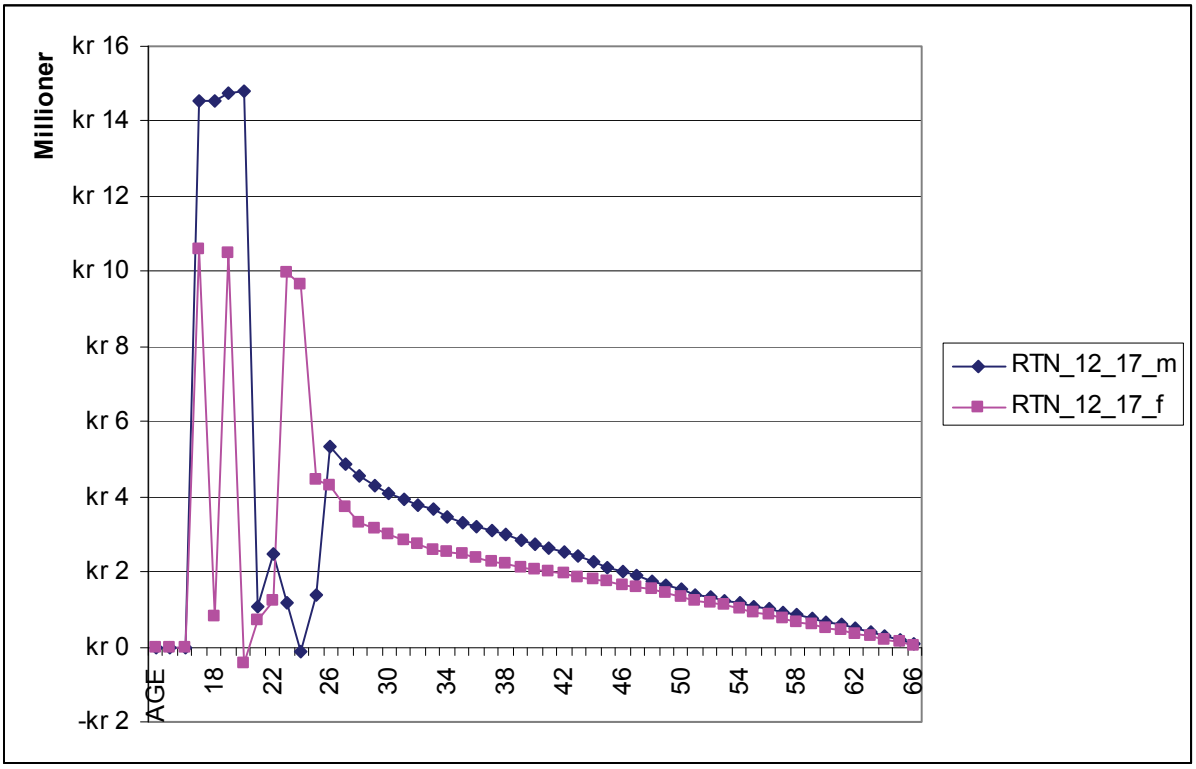

Figure A76: Returns to graduate education from basic upper secondary education in 2006.

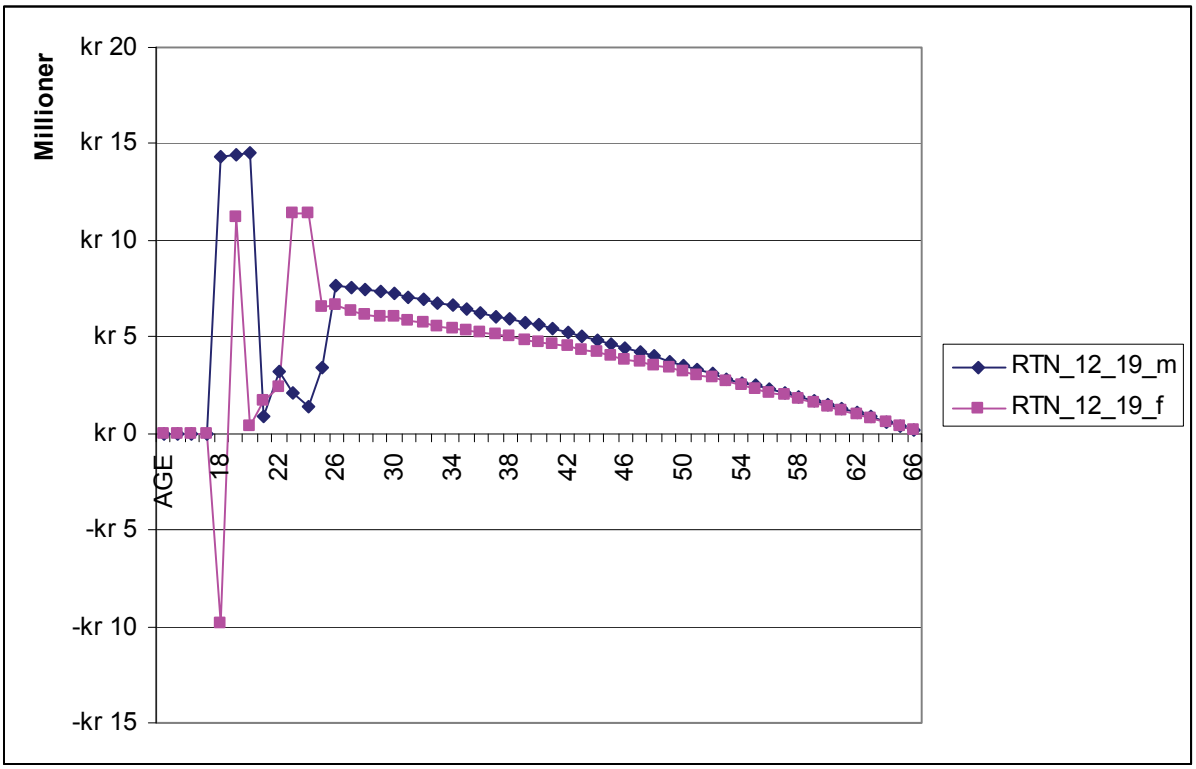

Figure A77: Returns to postgraduate education from basic upper secondary education in 2006.

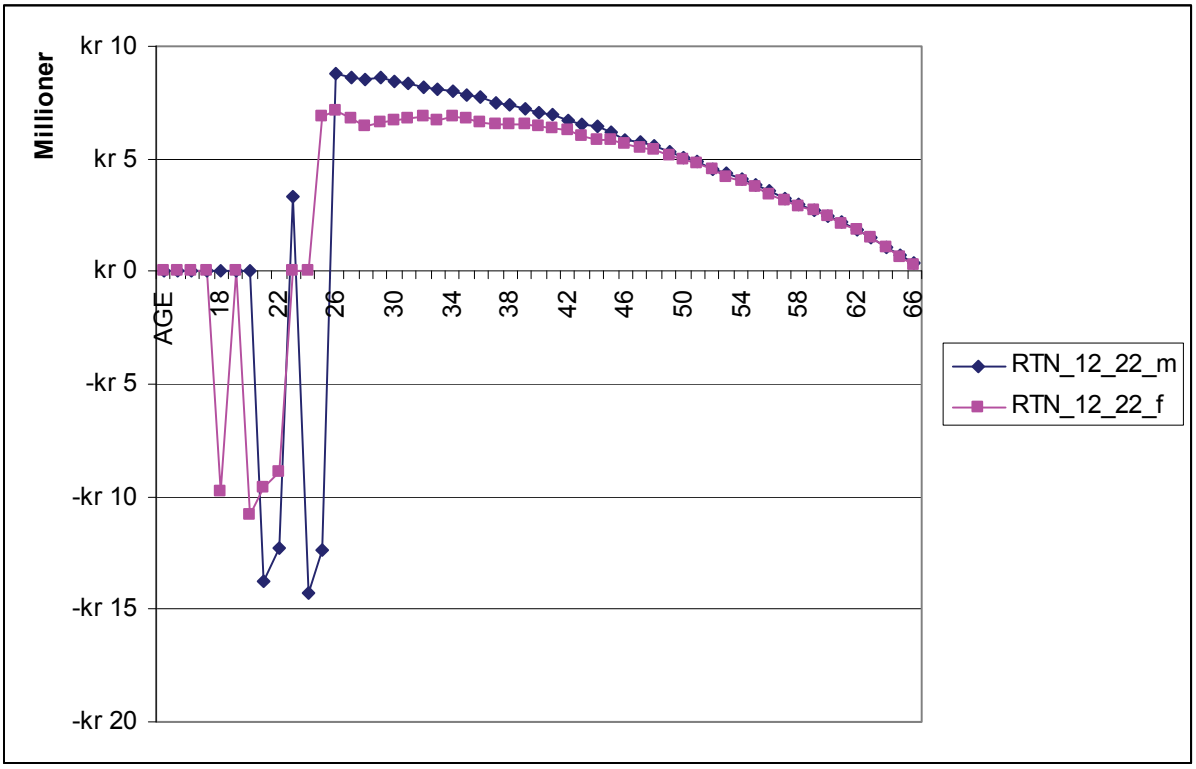

Figure A78: Returns to post-secondary education from final upper secondary education in 2006.

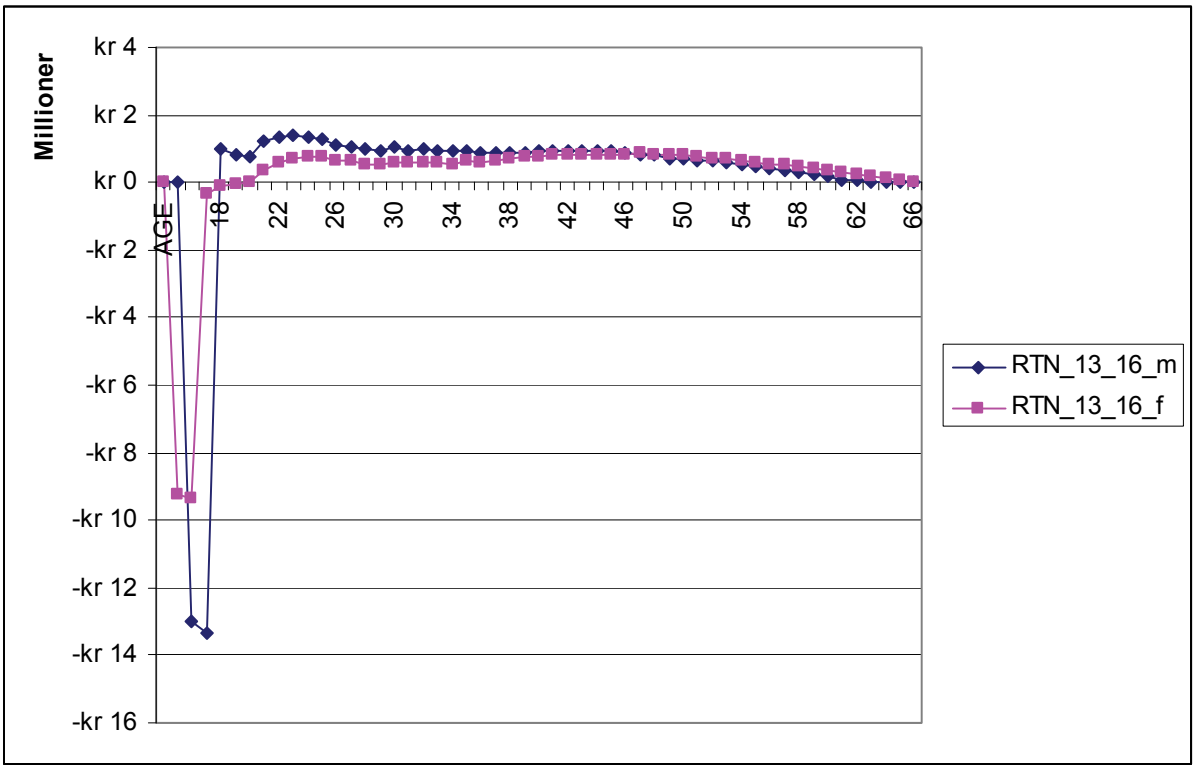

Figure A79: Returns to undergraduate education from final upper secondary education in 2006.

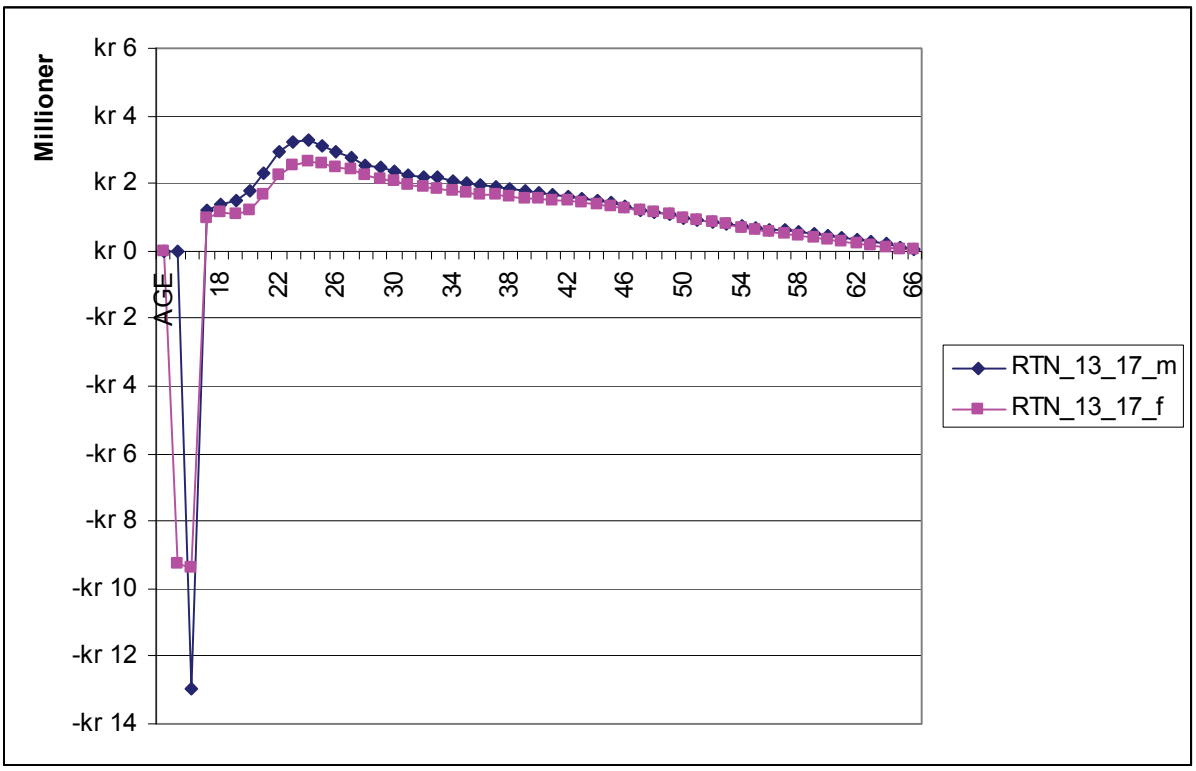

Figure A80: Returns to graduate education from final upper secondary education in 2006.

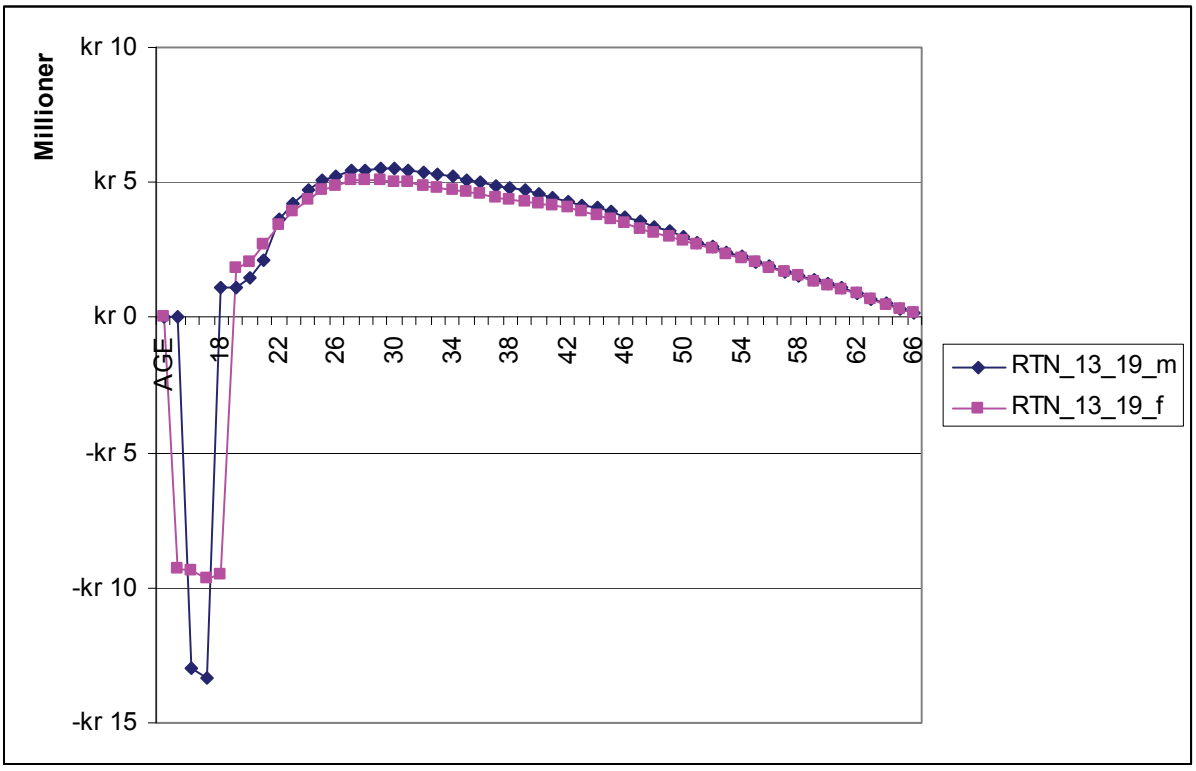

Figure A81: Returns to postgraduate education from final upper secondary education in 2006.

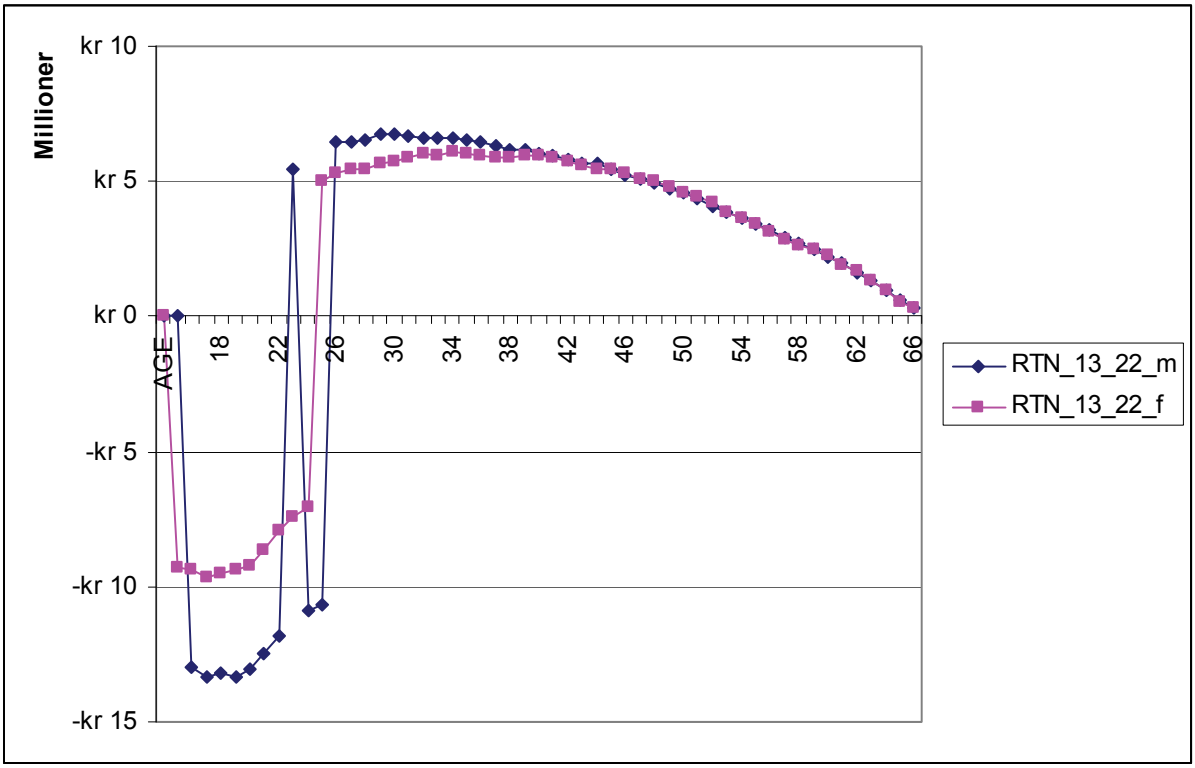

Figure A82: Returns to undergraduate education from post-secondary education in 2006.

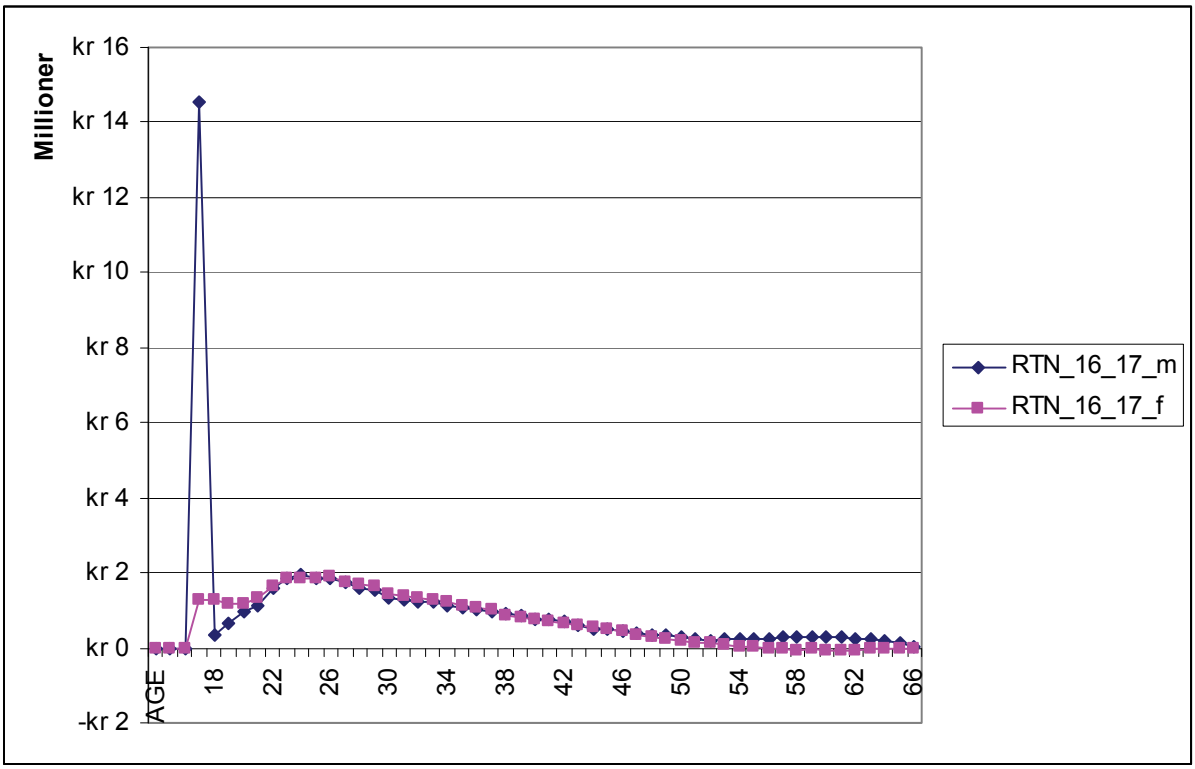

Figure A83: Returns to graduate education from post-secondary education in 2006.

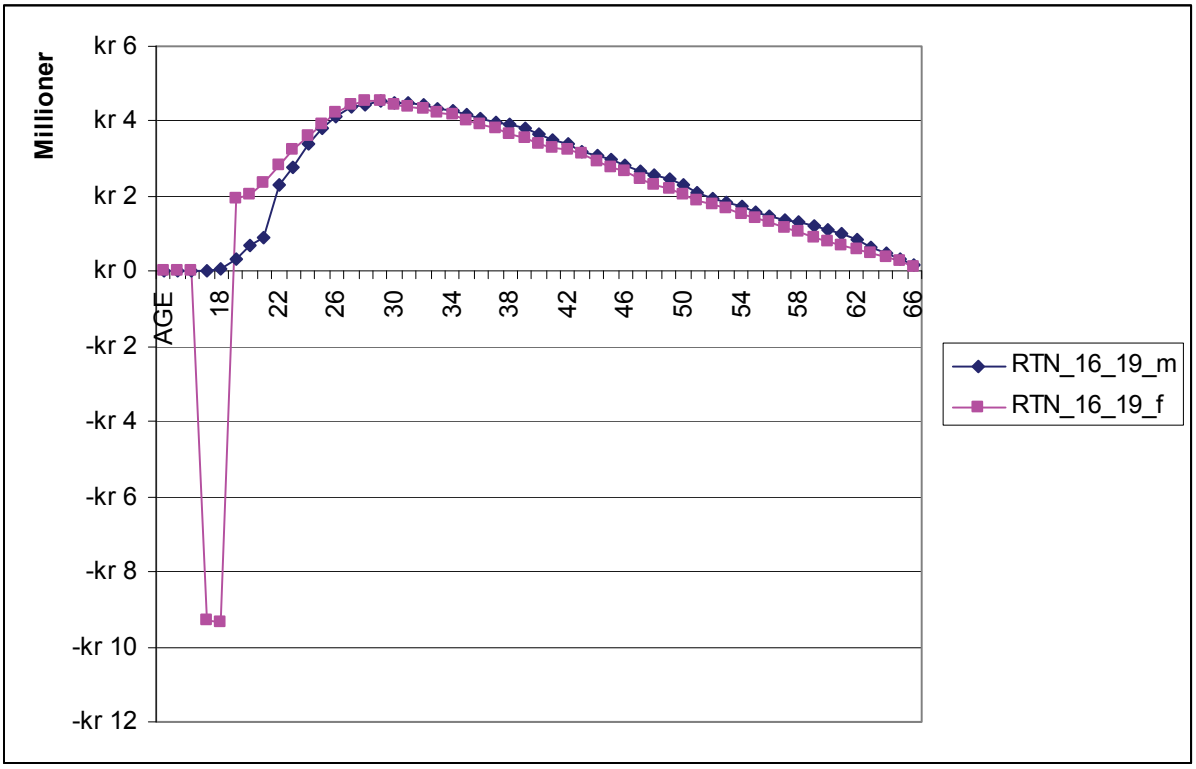

Figure A84: Returns to postgraduate education from post-secondary education in 2006.

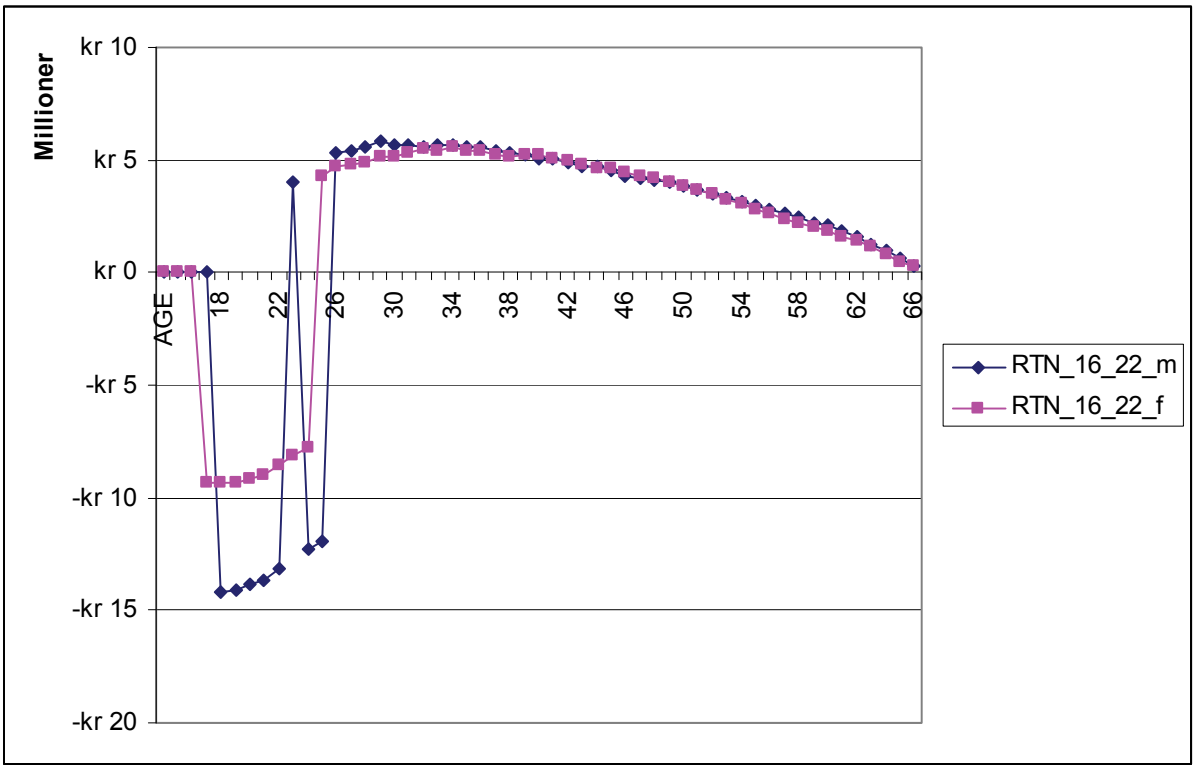

Figure A85: Returns to graduate education from undergraduate education in 2006.

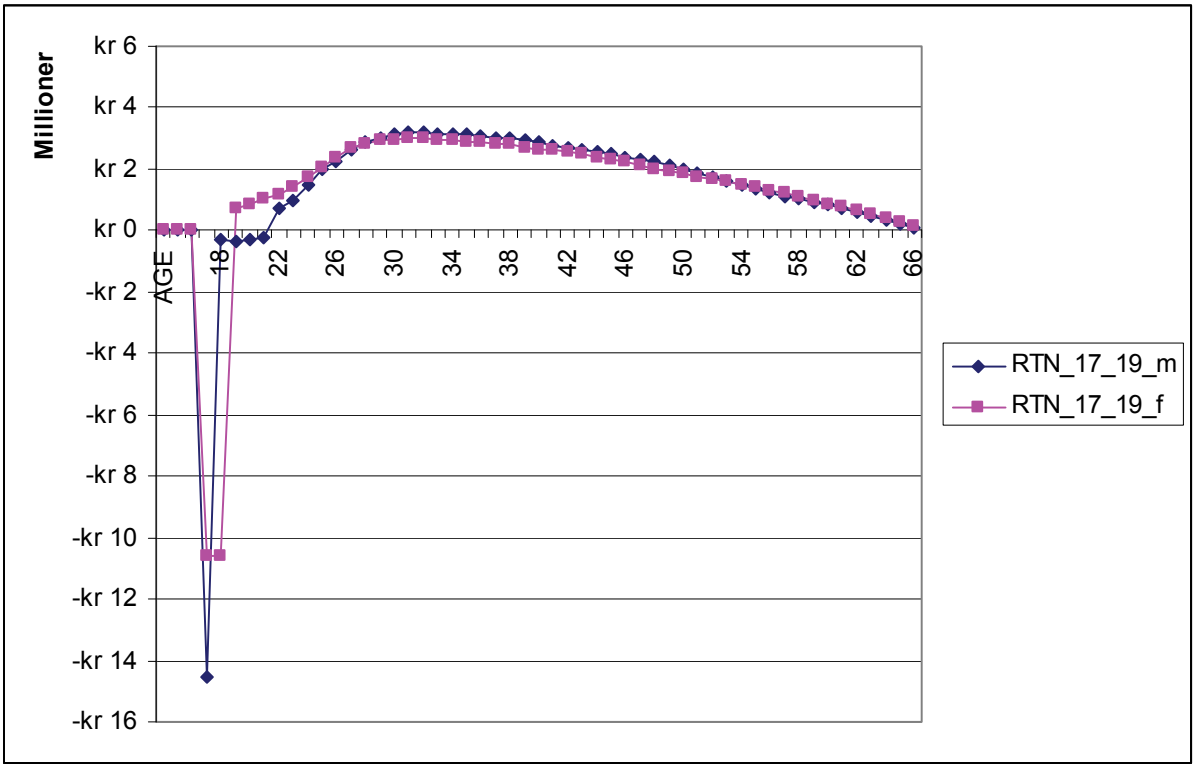

Figure A86: Returns to postgraduate education from undergraduate education in 2006.