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# Evolution of Intergenerational Mobility in Norway between 1900 and 1945

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Master thesis in Economic Analysis

## NORGES HANDELSHØYSKOLE

# Abstract

The 1900s were a century of remarkable changes in the Norwegian society. In socioeconomic terms, Norway went from being a country around the European average, to becoming one of the richest countries in the world with a highly developed welfare system. This thesis investigates the evolution of intergenerational mobility in education and occupation for men born in the first half of the century. Using survey data collected between 1957 and 1973, I estimate intergenerational coefficients for men born between 1900 and 1945, along with occupational distribution. I find that in terms of intergenerational mobility in educational attainment, the Norwegian society witnesses a slowly increasing trend over the first 40 years, however, making a remarkable jump between 1930s and the early 1940s. Thus, after having a substantially higher persistence in education between fathers and sons than the U.S. in the 1930s, Norway reach the U.S. level in a time span of 10 years, before levelling off around the West-European average for the rest of the century. I find that one of the main driving forces behind this increase in intergenerational mobility, is increased upward mobility among sons of lower educated father. In terms of intergenerational mobility in occupation, I find increased rates of mobility between those born between the early 1900s and the early 1920s, however constant for the remaining cohorts. These results are consistent with previous research, and solidifies the argument that the high degrees of intergenerational mobility in Norway was a result of developments in the mid-1900s.

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# 1. Introduction

"Man is born free, but everywhere in chains". The opening line in Jean Jacques Rousseau's *Du contrat social* is a picture that can be viewed from an endless number of perspectives, one of these being the perspective of education. In theory, people are born with the possibility of freely choosing their educational attainment. However, underlying this perceived freedom in educational attainment lies a large system of chains that bind us in some way or another, extending far beyond educational attainment. In recent decades, many researchers have been particularly interested in one part of this system of chains; often categorized as family background and understood in a broad sense as incorporating both family and neighborhood background. These networks of chains contain more and less visible parts, such as family wealth and innate abilities. In addition, the primacy of different chains differs across countries and time. Traditionally, research has looked at intergenerational persistence through the lenses of parents and children's income levels and occupational persistence. A separate, but closely related area, is that of intergenerational transmission of education. All of these areas give us a distinct perspective of the link between parents and children. And combines to answer to what extent children are born with equality of opportunity or born with a more or less pre-determined future.

One of the main arguments behind the high intergenerational mobility in Norway is the societal structures, namely the structures around the welfare state with its redistributive institutions. This welfare state was primarily built in the years after WW2, especially between the 1960s and the 1990s with developments in social and family policies. However, some of the structural changes can be traced back even further. Several recent studies have looked at the historical evolution of intergenerational mobility in Norway in order to investigate the reasons for the high estimates of intergenerational mobility. Modalsli (2017) uses data for the period 1865 to 2011 and finds evidence for increasing intergenerational mobility in occupations over the entire period. Pekkarinen et. al. (2017) estimates intergenerational earnings elasticities for cohorts born between 1930 and mid-1970s. They find that intergenerational mobilities increased substantially for cohorts born between 1930s and the early 1940s, leaving that decade as a particularly interesting decade related to intergenerational mobility.

In this thesis, I will contribute to the literature on the evolution of intergenerational mobility in Norway by investigating the period from 1900 to 1945. More specifically, I will focus on

both intergenerational transmission of education and occupations for father and sons. This provides the analysis with a different aspect of intergenerational mobility, and thus gives us a broader picture of the changes in intergenerational mobility between 1900 and 1945. Using survey data, I am able to extend the analysis on persistence in educational attainment further back than one could do with register data, and thus analyze cohorts born all the way back in 1900. As far as I know, this is the first analysis to estimate intergenerational mobility in education all the way back to sons born in 1900. The data consists of four surveys, conducted between 1957 and 1973. These surveys include, among other, information on both child and parent's educational attainment and occupation. This enables us to look at educational attainment and occupations for children born between 1900 and 1945, and subsequently parents born between 1860 and 1920.

The rest of this thesis is organized as follows: First, I will lay the theoretical foundation for this thesis, before I continue by presenting important parts of the literature on intergenerational mobility. Then I will delve into presenting the data I have used in this thesis, before I continue on the methods used. In section 6 and 7, I will conduct my analysis and present the results, as well as looking at some of the potential underlying mechanisms that affects persistence levels across generation. Finally, section 8 concludes the thesis.

## 2.  Theory

The main focus of this thesis lies in understanding persistence across generations. Why do children of well-educated parents themselves attain high levels of education? Or, why do sons of white-collar workers, typically end up in similar white-collar jobs themselves? An important step into understanding this persistence, is thus to get a better understanding of how different measures of persistence have evolved over time. However, in order to say something about the evolution, we need a theoretical understanding of the terms and mechanisms that are in play. The terms persistence and intergenerational mobility are closely related, being two sides of the same coin. One way of looking at the relationship is that intergenerational mobility is a breaker of persistence, or in other words, absence of persistence. Thus, in this thesis, I will use both terms interchangeably, the only difference being from which direction I describe the events.

In order to understand these mechanisms and structure our thoughts around them, we need a theoretical foundation to build upon. Much of the theoretical foundation for the intergenerational mobility research in economics were laid between the 1960s and 1980s. In this regard, Gary Becker's contribution in 1964 is often set as a starting point, though the lines can be drawn even further back. In an extension of the analysis in the book from 1964, Becker and Tomes (1979; 1986) continues the analysis and derives an economic model of intergenerational mobility. In this section I will briefly present the Becker and Tomes model, in order to help us understand the different channels through which persistence is created, upheld and broken down.

The model builds on an overlapping-generations framework, where parents derive utility both from their own current consumption, and the future utility of their children. By investing in their children's human capital today, the parents can later in life reap the benefits through increased socioeconomic conditions for their children, which leads to greater utility levels for the children. According to the model, parents maximize their own utility through their choices of current consumption and investment in their children's human capital, subject to a budget constraint. More formally, we have that the maximization problem (Björklund & Salvanes, 2011):

$$max \quad [U(C^p) + \alpha V(H^c, W^c)]$$
$$s.t.$$

$$W^c = (1+r)(W^p + H^p - C^p - \gamma S^c) \geq -\bar{X}$$

Where $H^c = f(H^p, A^c, S^c)$, is the human capital production function for children. If we interpret this model, the parents want to maximize the utility from their own consumption plus the discounted ($\alpha$) utility from their children's future human capital and bequeathed wealth levels ($H^c, W^c$). This objective function is maximized subject to a budget constraint, which says that the children's bequest should equal the next periods value of the sum of the parent's wealth level ($W^p$), human capital (for example returns to their skills in the labor market ($H^p$), parent's private consumption ($C^p$) and the investments in their children's level of schooling ($\gamma S^c$). Also note that we require that our parents have enough consumption to satisfy some minimum existence level $\bar{X}$. Furthermore, we have a relationship between children's years of schooling and human capital levels, given by the production function f. We see from the function, that the level of human capital for children is determined by their parent's human capital levels, children's endowed abilities ($A^c$) and children's years of schooling. Thus, we see that education is an important mechanism that relates to persistence, since parents can invest in their children's human capital levels through education.

An important assumption in this model is that of the relationships in the human capital production function. We assume that the productivity of investing in schooling is affected by parent's human capital, and the child's endowed abilities. Formally, we have that:

$$\frac{\partial^2 f}{\partial S^c \partial H^p} > 0 \ and \ \frac{\partial^2 f}{\partial S^c \partial A^c} > 0$$

This means that the parent's human capital levels, and the children's endowed abilities increase the productivity of schooling. Another assumption is that the derivative of the human capital production function is positive for all three arguments. The optimal solution following this model, is for parents to equalize marginal values across periods. Such that the last dollar invested in children's future human capital gives a marginal utility that is equal to the last dollar spent on current consumption.

From this model, we have a way of structuring the different channels through which persistence between parents and children are created and upheld. First, since we assume that abilities are inherited by children, we have a positive correlation between parent's abilities and their children's abilities. Thus, the same unobserved talent that gives rise to the parent's human capital level, also give rise to children's human capital level. Furthermore, this increases educational attainment for both parent and child, as the productivity of schooling increases in abilities.

Secondly, we have an indirect effect, where the parent's human capital level is correlated with children's years of schooling. This gives rise to lower transaction cost of schooling because parental human capital level increases the productivity of going to school. These mechanisms could for example be due to transmission of tacit knowledge from parent to child that increase productivity. Furthermore, we also have that parental human capital affects children's years of schooling through transmission of cultural values. For example, higher educated parents might have better information on psychological and socioeconomic benefits of attaining education, and thus induce children's educational choices. (Checchi, 2006).

A third channel of intergenerational persistence is related to financial constraints. From the model, we have a budget constraint, where the parent's face a trade-off between current consumption and investing in future socioeconomic status for their children. If families are wealth-constrained, they might end up with underinvesting in their children, thus leading to children with high ability taking too few years of schooling. Since lower level of wealth is correlated with lower levels of schooling, and vice versa, we have that lower educated parents might underinvest in their children's human capital levels, while highly educated (and rich) parents invest optimal. This gives rise to correlation of education across generations. This channel also overlaps with that of public interventions for example through direct subsidies or indirectly through lowering transaction costs related to attaining education.

We thus see that according to the Becker, both the education system and the workplace are important channels through which persistence is created, upheld or broken down. Higher educated parents typically invest in more schooling for their children because of financial flexibility, superior information or directly through affecting children's productivity in human capital formation. Furthermore, occupations have a direct link to education and thus persistence, as specialized jobs require professionalized skill-transmitting entities ("Schools").

# 3.  Literature review

There exists a large body of research on the relationship between family background and socioeconomic outcomes. In this thesis I will focus on two of the channels through which the transmission from parent to children run, namely educational attainment and occupational mobility. Thus, leaving out large channels such as intergenerational mobility in income and through migration. The chapter begins with a presentation of the early research on intergenerational mobility, before I give a short presentation research on intergenerational mobility in income. This is to give a broader perspective of the field, and also set mobility in education into a context. Then I will continue by presenting recent research on intergenerational mobility in educational attainment and occupations.

## 3.1 Early research

To what extent can one predict a person's future income based on which family he belongs to? And thus, to what degree is his future income a product of his own choices or factors he has not chosen himself? Furthermore, what are the underlying mechanisms that may cause persistence in socioeconomic outcomes across generations? Do children of more educated parents attain more education because more educated parents tend to have a larger stock of resources to which enables them to invest more in their children's human capital? Or do children of highly educated parents attain more education because they have inherited some genetical traits that lower the cost of human capital accumulation? The answer to this last question has great consequences for the scope and effects of educational reform, and thus remains an important question to try to answer. However, as so often in research, we already have a large body of literature which one can stand on the shoulders of and continue the search for answers.

Seminal work in intergenerational mobility dates back to Becker (1964), Coleman (1966) and Blau and Duncan (1967). Looking at the statistical relationship between fathers and sons occupational status, Blau and Duncan (1967) finds a weak correlation between the two. Furthermore, Becker and Tomes (1986) finds only a weak correlation between fathers and son's earnings of about 0.15, indicating a high degree of intergenerational mobility. The following decades expanded on the research, especially that of intergenerational transmission of earnings, and added among others two important aspects to this research, related to

measurement errors. Thus, the weak relationship in earnings could be due to a combination of insufficient quality of the data on earnings and the inability to separate between permanent and transitory income (Bowles, 1972; Bowles and Nelson, 1974; Atkinson, Maynard and Trinder, 1983; Solon, 1992, 1999; Zimmerman, 1992). Leading to an intergenerational earnings correlation that is substantially larger than earlier research, up to as much as three times higher than in Becker and Tomes (1986). (Bowles and Gintis, 2002). In the next section, I will give an overview of the more recent research on intergenerational mobility, especially focusing on educational attainment.

First, I will present recent research on intergenerational mobility in earnings, before I continue on educational attainment. Earnings mobility provides a useful context for intergenerational transmission of educational attainment, especially as educational attainment can be seen as one of the vehicles of earnings persistence.

## 3.2 Recent research on intergenerational mobility

### 3.2.1 Mobility in earnings

There are several different starting points when looking at intergenerational mobility. This thesis will primarily focus on transmission of educational attainment and occupations, however, closely related to these topics are that of earnings mobility. The central question is; how strong is the persistence in earnings and wealth across generations, and what are the driving forces behind this persistence?

A benchmark measurement for intergenerational mobility in earnings is the intergenerational elasticity of earnings (IGE). More formally, it is estimating the following equation.

$$log(Y_1) = \alpha + \beta log(Y_o) + \varepsilon$$

Where $Y_1$ are permanent earnings for children and $Y_o$ are permanent earnings for parents. The coefficient of interest is $\beta$, which is the expected percentage change in children's permanent earnings if we increase parent's earnings by one percent. Another related measurement is the intergenerational correlation of earnings, which is a normalized measurement where one account for differing standard deviation between generations. (Black and Devereaux, 2011).

There's a vast literature on estimating intergenerational elasticities and correlations, especially for the U.K., the U.S. and the Nordic countries. Jäntti et. al. (2006) uses national studies and register data in order to estimate comparable IGEs for the U.K., the U.S. and the Nordic countries for children born around 1958. They find that the Nordic countries exhibit the highest degree of intergenerational mobility in earnings, with an IGE ranging between 0.071 and 0.258. The U.S. shows the lowest degree of mobility, with and IGE of 0.517, and the U.K. lies between the two, with an IGE of 0.306. Similar results for the U.K. and the U.S. are found in Mazumder (2005) and Nicoletti and Ermisch (2007).

Analysing intergenerational earnings mobility in Norway, Bratberg et. al. (2005) uses longitudinal data for cohorts born in 1950, 1955, 1960 and 1965. They find an IGE of 0.155 in for the 1950-cohort, and 0.129 for the 1960-cohorts. This estimation is based sons' average earnings between the age of 31 and 35, and on five-year averages in earnings for fathers. Similarly, they find intergenerational correlations of for these cohorts of 0.148 and 0.114 respectively. Thus, there's no evidence for any increase in inequality for Norway during this period. Pekkarinen et. al. (2017) extends the analysis of earnings persistence further back in time and looks at cohorts born between the early 1930s and mid-1970s. They find that the intergenerational correlation in earnings increased substantially for the cohorts born between 1930 and early 1940s and remained stable for the post WW2 period. Hence, the post-WW2 trends aligns with that of Bratberg et. al. (2005).

### 3.2.2 Mobility in educational attainment

The following presentation of recent research is largely based on the Björklund and Salvanes (2011). They separate between two kinds of motivation for recent research on family background and educational attainment, the perspectives of equality of opportunity and child development.

The first starting point is that of equality of opportunity. If educational attainment is largely explained by factors which the persons themselves does not actively choose, there's a low degree of equality of opportunity. Hence, this rises the questions of how much of children's educational attainment is explained by family background, and how much is explained by children's own choices. Furthermore, this kind of reasoning has also motivated a large body of political reforms in order to achieve a higher degree of equality of opportunity. For example, one could argue that abilities are more uniformly distributed in a society than the stock of

resources, and more resources enables higher educational attainment. Thus, there's scope for efficiency gains by redistributing the resource pool such that those with high abilities and few resources are able to undertake more productive investments in their human capital.

The other starting point is that of child development. Children's future socioeconomic outcomes are dependent on three broad mechanisms: (1) The degree and type of parental choices regarding investment in their children's stock of human capital, (2) The choices made by children following the parent's investments, and (3) Policies conducted by the government that affects the environment of children and parents. From this starting point the main area of research has focussed on what types of parental investments are important for children's human capital formation, and how the importance of these investments vary over different periods of development. Also, which policies are more effective at increasing human capital formation among children, and at what period in their lives are they most effective. (Björklund & Salvanes, 2011).

As mentioned earlier, a central research question is how much of the variance in years of schooling is explained by family and neighbourhood factors? Here, family and neighbourhood factors are broad categories consisting of factors such as parental education level, genetic traits, parental rearing skills and a common environment. A broad measure of these family and neighbourhood factors is a sibling correlation, which tells us the fraction of the variance in years of education that is shared across siblings. Björklund & Salvanes (2011) find that based on several studies on European and US data, the sibling correlation typically lie between 0.4 and 0.6. Furthermore, the sibling correlations tend to be higher in the US than in Europe. Studies on Norwegian data such as Raum et al. (2006) and Björklund & Salvanes (2011) estimates sibling correlation of around 0.41, and somewhat, though not significantly, larger for sisters than for brothers. An extension to this approach, attempting to decompose the effects into family and neighbourhood effects, is found in Solon, Page and Duncan (2000). They estimate a variance-component model, using data that identifies individuals of different families growing up in the same neighbourhood. By including one component for the neighbourhood and an orthogonal component of the individual, they are able to estimate an upper bound for the neighbourhood effect. A comparison between this neighbourhood effect and the overall sibling correlation, they conclude that the neighbourhood effect explains at most a third of the factors that siblings share.

Another area of research on intergenerational mobility comes from estimates of persistence between parents and children in educational attainment. Hertz et. al. (2007) uses data from 42 nations located all over the world and estimates 50-year trends in intergenerational persistence of educational attainment. They calculate both the intergenerational elasticity of educational attainment (IGE) and the intergenerational correlation for cohorts born between 1920s and 1970s. They find that the IGE varies from 0.2 to 1.27, with most countries lying between 0.4 and 0.8. While the intergenerational correlations typically vary between 0.3 and 0.6. For both measurements, the Nordic countries stands out for having the lowest persistence an average intergenerational correlation of 0.34. Similarly, the non-nordic high-income Western nations had an average correlation of 0.41. The paper also estimates the overall 50-year trends in educational persistence between parents and children and finds a decline for IGE over the 50-year period by about 0.051 per decade. On the other hand, the intergenerational correlation showed no trend.

In other studies, we see differing results when it comes to the development of intergenerational mobility during the 20th century. Checchi et. al. (2008) studies persistence in educational attainment for Italy for cohort born between 1910 and 1975. They find a clear increase in intergenerational mobility with a correlation falling from 0.575 for the oldest cohort to 0.472 for the youngest cohort. Heineck and Riphahn (2009) estimates persistence in education using German data for cohorts born from 1929 through 1978. They find no clear changes in the intergenerational persistence of education during that period for the German society. A third study by Blanden and Machin (2004) looks at the recent educational expansion for the U.K. and finds that children from richer families have benefitted the most from these expansions. Thus, signalising that these educational expansions might favour families where parents have higher levels of education, and thus reducing intergenerational mobility in education.

While the research above, points to a clear persistence in educational attainment across generations, the results can only be interpreted as a statistical correlation and not a causal impact. Hence, a large part of recent research focus on estimating the causal impact of parents' educational attainment on children's years of schooling.

## 3.3 Occupational mobility

Another branch of intergenerational mobility is the relationship between parents and children's choice of occupation. An advantage to looking at intergenerational mobility through

the occupational lens, is the quality of the data. First, there are lower probabilities of measurement errors due to lack of recall by children, since parent's occupation is easier to remember than other economical characteristics such as income and education. Secondly, occupational data typically goes further back in time, hence enabling researchers to calculate longer trends of intergenerational mobility. (Björklund & Jäntti, 2000)

In recent years, there has been a growing literature on long-run trends of occupational mobility have evolved. Long and Ferrie (2013) calculates and compares occupational mobility rates for Britain and the US over the 19th and 20th century. By using a comparable set of surveys and census data, they find that the US had significant higher occupational mobility rates in the latter half of the 19th century compared to Britain. However, the mobility rate decreased in the US between the 19th and 20th century, while there was no such decline in mobility rates for Britain.

A similar paper on the Norwegian society is Modalsli (2017) who looks at intergenerational mobility in Norway between 1865 and 2011. The papers use Norwegian census data, and thus calculates occupational mobility for the entire adult population in the years 1865, 1910, 1960, 1970, 1980 and 2011. Modalsli finds a substantial increase in occupational mobility in the Norwegian society during the period, with an Altham statistic falling from 24.1 to 19.1. The Altham statistic is a measure for the distance between two matrices, and in this context measures the distance between the a 4x4 occupational matrix and the matrix constituting perfect occupational mobility. Hence, a decrease in the Altham statistic signifies a matrix that is closer to full mobility. The Norwegian results differs from findings from Britain and the US, who experienced a moderate and strong decline in mobility respectively.

# 4. Data

In this section I will present the data that is used in the empirical analysis, as well as describing how I recode the data for my analysis. Since the analysis consists of two parts, one on the persistence of educational attainment and the other on occupational mobility, I will keep the discussion on the data separate for the two. Hence, after a general introduction to the data, I start of by discussing the data on educational persistence, before I continue with the data on occupational mobility.

## 4.1 Overview of the data

The data material in this analysis consist of a combination of four independent surveys conducted between 1957 and 1974. Two of the surveys are National Election Surveys, initiated by Stein Rokkan and Henry Valen in 1957 and 1969. These surveys aimed at analysing political parties, political recruitment, voting behaviour and the role of mass media among others (Aardal, 2017). However, they also included variables on both educational attainment for respondents and parents, as well as occupational data. For the 1957 election survey, there were 1 544 respondents born between 1858 and 1937. Of these respondents, 761 of them were males and 783 were females. Similarly, for the 1969 election survey, there were 1 595 respondents born between 1890 and 1949, whereas 839 were males and 756 were females. A more extensive elaboration of the structure of this data will be presented in the chapter 4.2.

The third dataset is a survey on the occupational career of 3471 men born in 1921, 1931 or 1941, conducted in 1971. The survey, *Yrkeshistorieundersøkelsen*, were an initative from the Institute of Applied Social Reasearch (INAS), aiming at analysing the distribution of living-conditions and life chances in the Norwegian society (Ramsøy, 1977). The sample was drawn randomly from the population of men born in the three cohorts, who were listed in the central population register per 1970. The survey includes variables on both educational attainment and occupation for parents and sons

The fourth and final dataset is the Norwegian survey on living conditions, initiated by the government in 1972 and led by Tor Rødseth. The survey consists of 2 966 respondents drawn randomly from the sample of the survey of consumer expenditure from 1973. The fact that the sample of the survey on living conditions is a subset of the 4 707 households from the survey

of consumer expenditure, means that some of our respondents comes from the same household.

When we combine these four surveys, we end up with base of 9 575 respondents, whereas 3 074 observations are women and 6 501 observations are men. In our empirical analysis, we restrict ourselves to looking at father-son pairs, for several reasons. Traditionally most of the research on intergenerational mobility have been conducted on fathers and sons, hence giving us better scope to compare our results with earlier results. However, the most important reason in our context is that the largest survey in our dataset is the Norwegian occupational life history study only includes men. Hence, in our combined dataset, we have around 68% men and 32% women. In addition, since educational attainment typically differs between men and women in this particular period, using both sons and daughters combined would affect our results. Thus, after keeping only father-son pairs, we're left with a total of 6 247 observations for our analysis. Figure 1 shows the composition of our dataset between 1900 and 1945. As one can see the share of survey 1 to 3 is approximately equal up until 1936, expect for the years where survey 4 is in play. After 1936, survey 1 and 3 share approximately equal shares of the dataset. We can also here see that because of the size of survey 4 relative to the other surveys, the cohort born in 1921, 1931 and 1941 is completely dominated by this survey. Challenges related to this is discussed in the next section.

**Figure 1:** Survey composition by birth year
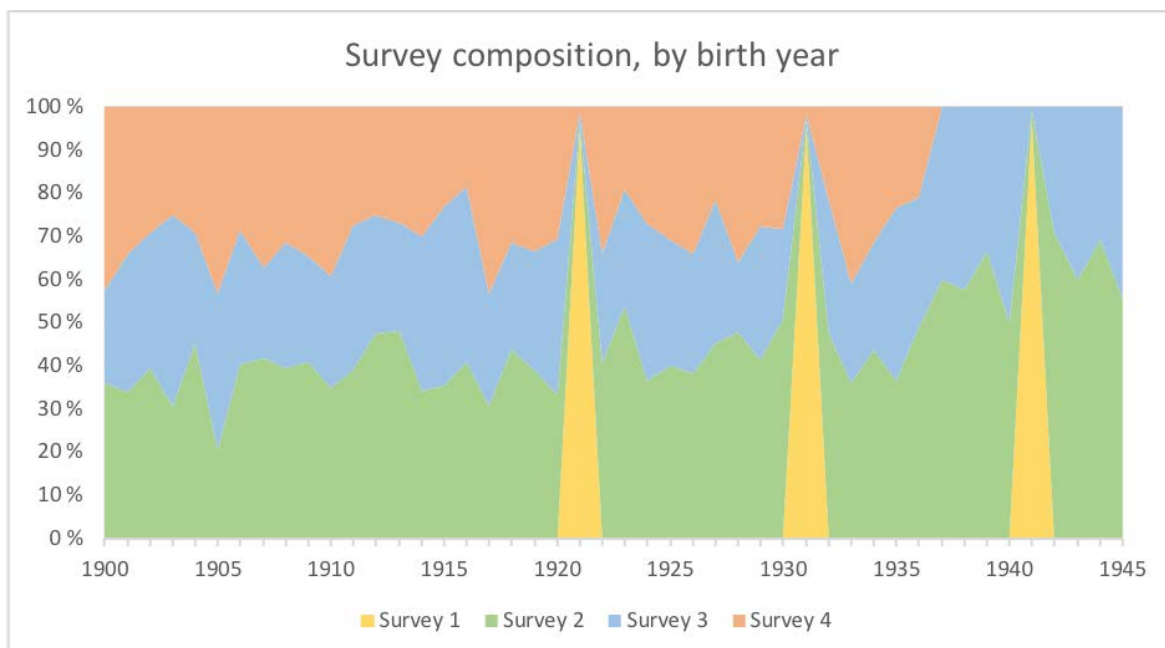
## 4.2 Persistence in educational attainment

In order to conduct an empirical analysis of the persistence in education across generations, one need data on both children's and parent's educational attainment over time for different birth cohorts. Ideally one would want to know the exact years of schooling for both generations. However, this ideal gets harder and harder to meet the further back in time one goes, because of a lack of public educational records for earlier periods. Therefore, one way to address the question of the intergenerational mobility in education for the first half of the 20th century is to use national surveys targeting a representative sample of the population. This thesis combines three such surveys, conducted between 1969 and 1973. A fourth survey conducted in 1957 is also described in this section, however this falls short of the final analysis due to various reasons. One potential drawback of using surveys rather than register data, are the chances of imperfect recall from respondents, hence one might face problems of larger measurement errors. However, one would expect better recall by children for their parent's educational attainment, compared to for example income data (Checchi et. al., 2008).

### 4.2.1 Consolidation of the surveys

The main challenges related to using this historical survey data for our analysis is that of adequately coding educational attainment. Ideally, one would want the surveys to ask its respondent about the exact years of education for both them and their fathers. However, this ideal is seldom satisfied in reality, and one has to develop a method to recode the data into years of education. This is further complicated by the fact that the different surveys formulate questions about educational attainment somewhat differently. Hence, in this subchapter, I will describe how I consolidated the four surveys into one combined dataset, and potential challenges related to this consolidation.

### 4.2.2 Survey 1: Norwegian occupational life history survey from 1971

This survey includes the most granulated educational attainment data of the four surveys. For sons, we have information on every educational activity undertaken up until the survey, which includes code for which activity, actual and typical duration of activity and whether or not the activity was completed. My procedure in coding this information to years of education consisted of manually going through each of the 3471 observations and assigning years of education based on the information. In this process I aligned my procedure as close as possible

to that of the education standard (SSB, 1970). First, my main conceptual procedure was to split the educational activities into general education and vocational education. Then I added the vocational education on top of the general education. When coding from kind of vocational education to years of schooling I took into account the typical length of the activity and to some extent the standardized educational level grouping. For example, if a person had 7 years of general schooling and then 1-year of agricultural training at both lower and higher secondary level, he is assigned 9 years of education. However, according to the education standard, educational activities at higher secondary levels is supposed to equal between 10 and 12 years. Furthermore, if this person instead had 9 years of general schooling, he would be assigned 11 years of schooling. I therefore assume that the duration of the educational activity "trumps" the standardized groupings of educational activity. However, in cases of doubt I have leaned on the standardized grouping of educational levels. In all the coding I took account of the typical duration of the activity and not the actual. Thus, if the typical educational attainment for medical training is 6 years, I assign 6 years of higher education independent of if the person actually completed the training in less or more than 6 years.

Another guiding principle in the procedure was that if a person attained different kinds of educations, I chose the longest one. This is in accordance with the procedure for the Norwegian standard of education. For example, if a person had two years of mechanical education before attainting three years of agricultural education, I assigned him in total three years of schooling for the agricultural education.

For the fathers, there are two variables relating to education. The first one asks whether or not the respondents father have education above primary school (7 years), the other asks how many years above primary school. The answers for the second question are categorized into four categories; (1) Less than 1 year, (2) Between 1 and 2 years, (3) Between 3 and 4 years, and (4) 5 years or more years. We then have a nicely way of distinguishing years of education between 7 and 12, however, the survey doesn't distinguish between years of schooling from 12 and above. I therefore make use of the variable on profession in order to separate out the ones who have more than 12 years of education from the ones who only have 12 years of education.

The profession variable is based on the Nordic standard classification of occupations from 1965. The variable consists of three digits which refers to a specific profession group. We can therefore use information on the educational requirements for different professions to separate

out the fathers who have more than 12 years of education. In order to establish a link between different professions and years of schooling, I used the data for sons. By calculating the mean years of education for each profession, given that the years of education were 12 years or more, I had a clear link between professions and the years of education typically attained for those professions. Hence, I was able to better distinguish between fathers who had 12 years of education, and those who had between 13 and 19 years of education.

### 4.2.3 Survey 2: Norwegian survey on living conditions from 1974

This second survey has different formulations of the educational attainment variables for sons and fathers, therefore I'll discuss the recoding separately for sons and fathers. For the sons (respondents) educational attainment consists of two variables; (1) general education level, (2) vocational education lasting at least 5 months. For the fathers on the other hand, the structure is similar, however variable (1) on general education is less granulated. Hence, instead of being divided into 8 categories of general education between 7 and 12 years of schooling, it's divided into three categories, namely 7, 9 or 12 years of general schooling. However, our recoding procedure is similar for both generations. We simply add these two variables on top of each other, with some exceptions, see next paragraph.

The main challenge we face in the coding of education in survey 2 is to distinguish the years of education within an educational class. Thus, if we have a son whose general level of education is primary school (7 years) and he has vocational education on higher secondary level, do we give him 10, 11 or 12 years of schooling? One solution is to assume that the mean is 11 years, that is, as many with 10 years as with 12 years of schooling. However, this leads to an underestimation for all children who in reality had 12 years of education and an overestimation for all children with 10 years of education. Furthermore, the distinction between the two are important, as the one group undertakes 20% more years of education, which signalises some underlying difference between the two. The same problem also arises for higher educational levels.

A second way of responding to the challenge is by using occupation as a proxy for different educational lengths. For example, if we find that engineers typically have at least 12 years of schooling, and the son in the example above is an engineer, we give him 12 years of schooling. However, if he were a ship captain, who typically has 10 years of education, we give him 10 years of education. In order to use this approach, we need a clear link between occupations

and educational length, which we get from sons in survey 1. Hence, for each educational level, we restrict ourselves to looking at sons and fathers with years of schooling between the extremes of that level, and calculate profession means. Thus, for educations on higher secondary level, we calculate the mean years of education for each profession, given that years of education lies between 9.5 and 12.5. I then code years of education as is shown in table 1.

**Table 1**: Coding rule of children's educational attainment

| Profession mean | Assigned years |
|---|---|
| $9.75 \leq mean \leq 10.25$ | 10 |
| $10.25 < mean < 10.75$ | 10.5 |
| … | … |
| $11.75 \leq mean \leq 12.25$ | 12 |

The same procedure is conducted for each educational level above higher secondary. However, for education levels below higher secondary I simply add one year of education if the respondents have education above the general education.

The procedure is a bit different for fathers, mainly because we lack the variable that tell us which kind of educational activity is undertaken. From the survey, we only know whether the father had 7, 9 or 12 years of education. And whether or not he had vocational education lasting at least 5 months. The way I code years of schooling for these fathers is first by separating between those who have 7, 9 and 12 years of general education. Then I use the information from the vocational education for the son's generation to identify any relationship between general and vocational education. From this, we get that of those who have between 7 and 10 years of general education, 91% had vocational education on lower or higher secondary level. Another 7.6% had vocational education for "university I"-level (13-14 years) and the remaining 1.4% had more than 14 years of education. Thus, we see that persons with 7 or 9 years of general education typically attain vocational education at secondary levels, especially when we take into account the fact that younger cohorts (sons) typically attain more education overall than older cohorts (fathers) in the period we're looking at.

What I do next is to use the profession information to establish a relationship professions and years of education. I do this separately for each level of general education. For those with 7 years of general education, I use the son's generation in survey 1 to calculate the profession means, given that they have between 8 and 11 years of education. For the fathers with 9 years of education, I calculate profession means given that years of education are between 10 and 13 years. At last, for the fathers with 12 years of general education, I calculate profession means given that years of education is 13 or more. The reason I choose a four-year window for those with 7 and 9 years of general education is twofold. First, as discussed above, the majority of these have vocational education on the secondary level, meaning total years of education between 8 and 12 years. Thus, I'm only interested in the observations per profession that have years of schooling on the secondary level. Secondly, if I include all 5 years (8 to 12), the profession means would probably be skewed. This because there are several observations who have 12 years of general education and no vocational education. This group would be included in the mean, and thus positively skew the mean years of education per profession, such that observations with 7 years of general education would get too many years of vocational education. The same argument goes for those with 9 year of general education and is why we restrict ourselves to looking at observations with 10 to 13 years of education instead of 10 to 14 years. Also, it seems reasonable that there are few educational activities on the secondary level that lasts longer than 4 years.

## 4.2.4 Survey 3: National election survey from 1969

The third survey includes variables on general and vocational education. For the sons, three variables address educational attainment. The first variable categorized education into 9 categories between primary school and college/university. The second variable is about vocational education, consisting of 18 broader groups of educational activities. The third variables groups education into years above primary school, up until 7.5 or more years above primary school. I code years of schooling by using the third variable which distinguished between every year above 7 years, until 14.5 or more years.

For fathers, we have two variables on education equal to the first and second above. Hence, we add the vocational education to the general education in order to get years of schooling. One challenge we face here is to link the vocational education group to years of schooling. Since we do not have the education code as we had in survey 1 and 2, we have to map the son's educational information unto the fathers. We do this by calculating mean years of

education per vocational education group and for each level of general education, using the information from all four variables. For example, the mean of agricultural education for sons with only primary school becomes the proxy for years added to fathers with the same education.

## 4.2.5 Survey 4: National election survey from 1957

The fourth survey defines education equally for both sons and fathers and consists of three variables: (1) A variable for the level of general education from 7 years to college/university, (2) A variable for what kind vocational education, given that the person has any at all, and (3) A variable that splits vocational education into higher or lower degree. When combining these three variables into years of education, the main challenge is to figure out how many years to give vocational education of different degrees. One way is to look to the election survey from 1969, however this is not a one to one connection. First, survey 3 doesn't split between lower and higher degrees. Secondly, the grouping of vocational education somewhat differs between the two surveys. However, using survey 3 as a mapping tool seems to be the best procedure available. Hence, I calculate the mean years of education per vocational education and assumes that anything lasting three years or more represents higher degree and vice versa. In the calculation of years for each vocational education, I compare the variable "Years above primary school" and the variable for attainment of general education for son's in survey 3.

Two aspects worth mentioning in the coding of years of education. The first one is the challenge when mapping a son's generation's years of education to that of the father's generation. Throughout the 20th century, several reforms were implemented in order to increase the duration of certain educations. For example, the duration of the education of teachers changed from 2 years to 3 years in 1902, and then from 3 years to 4 years from 1930. (Karlsen, 2005). This leaves it problematic to map son's relationship between professions and educational attainment onto the fathers. One solution to this would be to assume that fathers in general have 0.5 to 1 years fewer years of education for the same vocational training than their children, however, this seems like a strong assumption. Instead, I keep the fathers' years of education equal to that of the son's, however, for professions I know for a fact have changed the duration of the education during this period, I have changed accordingly.

The other aspect is whether calculating years of education based on professions are an accurate procedure. For some profession, such as lawyers, doctors and clergymen, one can be certain

that they have all attained a university education of 5 to 7 years. However, for most of the professions, there exists no such clear link to educational attainment. For example, from the population census of 1970 we have that for public administrators, 14% had between 8 and 9 years, 24% had between 10 and 11 years, 14% had 12 years and 48% had 13 years or more. Thus, if we were to calculate a mean, we would assign each public administrator 13 years of education. This would conceal much of the information, as individuals who in reality only had 8 years of education would attain 13. And individuals who in reality had 18 years of education would only attain 13 years. There's probably a large difference between the men who attains 8 years of education and the men who attain 18 years of education, however, this information would be lost when calculating mean. Furthermore, this example illustrates the rawest measure of profession-based means. In order to keep some of the information, we take into account other variables in our surveys, such as that of general education. If we know that a person has 12 years of general education, vocational education and works as a public administrator, he must have between 13 and 19 years of education. Thus, this person is assigned 16 years of education. If a person has 7 years of education, vocational education and works as a public administrator, he must have between 8 and 12 years of education. This is because, without high school (10 years) or artium (12 years), he cannot attend higher education. This leaves him with 10 years of education, instead of 13. Hence, the procedure of calculating profession-based mean given some educational information, gives us a better estimate of years of education, and is therefore the procedure I have used.

## 4.3 Occupational mobility

For father and son's occupations, we have to limit our analysis to survey 1 and 2. The data on occupations comes from a 3-digit code from the Nordic classification of occupations (1965). The formulation of the occupation questions differs somewhat for the two surveys, and for father and son. For the Norwegian occupational life history survey from 1971 (survey 1), we have father's occupation at the respondent's birth and when the respondent was 14 years old. For the respondents themselves, we have information on every occupation they've had up until 1971. I use fathers' occupation when the respondent were 14 years old as the occupational variable for fathers. For sons, I use the last occupation registered, thus we have the occupation at the age of 50 for the oldest cohort, at the age of 40 for the next cohort, and at the age of 30 for the youngest cohort. This leaves us with data on fathers' occupation at around the age of 45 while the sons' occupation is given at the age of 30, 40 or 50. This leaves us with the

problem of life-cycle bias, as some occupations typically depends on the age. An example is that sons of farmers typically don't take over the farm until the father retires, thus the measuring sons at a young age could potentially leave out important information. In order to minimize life-cycle bias, we use data on father's occupation at the respondent's birth for the youngest cohort given that the age is at minimum 30 years, and measure fathers occupation when the respondent were 14 years old for the two oldest cohorts. In addition, we restrict the sample to only include individuals between 30 and 60 years of age, following the methodology in Modalsli (2017).

In the Norwegian survey on living conditions from 1974 (Survey 2), the occupations are measured as the father's main occupation during the respondent's childhood and the respondent's occupation at the time of the survey. Again, I limit the sample to measuring occupations for individuals at an age between 30 and 60 years.

# 5. Methods

In this section I will present the relevant methodology of the empirical analysis. First, I will focus on ways of estimating intergenerational mobility in educational attainment, before I continue with looking at the tools available for analysing occupational mobility

## 5.1 Persistence in educational attainment

There exists a wide array of approaches available when estimating intergenerational mobility in educational attainment. In this thesis, I will measure educational mobility in two ways. The first one treats education as a continuous variable, while the other treats education as a discrete variable.

First, when estimating persistence in educational attainment there are two related measurements that are widely used, the intergenerational regression coefficient of education and intergenerational correlation of education. The main difference between the two, is whether or not they incorporate differences of variance in education between the two generations. Hence, if the variance of education is equal in the two generations, the two measure are equal. If the standard deviation of education is higher in the parent's generation than in the children's, then the correlation exceeds the regression coefficient, and vice versa. Furthermore, since the variance in education typically have increased in recent decades due to a general increase in educational attainment, the two measurements can yield vastly different trends. (Black, Devereaux 2011)

More formally, we estimate the following regression:

$$S_i^c = \alpha + \beta S_i^f + \varepsilon_i \qquad (1)$$

Where $S_i^c$ is the years of schooling for children i, $S_i^f$ is years of schooling for the father of children i, $\alpha$ is a cohort fixed effect and $\varepsilon_i$ is an error term. Here, the coefficient of interest is $\beta$ which is the intergenerational regression coefficient. This term tells us how many more years of schooling one would expect children to attain, if we were to increase their father's years of schooling by one year. Hence, it tells us something about the persistence of educational attainment across generations. Thus, $(1 - \beta)$ becomes our measure of

intergenerational mobility. This regression coefficient also relates to the intergenerational correlation of education through the following equation:

$$\rho = \frac{\sigma^f}{\sigma^c}\beta \qquad (2)$$

Where $\rho$ is the intergenerational correlation of education, $\sigma^f$ is the standard deviation in education for the parent generation, and $\sigma^c$ is the standard deviation in education for the children's generation.

Compared to the intergenerational regression coefficient in earnings mobility, the measurement for educational attainment has some benefits. First, there's less danger of life-cycle biases, as most people tend to finish their educations in their mid-20s. Second, in terms of measurement error educational attainment has the benefit of being easier to recall. This is especially important when using survey data, where one relies on the respondent's ability to recall information about their parents. (Black and Devereaux, 2011)

The second measure of intergenerational mobility in educational attainment are transition probabilities across specific levels of educational attainment. (Deutscher & Mazumder, 2019)

$$Pr\left(S_i^c = x \mid S_i^f = y\right) \qquad (3)$$

Here, $S_i^c$ is the son i's years of schooling and $S_i^f$ is the father of i's years of schooling. For example, this measurement can tell us the probability that the son has educational attainment above high school given that his father only has primary school. Thus, the transition probabilities tell us something about the persistence of certain groups in society, rather than the overall persistence across all groups. A drawback to the use of transition probabilities in is that of the "ceiling/floor"-problem (Deutscher and Mazumder, 2019). In my analysis, I divide education into the four bins; primary school, lower secondary school, high school, and college/university. The "ceiling/floor"-problem is thus that those with university as their highest attained level of education, cannot possibly attain any more education. The same holds for those without any education, who cannot attain any less education. This would constrain the degree of mobility. Moreover, by treating education as a discrete variable one would mask over some potential mobility. For example, if the average son of a father with primary school attains 10 years in 1940, but 12 years in 1960, we would have a large increase in mobility,

however, both belong to the high school bin, such that transition probabilities wouldn't include this mobility.

In order to dig deeper into the underlying mechanisms of the intergenerational mobility results, we further dissect total years of schooling into subsets of smaller intervals. This method comes from Raftery and Hout (1993). We specify a minimum and a maximum, and thus normalize the years of schooling between these extreme values. More formally, we have the following rule of division between a given min and max:

$$
\widehat{YoS}_i^{Child} = \begin{cases} 0 & \text{if } YoS_i^{Child} \leq \min \\ YoS_i^{Child} - \text{Min} & \text{if } \min \leq YoS_i^{Child} \leq \max \\ \text{Max} - \text{Min} & \text{if } YoS_i^{Child} \geq \max \end{cases}
$$

To give an example of the dissection method, we specify the interval 10 to 12. Hence if years of schooling is 10 or less, then $\widehat{YoS}_i^{Child} = 0$. If years of schooling is 11, then $\widehat{YoS}_i^{Child} = 2$ and if years of schooling is 12 or more, then $\widehat{YoS}_i^{Child} = 2$. This reformulation lets us delve into the margins, and thus gives us richer information the changes in intergenerational mobility.

## 5.2  Tools of occupational mobility estimation

Following the methodology in Modalsli (2017) and Long and Ferrie (2013) we classify occupation into four classes, white collar, farmers, skilled / semi-skilled and unskilled. Here, the division between white collar and blue collar (skilled/unskilled) is roughly equal to the division between non-manual and manual work. Furthermore, the division between skilled/semi-skilled and unskilled is based in the requirement of vocational education. Hence, skilled/semi-skilled occupations require some sort of vocational education, such as that of mechanics and electricians, while unskilled occupations depend mainly on pure physical work.

Another important aspect of our classification is that they constitute no clear difference in social rank. That is, one can't claim that persons in white-collar jobs belongs to a higher social rank than people in skilled blue-collar jobs. This is because, even though white-collar work includes occupations that can be regarded as of higher social status, such as lawyers, clerics and business executives, the group also include occupations whose social status is more unclear, such as teachers and ship captains. Thus, one could a son of an accountant become a

Chief Financial Officer in a firm, which clearly involves a vertical move in social status, however would not be classified as upward mobility in our analysis because both occupations belong in the white-collar group. Thus, moving from one occupation group to another can be seen as an "sectoral" shift, meaning as much a horizontal move as a vertical move. (Modalsli, 2017)

## 5.2.1 Measure of probabilities

In the analysis of intergenerational mobility in occupations, I use tools of categorical analysis. This involves analysis matrices, both by themselves and compared to other matrices. The main matrix is a 4x4 matrix with father's occupational group as the rows, and children's occupational group as the columns. Given the four categories of occupations, white-collar (w), farmer (f) skilled/semi-skilled (s) and unskilled (u), we have the following general 4x4 matrix:

$$A = \begin{bmatrix} a_{ww} & a_{wf} & a_{ws} & a_{wu} \\ a_{fw} & a_{ff} & a_{fs} & a_{fu} \\ a_{sw} & a_{sf} & a_{ss} & a_{su} \\ a_{uw} & a_{uf} & a_{us} & a_{uu} \end{bmatrix}$$

Here the general form of each argument is $a_{ij}$ where i is the fathers's occupation and j is the sons's occupation. The first measurement of mobility is the probability that a son ends up in anoccupation j, given that his father's occupation is i. More formally:

$$p_{ij} = \frac{a_{ij}}{\sum_{j=1}^{4} a_{ij}}$$

Where both i and j runs from 1 to 4 representing the four occupational groups: $\{1, 2, 3, 4\} = \{w, f, s, u\}$. For example, if $p_{ww} = 0.75$, we have that a son of a white-collar father has a 75% probability of himself entering a white-collar occupation. A step toward higher mobility would be a distribution of probabilities that are more uniformly distributed across all occupational classes. This measure of intergenerational mobility can give us useful information on the level of mobility and on the development of mobility over time, however there's at least one major drawback. This measure doesn't take into account general shifts in the prevalence of different sectors over time. Thus, because the share of sons with fathers in the farming sector is typically larger for the oldest birth cohort than for the youngest, one can't directly compare the mobility measurement for two different periods. A solution to this problem is assessing relative mobility.

## 5.2.2 Measure of relative mobility

A tool for assessing relative mobility is to look at standard two-way odds ratios. We first estimate a measure of the advantage a son of father with occupation i has of entering occupation j, relative to all other occupations. Also, in this measurement we only look at entering into and out of the main diagonal in our matrix. That is, we let i = j. Thus:

$$p = \frac{p_{i,i}}{p_{\neg i,i}} = \frac{p_{i,i}}{(1 - p_{i,i})}$$

In the case where i = white-collar, we have the probability that a son of a white-collar worker ends up in a white-collar occupation, relative to the probability that a son of a white-collar worker ends up in a non-white-collar occupation. Furthermore, to account for the changing availability of different occupational groups, we have to compare this probability ratio for a son of a specific occupational group to that of a son of any other occupational groups. Thus, as a second measurement of occupational mobility, we calculate the following statistic:

$$\theta_{2,i} = \log \left[ \frac{p_{i,i}/(1 - p_{i,i})}{p_{\neg i,i}/(1 - p_{\neg i,i})} \right]$$

Where $\left[ \frac{p_{i,j}/(1 - p_{i,j})}{p_{\neg i,j}/(1 - p_{\neg i,j})} \right]$ is the advantage the son of a father with occupation i has of entering occupation i, relative to a son of a father with occupation not-i has of entering occupation i.

## 5.2.3 The Altham statistic

The final measurement I use for intergenerational mobility in occupations, is an extension of the previous measurement. Instead of restricting us to only look at two-way odds ratio for changes into and out of the main diagonal, this measurement incorporates all possible two-way ratios in the 4x4 matrix. For example, this measurement includes the possible changes in the advantage a son of a skilled worker has of entering a white-collar occupation relative to that of a son of an unskilled worker has of entering a white-collar occupation. While previously we only compared this advantage for sons of white-collar worker to sons of non-white-collar worker. Thus, following Modalsli (2017) we have the following measure of intergenerational mobility, where we have a set of father's occupations (indexed i and l) and a set of sons' occupations (indexed j and m)

$$\theta_{i,j,l,m} = \log \left[ \frac{p_{i,j}/p_{i,m}}{p_{l,j}/p_{l,m}} \right]$$

In a 4x4 matrix we have 144 such odds ratios, however only 36 of them are unique because of symmetry. This measurement can be used to compare the evolution of relative advantages for sons of fathers in different occupational groups in and out of different occupational groups. However, in order to estimate an overall level of intergenerational mobility for a society we have to aggregate the sum of odds ratios into a single measure. One measure was suggested by Altham (1970), which calculates the distance between two matrices. This distance is measured by comparing the full set of odds ratios for the two matrices and computing the quadratic mean of these differences' times a constant. Following Modalsli (2017), we let the first matrix, A, be the matrix for a period's distribution of fathers and sons' occupations, and the second matrix, Q, be a distribution of perfect mobility. The matrix of perfect mobility is such that fathers and sons' occupational distribution is uniformly distributed across all classes. That is equal probability for entering any occupation for sons of fathers with any occupation. For this matrix, Q, all odds ratios are 1, such that all log(odds-ratios) are 0. We therefore have the following equation, where the Altham statistic, d, can be interpreted as the distance from our society's distribution to that of perfect mobility;

$$d(A, Q) = \left[ \sum_{i=1}^{N} \sum_{j=1}^{N} \sum_{l=1}^{N} \sum_{m=1}^{N} \left( \theta_{i,j,l,m}^{A} \right)^2 \right]^{1/2}$$

In addition to calculation the overall Altham statistic, we also follow Modalsli (2017) in calculating the Altham statistic for subsets of only farm and non-farm occupations. Thus the, following table illustrates the three sets for the three Altham statistics:

**Table 2:** Unique odds-ratios in a 4x4 matrix

| Son (j, m) / Father (i, l) | WS | WU | SU | FW | FS | FU |
|---|---|---|---|---|---|---|
| WS | $\theta_{WWSS}$ | $\theta_{WWSU}$ | $\theta_{WSSU}$ | $\theta_{WFSW}$ | $\theta_{WFSS}$ | $\theta_{WFSU}$ |
| WU | $\theta_{WWUS}$ | $\theta_{WWUU}$ | $\theta_{WSUU}$ | $\theta_{WFUW}$ | $\theta_{WFUS}$ | $\theta_{WFUU}$ |
| SU | $\theta_{SWUS}$ | $\theta_{SWUU}$ | $\theta_{SSUU}$ | $\theta_{SFUW}$ | $\theta_{SFUS}$ | $\theta_{SFUU}$ |
| FW | $\theta_{FWWS}$ | $\theta_{FWWU}$ | $\theta_{FSWU}$ | $\theta_{FFWW}$ | $\theta_{FFWS}$ | $\theta_{FFWU}$ |
| FS | $\theta_{FWSS}$ | $\theta_{FWSU}$ | $\theta_{FSSU}$ | $\theta_{FFSW}$ | $\theta_{FFSS}$ | $\theta_{FFSU}$ |
| FU | $\theta_{FWUS}$ | $\theta_{FWUU}$ | $\theta_{FSUU}$ | $\theta_{FFUW}$ | $\theta_{FFUS}$ | $\theta_{FFUU}$ |

The whole range of the table constitutes conventional Altham statistic, d. The green area constitutes the non-farm Altham statistic, and the blue area constitutes the farm Altham statistic.

# 6.  Analysis

In this section I will conduct the analysis and document the evolution of intergenerational mobility in educational attainment during the first half of the 20th century. First, I will present the general evolution of educational attainment during this period and look at some of the underlying mechanisms of this evolution. The second part looks at intergenerational mobility in education, both describing the trends and the potential mechanisms. In the next chapter, I will continue the analysis by looking at intergenerational mobility in occupations.

## 6.1 Descriptive trends

The first half of the 20th century were a period of formidable change in the Norwegian society. Between 1920 and 1950, the GDP per capita had doubled in size, from 3 000 to 6 000 (measured in 2002$). An increase that was shared across all Nordic countries. (Grytten, 2014). In terms of the educational system we see a large expansion, with notable reforms in 1897, 1920, 1935/36 and 1947. The overall education level of the Norwegian population increased by 24% from 8.5 years for those born in 1895 to 10.5 years for those born in 1945.

**Figure 2:** Shares at different margins of the schooling system and average years of schooling
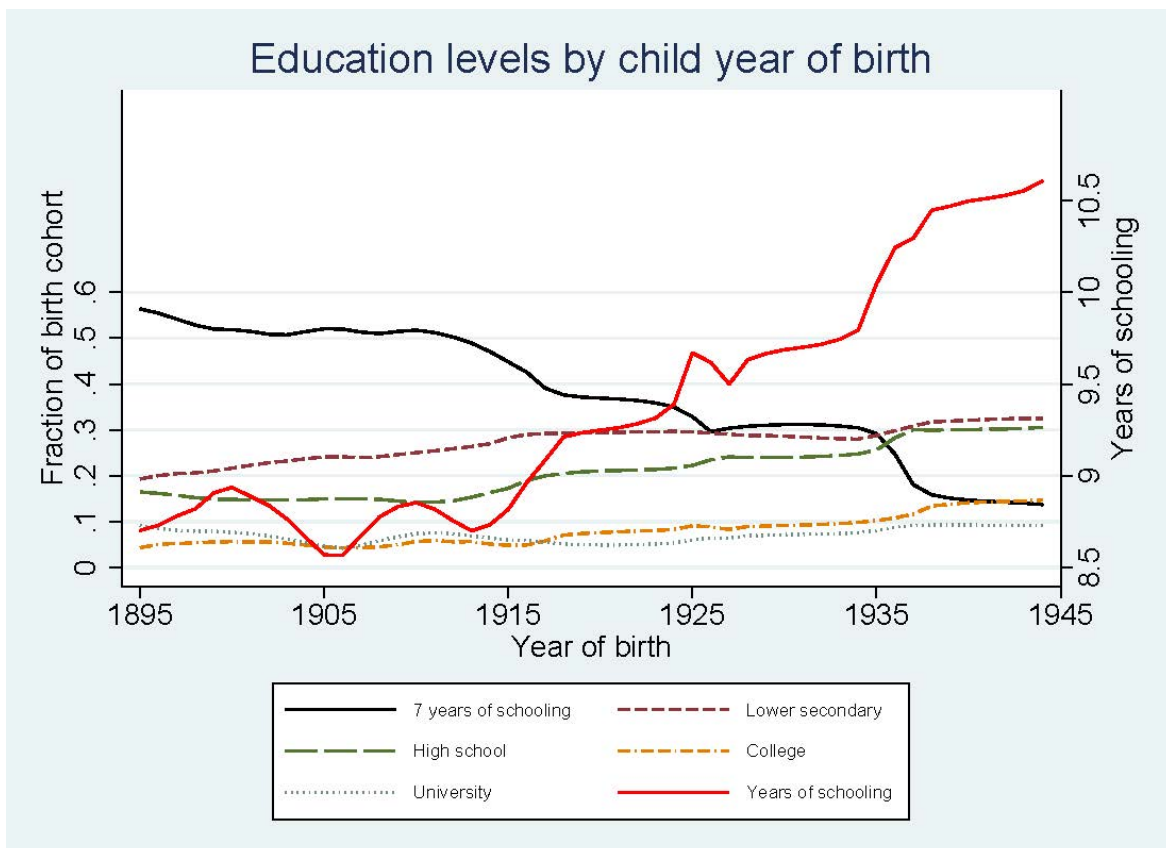
One can also look at the changing composition of schooling in the society and get an idea of what drives this increase in average years of schooling. For those born in 1900, around 50% of them had primary school as their highest educational attainment. By 1940, this share had decreased to about 14%. Furthermore, one can also see a steady increase in the share of men at lower secondary levels, rising from 20% to 33% of the population. We also see that there was about a doubling of the share who undertakes high school (Gymnasium) and higher education during our period. Especially beginning in the early 1930s we see a sharp decrease in the share of the population attaining seven years of education, and consequently an increase in shares at all the levels above primary school.

From this figure, one can tell the story of a society whose inhabitants attains increasing levels of education throughout the first half of the 20th century. This increase is primarily driven by people extending their education beyond primary school. From 1895 until 1915, we see a clear increase in people attaining lower secondary level schooling rather than primary school. However, the largest increase in average years of schooling happens for the 1915-cohorts and

onwards. This increase looks to be driven by more people attaining 10 years and above, that is, high school or higher education.

This is a first step into describing the evolution of educational attainment during the first half of the 20th century. However, it says nothing about any changes at the margins. Thus, was this increase in educational attainment driven primarily by higher recruitment of sons with low educated fathers, or were sons of highly educated fathers attaining more education?

To further analyze the evolution of intergenerational mobility, I focus on mobility at different educational levels. I split educational attainment into three margins; lower secondary and below, high school level, and college/university level. For each of these margins, I look at the changes in educational attainment for sons of parents with different educational levels, as described in chapter 5. This gives us an idea of which groups experienced increased mobility in the period

In figure 3a) I illustrate the trends in educational attainment at the lowest educational margins, that is for lower secondary and below. As one would expect, there's a clear difference between sons of fathers from different educational levels. Almost all sons of fathers with high school or beyond, attains at least 9 years of schooling, which can be seen by the trend being almost 2 for the entire period. Furthermore, the numbers are lower for sons of both lower secondary educated fathers and fathers with seven years of schooling. The overall pattern for the first half of the 20th century is a convergence in the recruitment into lower secondary school.

**Figure 3:** Average years of schooling separated by educational margins and fathers' education
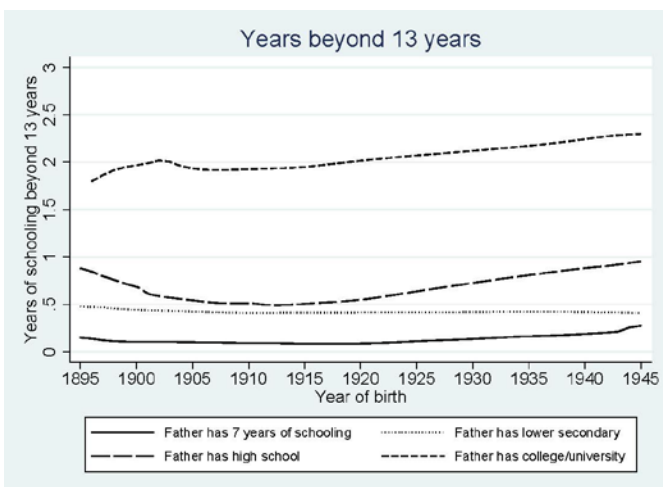
a)
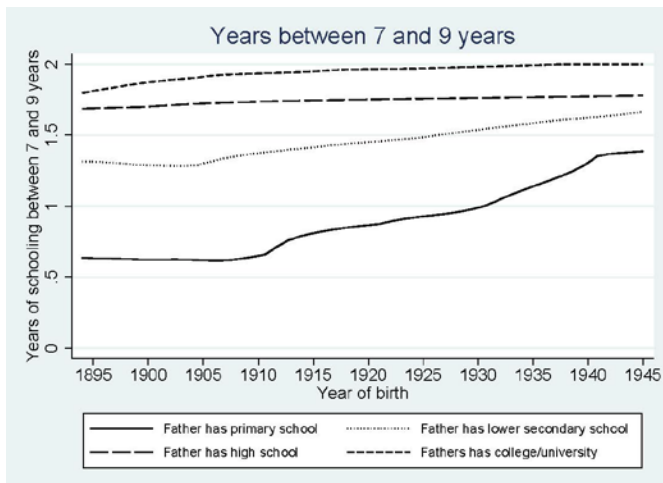
b)
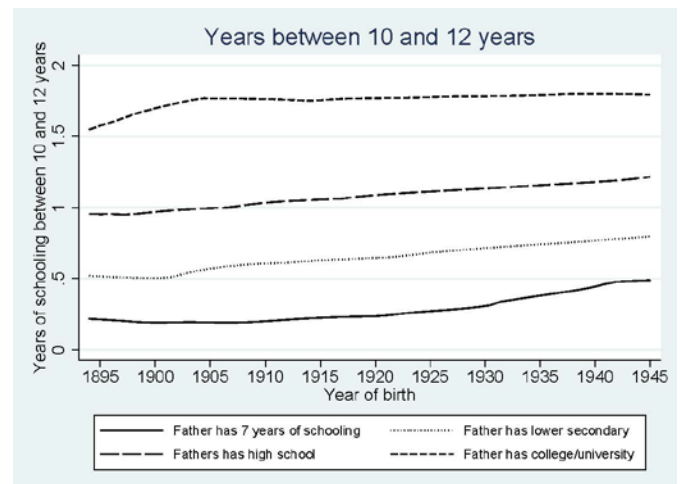




c)



*Note: These figure looks at average years of schooling at different margins of the educational distribution. For example, a) shows the average number of years of schooling at the lowest educational margin (lower secondary and below). Such that 7 years of education = 0, 9 years = 2, 10 years = 2 etc*

Starting from around 1905, we see a steady increase in mobility into lower secondary by sons of lower secondary educated fathers. For sons of fathers with seven years of schooling we see that the mobility into lower secondary school, starts 5 years later at around 1910. After a steady increase between 1910- and 1930-cohorts, we see an accelerated increase for those born in the 1930s. Hence, we see that for the cohorts between 1930 and 1940, it was mainly sons of lower educated fathers that increased their educational attainment at the lowest margin. Furthermore, we see that the trend is again parallel for the cohorts after 1940. Even though sons of both fathers with primary school level and fathers with lower secondary level experiences increased mobility into lower secondary, the increase is almost 3 times larger for sons of primary educated fathers. Thus, if we link this to figure 2 above, we now see that the increase in the share who attains lower secondary schooling throughout our period, is mostly due to increased mobility into lower secondary from sons of fathers with primary school, and partly by sons of fathers with lower secondary.

When it comes to intermediate margin of the schooling distribution (10 to 12 years) in figure 3b, there are several interesting trends to note. First of all, we see that all four groups experienced an increase in years of schooling at the intermediate margin, however at different periods. The first ten years are dominated by sons of fathers with college or university education attaining more years of schooling at the high school level. Thereafter, the trend is constant for this group. Moreover, close to all sons attain 12 or more years of schooling, as you can see from the trend lying close to 2.

For sons of fathers with high school we see a smooth increase from the 1905-cohort and until the 1945-cohort. For both of these groups, we have to keep in mind the small samples for the first 10 years, thus, it's there a strong uncertainty related to the trend up to around 1910. The two groups with the lowest levels of educated fathers both experienced increases at the intermediate level, starting around 1904 for son of fathers with lower secondary and around 1910 for sons of fathers with primary school. However, we see an accelerated increase in mobility into high school by sons of fathers with primary school in the 1930s, levelling off in the early 1940s. Thus, since 1905, we see that the increase in the share of men attaining high school level education is equally share by sons of fathers with high school or less. While sons of father with education at the college or university level show no sign of mobility into high school after 1905, which relates to the fact that most of these sons attains college or university level education for the entire period.

For the top margin of the schooling distribution (13 years and beyond), figure 3c, the increase in years of education is primarily shared between the sons of fathers with high school or beyond, both experiencing about an equal growth in attainment of college or university education between the 1915 and 1945-cohorts. Interestingly, the mobility into college and university starts earlier for sons of college and university educated fathers, at around 1905, while it starts around 1920 for sons of high school educated fathers. However, there's a striking difference in years of schooling between sons of high school educated and college/university educated fathers for the entire period.

Furthermore, the increase in educational attainment at the highest margin is small for sons of lower secondary fathers, but there's a sharp increase in higher educational attainment for sons of fathers with primary school starting in the early 1940s. Thus, the sharp increase in college education starting around 1935 in figure 2, stems from increases by sons of fathers with primary school, high school and college/university level education.

These figures give an interesting picture of the changes during the 20th century. At all margins, we see that sons of higher educated fathers are the first to expand in educational attainment, with sons of lower secondary parents and primary school educated parents joining in on the expansion at later stages. We also see a clear difference in which educational levels see the largest increase in attainment from different groups. Sons of lower educated fathers are mainly expanding into lower secondary and high school, while sons of higher educated fathers are mainly expanding into high school, college and university. A final interesting aspect from these figures, is that while the increase is somewhat steady for sons of fathers with lower secondary or beyond, we see that for sons of fathers with seven years of schooling, much of the expansions takes place in the 1930s and 1940s.

## 6.2 Evolution of intergenerational mobility in educational attainment

Next, we estimate the persistence in educational attainment between fathers and sons. Figure 4 reports our estimates of the cohorts divided into 5-year bins, and with a 90% confidence interval. We use 5-year bins in order to increase the observations at each group, as especially for the early years we have few observations per year.

**Figure 4:** Evolution of the intergenerational mobility coefficient in education
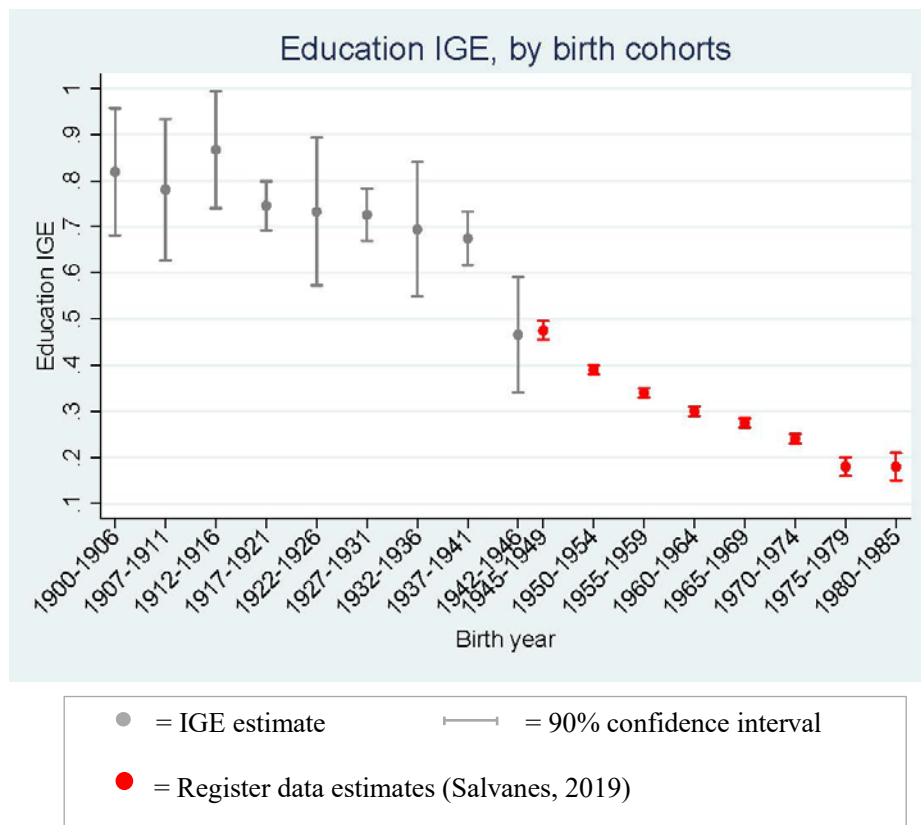


For the oldest cohort, we see a high IGE of around 0.82. Meaning that there's almost a one-to-one persistence in educational attainment between fathers and sons. Over the next two birth cohorts, this persistence fluctuates around 0.82, however there's a high degree of uncertainty in these estimates. Still, this indicates that there's a very high intergenerational persistence in educational attainment. It's also important to note that we do not have an estimate for the IGE for the latter part of the 19th century, and thus do not know whether the IGE of 0.82 is an anomaly, or on the trend. Thus, the first three cohorts could in fact carry on the same trend as the previous century, and not constitute an increase or decrease in intergenerational mobility. The estimates for the next three cohorts, for the years 1917 to 1931, we seem to see the start

of an increasing trend in intergenerational mobility, however, stabilizing around 0.74. Starting from the 1932/1936-cohort, we see a continuation of the slow downward sloping trend. In 1927/1931-cohort had an IGE of 0.72, which is on 0.1 lower than that of 30 years earlier. The IGE declines to a new low at 0.70 for the next cohort, though these estimates have a large confidence interval. The persistence levels then continue to decline over the latter part of the 1930s to 0.67 for the 1937/1941 cohort. Hence, our results show a clear trend of a slow increasing intergenerational mobility for men born in the 1930s. For the youngest cohort, those born between 1942 and 1946, there's a remarkable jump from the previous birth cohort, from 0.67 to 0.46. This indicates some drastic changes happening for those born in the early 1940s. However, this is the last estimate in our dataset, and we do not know whether this is just an anomaly, or an actual increasing trend. In order to address this, I've plotted register data estimates from Salvanes (2019), starting from 1945/1949-cohort (in red). Thus, there's a two-year overlap between my last estimate, and the first of the register data estimates. Interestingly, we see that our estimate for the 1942/1946-cohort is consistent with those of Salvanes (2019), however much larger confidence intervals for our estimate due to small sample size for the survey data.

We also see that, compared to register data estimates from more recent decades, the IGE for the 1900 to 1941 cohorts are strikingly high, and one might question the validity of these estimates. Interestingly, these high early estimates correspond to those IGE estimated for India between 1940 and 1970 (Azam & Bhatt, 2015). However, the steep decline between the two last cohorts in our dataset stands in contrast to the gradual decline estimated in India over the latter half of the 1900s. This similarity in levels, although 30-40 years apart, suggest that the estimates calculated for (newly industrialized) Norway in the early 1900s fit well with estimates for NIC-countries, such as India, in the late 1900s.

These results indicate that sons born in 1940s seem to have grown up in a completely different society in terms of availability of opportunities, independent of his father's education level. These results are consistent with estimates from Hertz et. al. (2007), where we see a similar drop from 0.67 to 0.40 between the 1941- and the 1946-cohort. It's also consistent with the findings of Pekkarinen et. al. (2017), which find that intergenerational mobility in income increases sharply between cohorts born in the early 1930s and the early 1940s. The low degree of educational persistence for the youngest cohorts is s large contrast to the older cohorts and indicates that the high intergenerational mobility in Norway relative to countries such as the U.K., the U.S., and southern Europe are due to large changes over a relatively short span of

time. Norway goes from having a substantially lower intergenerational mobility rate than the U.S. to, over a 10-year period, equalize mobility rates and thereafter lying just below the US rate for the rest of the 20th century. (U.S. estimates are based on Hertz et. al. (2007)).

In order to get an idea of the underlying mechanisms that drive this increase in intergenerational mobility, we can look at how the distribution of education evolves for sons of fathers with different educational background. In the four figures below, we separate between fathers with only primary school, lower secondary school, high school, and college or university.

**Figure 5:** Share of children attaining specific levels of education, by fathers' level of education

a)                                                      b)

c)



Distribution for sons of fathers with high school

d)



Distribution for sons of fathers with college or university
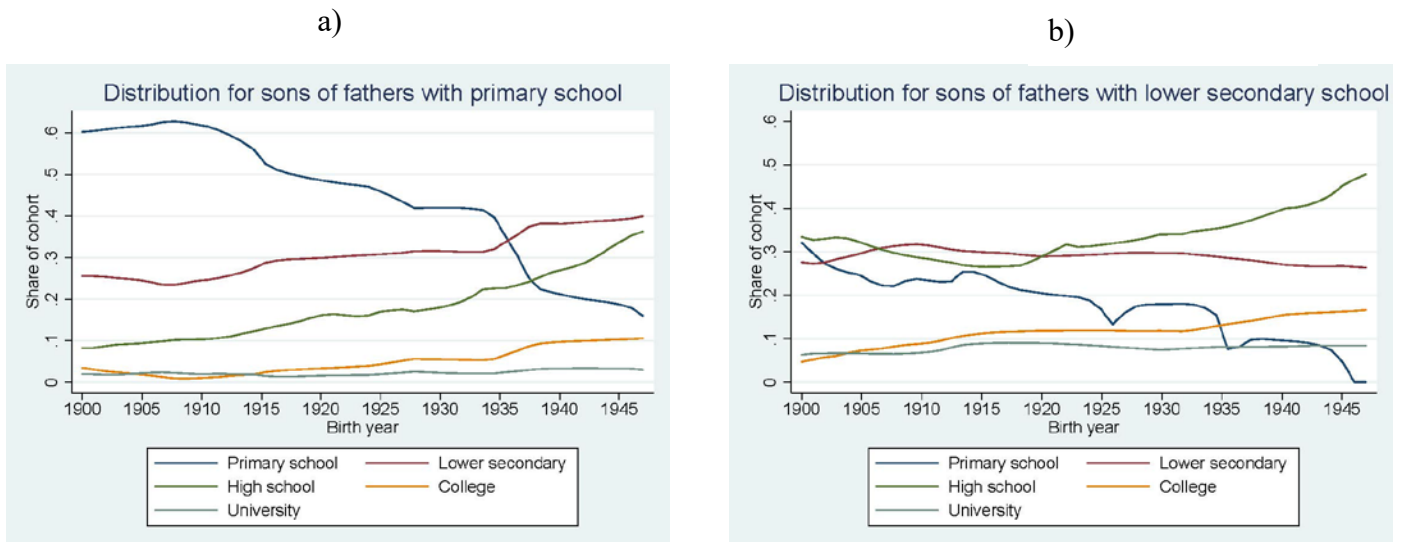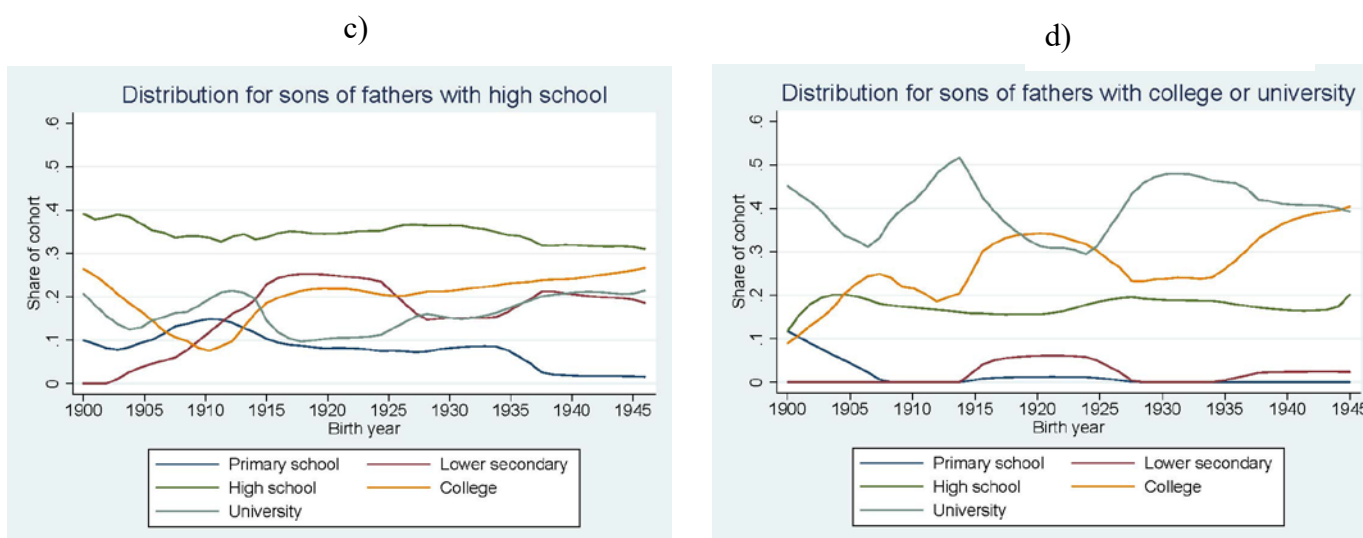
For sons of fathers with primary school level education, we see a steady decline in the share who attain only seven years of schooling, however a sharp decline around 1935. This fits well with the continuation school law from 1947 (the 1935-cohort is 14 years in 1949). This law opened up for municipalities to decide whether or not to make continuation school mandatory for those who didn't continue on other tracks after primary school. Furthermore, counteracting the decline in sons with seven years of schooling, we see increased movements into lower secondary, high school and college. However, mobility into high school seem to dominate in size. Linking this to the evolution of the intergenerational coefficient, we see that increase mobility into especially high school, accelerating around 1942, seem to align with the decrease in educational persistence. Thus, indicating that upward mobility from sons of fathers with seven years of schooling is a driving force behind the increase intergenerational mobility in education.

For sons of fathers with lower secondary education, we see a steady decline in the share who attain seven years of schooling, throughout the period. Furthermore, there's increased mobility into college over the entire period and into high school starting around 1920. There's no sign of mobility into university for this period. Interestingly, the period is dominated by a striking increase of sons who attain high school level education, rising from around 30% to 50% between 1920 and 1950. Hence, some of the increase in intergenerational mobility seems to come from son of father with lower secondary education attaining high school and college education, rather than primary and lower secondary.

For both sons of high school educated fathers and fathers with college or high school, the picture is a bit fuzzier. This is partly a consequence of a small and varying sample size, which again means that it's hard to interpret the earliest movements. For sons of high school educated fathers, we see that most of them attain high school level over the entire period. However, we see a declining trend from 1930 and onwards. At the same time, we see an increase into college and university level education. Thus, we see that sons of high school educated fathers are starting mobility into college and university levels relatively early, especially university, for which we see no sign of mobility from the sons of father with lower than high school education.

As for sons of fathers with college or university level education, we see a strong persistence. Over the entire period, the share who attains either college or university levels are close to 80%. The shares are somewhat lower for the earliest years; however, this is partly due to small of sample. For example, we have no observations of fathers with college or university education for the years 1903 and 1904. Thus, there doesn't seem to happen that much of a change for sons of father's with college or university education, except for some variation for shares between college and university education. However, the clear persistence in educational attainment across generations for this group is interesting.

From this analysis, we see that much of the increase in intergenerational mobility seem to be driven by sons of fathers at the lower levels of the educational system. For both sons of fathers with seven years of education and lower secondary, we see that the sons are mainly attaining schooling at educational levels above that of their fathers. Likewise, for sons of high school educated fathers, there's an increasing trend in attaining college and university, rather than high school as their father.

## 6.2.1 Marginal effects

Another aspect of the underlying changes related to intergenerational mobility, is the marginal effects on sons' educational distribution of increasing fathers' years of education. In the figures below, I have run a regression of the share of sons ending up with a given educational level on father's years of schooling. Thus, sons with seven years of schooling born between 1900 and 1906, we have that increasing father's years of education by one year, is associated with a 0.075 percentage point decrease in the share of sons who attain seven years of schooling.

**Figure 6:** Relationship between the share of sons who attains primary and lower secondary school and fathers' years of education

a)                                                            b)
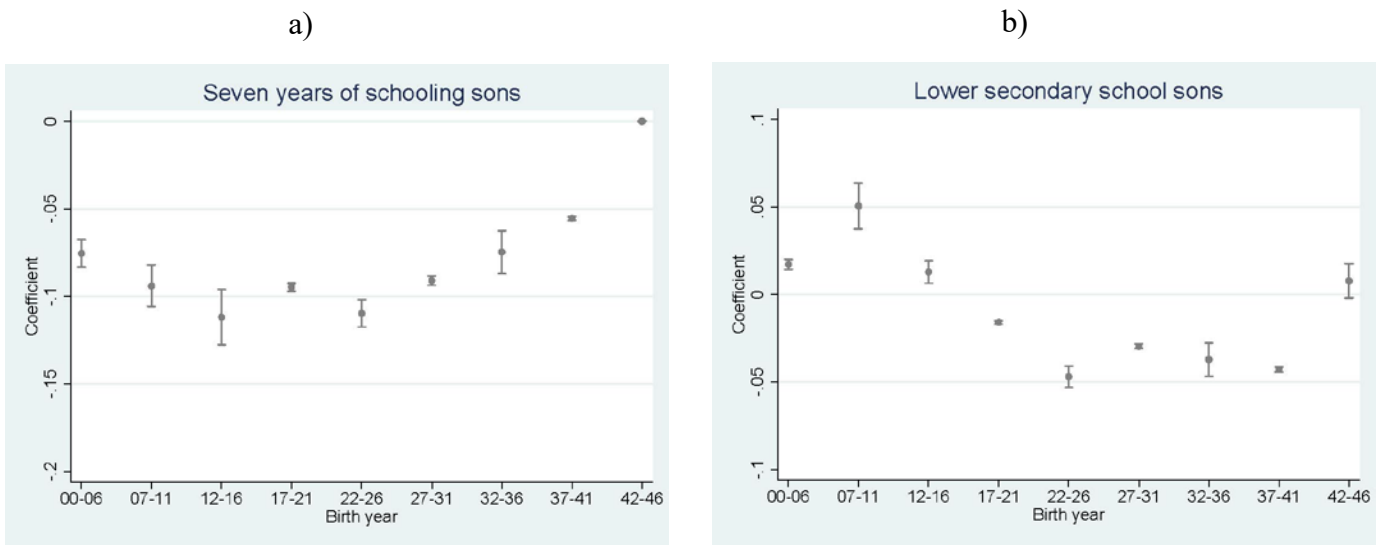


*Note: Regression of the share of sons attaining different levels of education on fathers' years of education. Coefficients are given in a 95% confidence interval.*

These figures give us insight into how important fathers' education are for sons' educational attainment as specific margins of the schooling distribution.

As for children with seven years of schooling in the left panel, the coefficient is negative for all cohorts expect the last one when its 0. Thus, increasing the years of father's education, we would expect a marginal decrease in the share attaining seven years of schooling. This coefficient increasing in size over the next two cohorts, would indicate that the share of sons having seven years of schooling is first decreasing among higher educated fathers. While the turn around mid-1920s would suggest that the sons of lower educated parents are catching up on the decreasing trend in share attaining seven years. Thus, the trend toward zero for the youngest cohorts is due to less and less people overall attains only primary school.

If we look at attainment of lower secondary school, we see an interesting effect for the first half of our period. Up until 1916, the marginal effect of having a higher educated father is positive, suggesting that sons of highly educated fathers are the first to increase their mobility into lower secondary attainment. Thereafter, the decreasing trend suggests that sons of father's with lower education is catching up. Shifting from positive to negative around 1915 means that after 1915, increasing father's education would decrease the share who goes out of school

with lower secondary education. This is due to increased shares at lower education for sons of fathers with primary school, as well as decreased shares of lower secondary for sons of fathers with above primary school education. At this level, we also see a jump to zero for the last cohort. Potential causes for this jump are that both sons of primary educated fathers and lower secondary educated fathers (the two largest groups), attain an equal share of lower secondary schooling.

We have done the same exercise for sons of fathers with high school, college and university level education, and plotted the resulting plots below. At all of these levels, there's a positive relationship between the share of sons attaining the given educational level, and father's education level. For those born in the early 1900s, the coefficient is about equal across all three educational levels, at about 0.1. That is increasing father's years of education by one year, one would expect a 10-percentage point increase in the share who attains high school, college and university. However, by the end of our period, we see that for high school, the relationship is close to zero, essentially meaning that there's close to no relationship between fathers' education levels and the share of sons who attain high school level education. For sons of college educated fathers, the trend is downward sloping, however, there's still a substantial benefit of having a higher educated father.

**Figure 7:** Relationship between the share of sons who attains primary and lower secondary school and fathers' years of education

a)

b)
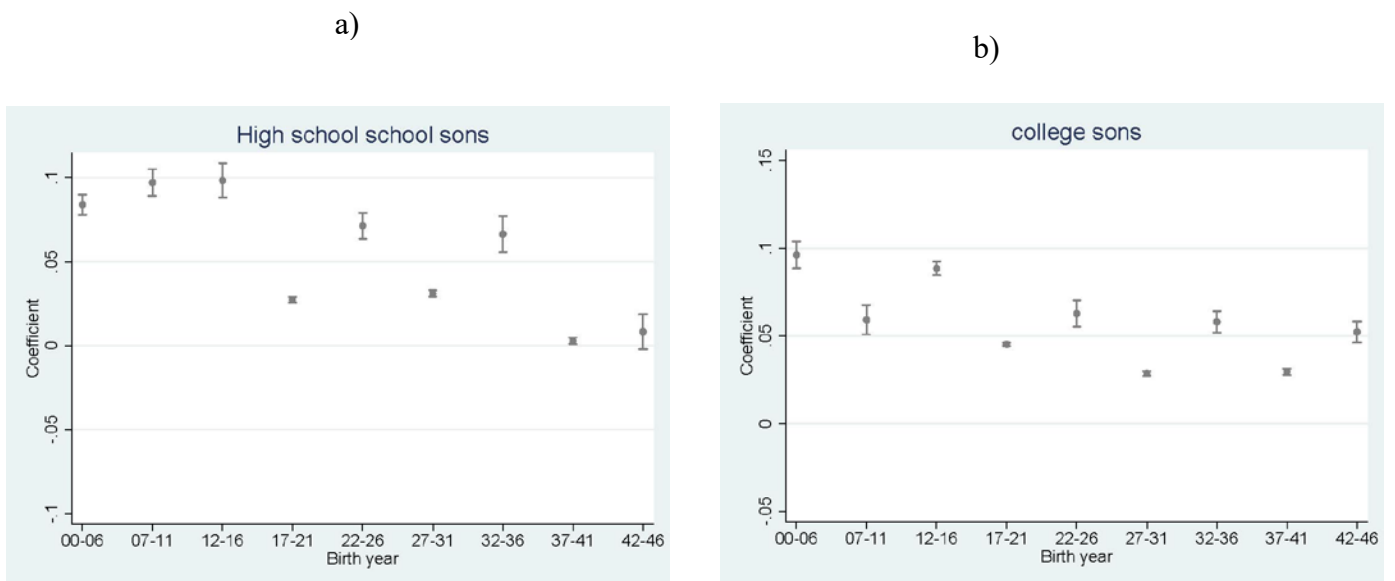
c)
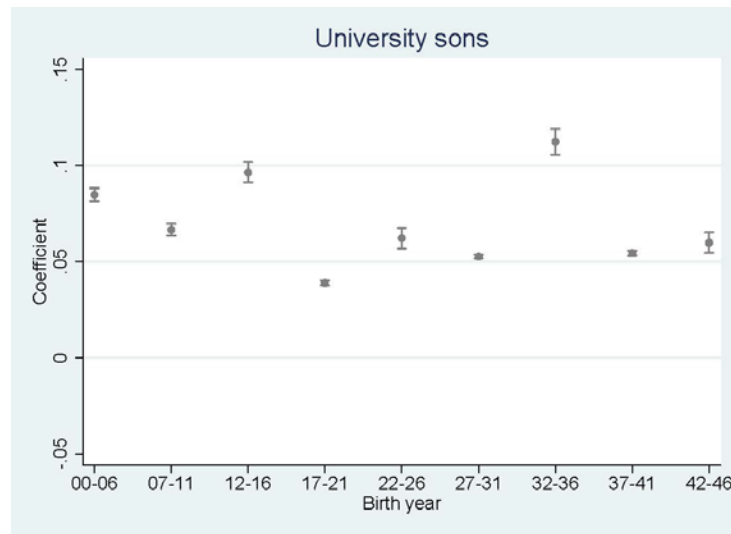


*Note: Regression of the share of sons attaining different levels of education on fathers' years of education. Coefficients are given in a 95% confidence interval.*

At the university level, we see no clear trend over the period. There looks to be a decreasing trend over the first 20 years, however stabilizing at a relatively high positive level for the rest of our period.

The interesting takeaways from these plots are first of all that the importance of having a higher educated father in terms of attaining high school and college level education is decreasing over our period. Furthermore, the mobility into high school seems to start earlier than the intergenerational mobility into college. For high school, we actually see close to no relationship between father's education and sons share of attaining high school for the two last cohorts. Meaning increased mobility into high school from sons of lower educated fathers. We also see an increase of mobility into college level from lower educated fathers, however, there's still a persistence between having a higher educated father and attaining college. At the university level, we see no signs of any increased mobility. These figures thus indicated that the increase in intergenerational mobility over our period, is related to the diminishing importance of father's education in the share of sons who attain high school levels and below. In addition, to a decreasing importance of father's education on the share of sons who attain college level education.

## 6.3  Potential underlying mechanisms

As we described in chapter 2, there are several different channels that creates and upholds persistence between parent and child. The educational system is one of the main mechanisms through which persistence is created, however, its thus also one of the mechanisms through which persistence is broken down. Above, I demonstrated that during the first half of the 20th century, the Norwegian society saw a remarkable drop in educational persistence, especially between the 1930s and 1940s. In this section I will delve into some of the potential underlying causes for this drop. In line with the human capital model from chapter two, we separate between three related mechanisms that affects educational persistence: (1) Governmental interventions, (2) Financial constraints, and (3) Job market effects.

### 6.3.1  Governmental interventions

Relating to the human capital model in chapter two, there are several ways in which governmental interventions might affect persistence in educational attainment. First of all, they can increase mandatory years of schooling, which can be understood as increased marginal returns to schooling (or more directly as increased marginal cost of not investing). They can affect information flows and cultural values, such that parents are aware of the returns of investing in schooling. Another important aspect is that they can, through public investments, directly affect the transaction costs of going to school, however I will discuss this mechanism under the role of financial constraints.

The increase in intergenerational mobility coincides with several big changes in societal structures conducted in Norway during the 1930s and onwards. A key political term in the period were equality, especially in relation to education. There were at this point in time, large differences between the schooling system between urban and rural areas. In the cities, the typical school year lasted 42 weeks, while in some rural areas the number of weeks were as low as 12. This discrepancy in educational possibilities based on geography, were thus one of the important areas to reform in order to seek equality of opportunity. The Norwegian Primary Education law were passed in 1936, and fully implemented by 1941. This reform increased

the number of mandatory weeks of primary school, especially for rural areas, and thus continued the process of converging the Norwegian education system between rural and urban areas. A second important change in regard to the reform were that of a new structure in secondary school, compromising two years of preparatory lower secondary school ("Realskolen"), and three years upper secondary school ("Gymnas"). After two years of lower secondary, they had the choice of either continuing on upper secondary or finish a third lower secondary year in order to graduate from lower secondary school. (Telhaug, 1986). The main takeaway from this new structure were the consolidation between cities and rural areas. In an analysis of this reform, Salvanes et. al. (2018) estimates an increase of 0.396 years of education for men associated with the reform. Thus, indicating that one of the mechanisms driving the increased mobility is the 1936 school reform.

Another aspect of the educational system is that in both rural and urban areas lower secondary school were divided into two tracks. The middle school ("Middelskolen") and continuation schools; a one- or two-year mix of theoretical and practical school. This continuation school had for a long time been in a part of the education system, however, it grew in importance during the 1940s in relation to the Continuation School law from 1947. In 1945, there were 358 continuation schools in Norway, however, by 1950 the number had increased three-fold to 1 130 schools (SSB, 1978). The continuation schools varied across municipalities both in duration and content. The Continuation school law made it possible for municipalities to make continuation schools mandatory for student who do not enroll in lower secondary school (Dokka, 1972). Hence, increased enrollment into continuation schools can partly explain why sons of lower educated father started to attain more education in the 1940s.

Another aspect of structural changes in the first part of the 1900s was the increase in public education beyond primary school. In 1890, 55% of the student enrolled in education above primary school (Høgre allmennskole) attended private schools. By 1940, this share was down to 4.5%, mostly due to large expansions of the public schools (Telhaug, 1986). This increasing role of government funded educational expansions is likely to have played a part in the increasing intake of sons from all social stratifications, thus leading to higher intergenerational mobility. Furthermore, one could also argue that with the increase of public schools at the intermediate educational levels (lower secondary and high school), political agendas, such as increases geographical equality, would play a more dominant part of the education system.

Overall, there are some indications that governmental interactions played some part in the increased intergenerational mobility during the first half of the 1900s.

## 6.3.2 The role of credit constraints

Another potential driving force behind the increased intergenerational mobility for those born in the early 1940s is changes relating to credit constraints. As described earlier, one of the three broad mechanisms behind persistence in educational attainment across generations is credit constraint, which might lead to underinvestment in human capital by poorer families. In order to investigate the role of credit constraint, I will use the extensive information available in the Norwegian occupational life history survey from 1971. Hence, I will only look at cohorts born in 1921, 1931 and 1941.

As mentioned earlier, the first half of the 20th century also witnessed large changes in terms of the general welfare level in Norway, with the GDP per capita doubling between 1920 and 1950. In our dataset we have reports from respondents describing the economic conditions growing up. From this variable, we have that for those born in 1921 to a father with seven years of schooling, 18% describes their economy as very poor, while 43% described it as barely sustainable. For those born 20 years later to fathers with seven years of schooling, this percentage was down to 2.5% and 25% respectively. Some of these high percentages are exaggerated due to the economic crisis in the late 1920s/early 1930s. However, these numbers indicate that fathers with seven years of schooling in the early 1900s constitutes as vastly different group than the fathers with seven years of schooling 40 years later in relation to economic conditions.

In the figures below, I plot educational attainment shares for sons growing up under different (subjective) economic conditions.

**Figure 8:** Share attaining specific levels of education, by economic conditions growing up

a)



b)



c)



d)
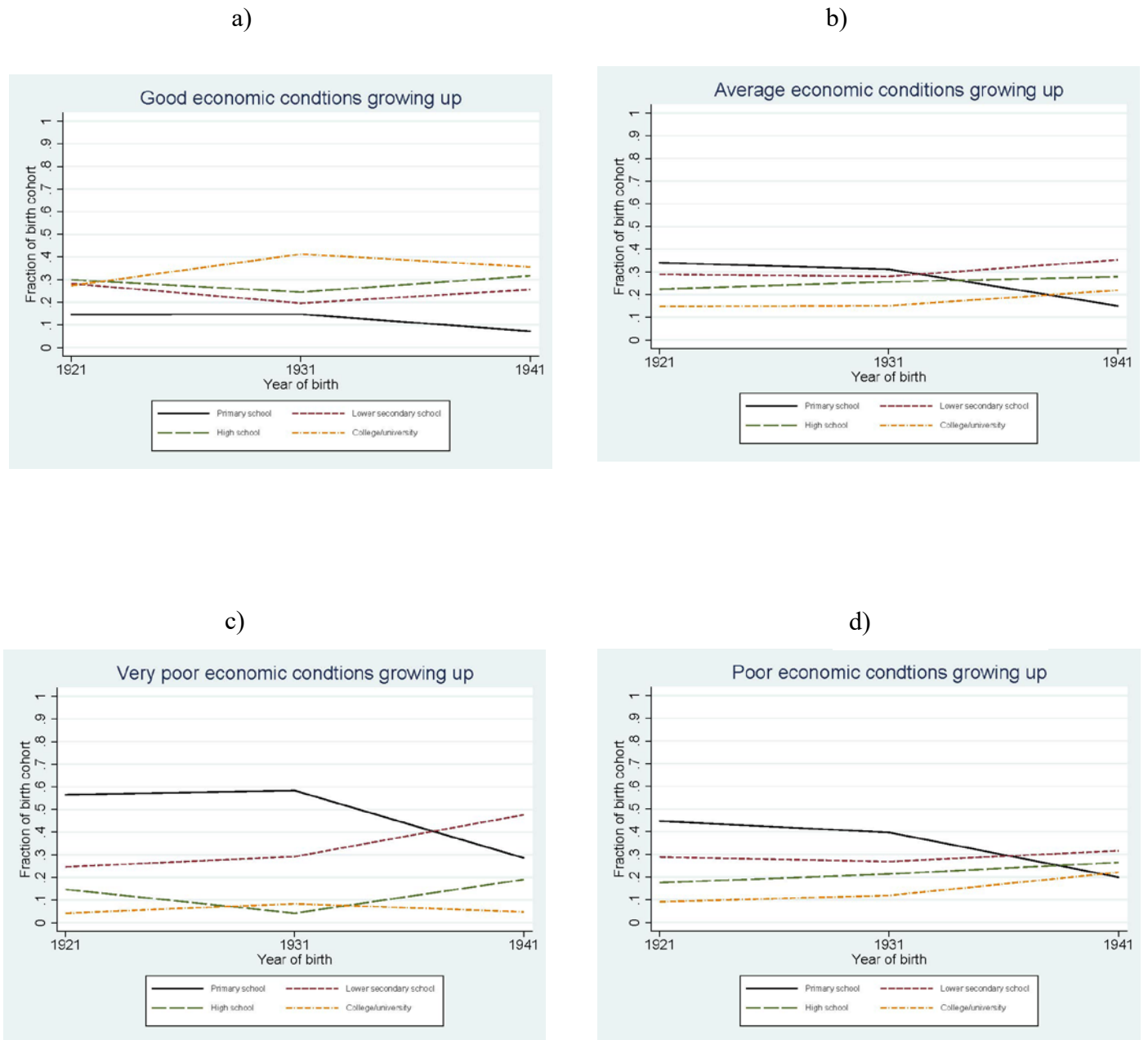


From these figures, we see that educational attainment varies massively over economic conditions. For those who grew up in the 1920s and reported very poor economic conditions, close to 60% attained no more than seven years of schooling. On the other hand, for those who reported good or very good economic conditions, only 14% went out of school after seven years. In addition, there's a clear relationship between father's years of education and economic conditions. 86% of those who reported very poor, and 73% of those who reported poor conditions, had fathers with only seven years of schooling, while fathers with seven years

of schooling constitutes 64% of the overall sample. Moreover, 86% of those who had a father with college or university education reported average or good economic conditions. A potential cause of increased intergenerational mobility is thus improved economic conditions, which removes credit constraints and thus potentially underinvestment in children's years of schooling.

An interesting takeaway from the figure above, is how similar the trend is across all backgrounds. The share of sons in primary school differs in level, however the trend is identical. The first two birth cohorts show similar shares of sons in primary school and is reduced by 50% between the two last cohorts. Based on this, one can argue that a large part of the increase in educational attainment during the 1930s and 1940s is related to the national education reforms in the 1930s. If there's was some other explanation, for example related to financial constraint or changing occupational composition, one wouldn't expect to see a similar drop across all economic backgrounds. Hence, the upward mobility effect of sons of fathers with primary school attaining more school seems to be driven by increased political factors.

**Figure 9:** Average years of education for sons of father with seven years of education, by economic conditions growing up
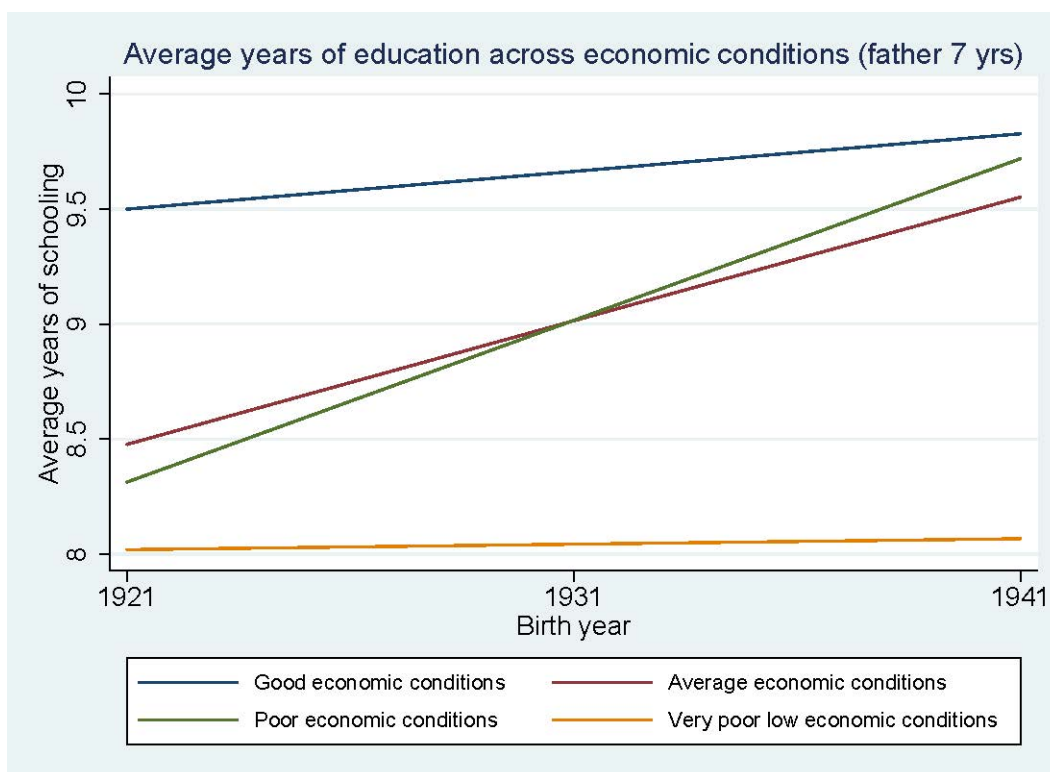
To delve further into the role of credit constraints, I restrict my analysis to sons of fathers with only primary school. In figure 9 I plot the average years of education for sons of fathers with seven years of schooling, across economic conditions.

First of all, we see that in 1931, there are substantial differences across economic conditions. Sons of fathers with seven years of schooling who grew up under good economic conditions, the average years of schooling were 9.5 years. On the other hand, it's between 8 and 8.5 for the other groups. Interestingly, we see a convergence in average years of education for all expect those who grew up under very poor conditions.

In figure 10 below, I look beyond the average years of education, and see where in the educational distribution the changes arise.

**Figure 10:** Share of sons of fathers with seven years of schooling who attains specific educational levels, by economic conditions growing up

a)                                                                b)

c)                                                                          d)
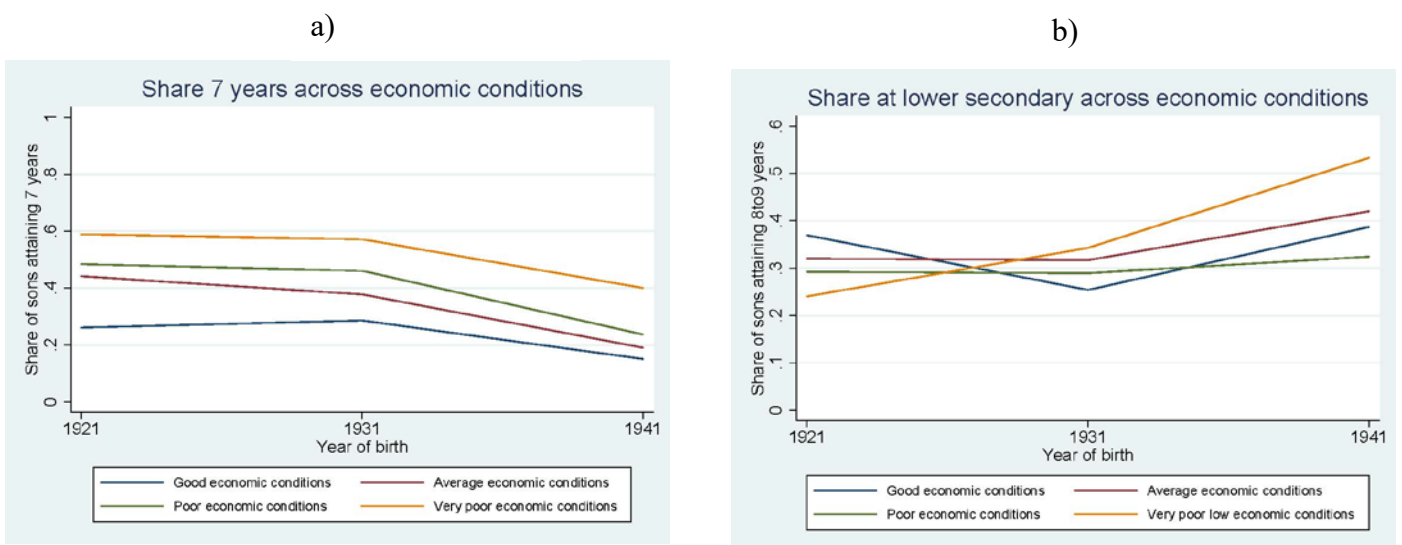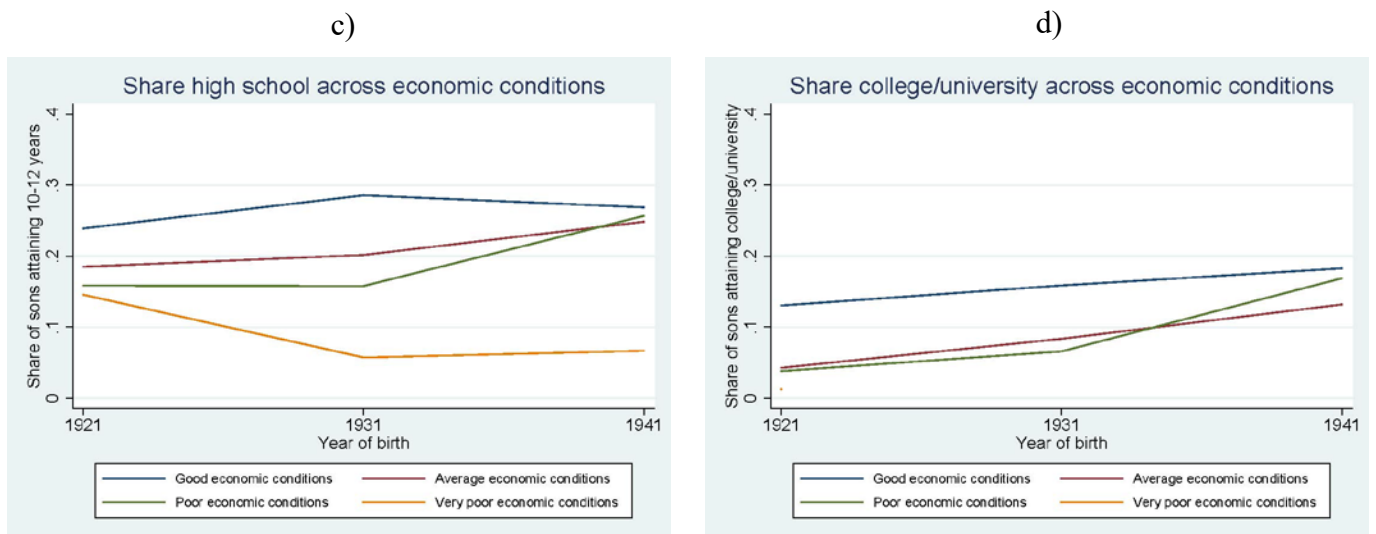


As figure 9 indicated, there are remarkable differences based on economic conditions. In figure 10a) we have that for sons of fathers with seven years who grew up under very poor economic conditions in the 1920s, 60% attained seven years of schooling. However, for sons of fathers with seven years of schooling who grew up under good economic conditions, only 30% attained seven years of education. Furthermore, we have a clear converging in shares who attain seven years for every group except those who report very poor economic conditions.

The pattern of convergence is seen at all educational level, except lower secondary, for sons who grew up under good, average and poor economic conditions. These figures thus indicate that the role of credit constraint plays a smaller and smaller part for everyone except those at the lowest economical margin. Hence, the fact that the share attaining college and university degree increased faster for sons of poorer fathers with seven years of education, than for sons of richer, points in the direction of increased educational investments in sons, who, if born 20 years earlier, would be underinvested in. The question thus remain in what way are sons from poor families less credit constrained in 1941 than in 1921?

There are several possible answers to this. One is that sons who reported poor economic conditions in 1941 actually experienced better economic conditions in absolute terms than those born 20 years earlier. However, because of the general welfare increase, they would see themselves as poor compared to others. Another possibility is that of increased public spending on education, thus reducing the transaction costs related to educational attainment. A third argument is that of direct lending through public lending agencies. In relation to this, an

interesting aspect is the establishing of the Norwegian public lending agency for students ("Lånekassen") in 1947. If we continue to concentrate on sons of fathers with seven years of schooling, we find some interesting trends in relation to the public lending agency. Those born in 1931 were 16 years when Lånekassen was established, thus being able to borrow money from the public throughout their higher education. However, there was restrictions on which kinds of educational activity that were eligible for a loan in Lånekassen. In 1947, its was restricted to colleges and universities. In 1950, it was expanded to include technical vocational schools ("Tekniske skoler"), before it in 1957 were expanded to be eligible for close to all forms of post-high school education (Telhaug, 1986). Thus, the 1957 expansions align with when our youngest cohort is 16 years, while the 1931-cohort is 26 years. I will now focus on sons who reported good, average or poor economic conditions growing up, as these are the only groups who attained college/university level education.

In figure 11, we see that for sons of primary educated fathers born in 1931, around 50% of those who attain college or university level education have a loan in Lånekassen. This share is equal irrespective of economic conditions growing up. However, in 1941, we see that among sons who grew up under good economic conditions, the share is still around 50%. However, for sons who grep up under poor or average economic conditions, around 70% had a loan through the public lending agency.

**Figure 11:** Share of sons of fathers with seven years of schooling who attain college or education level education and have a loan in the National Student Lending Agency
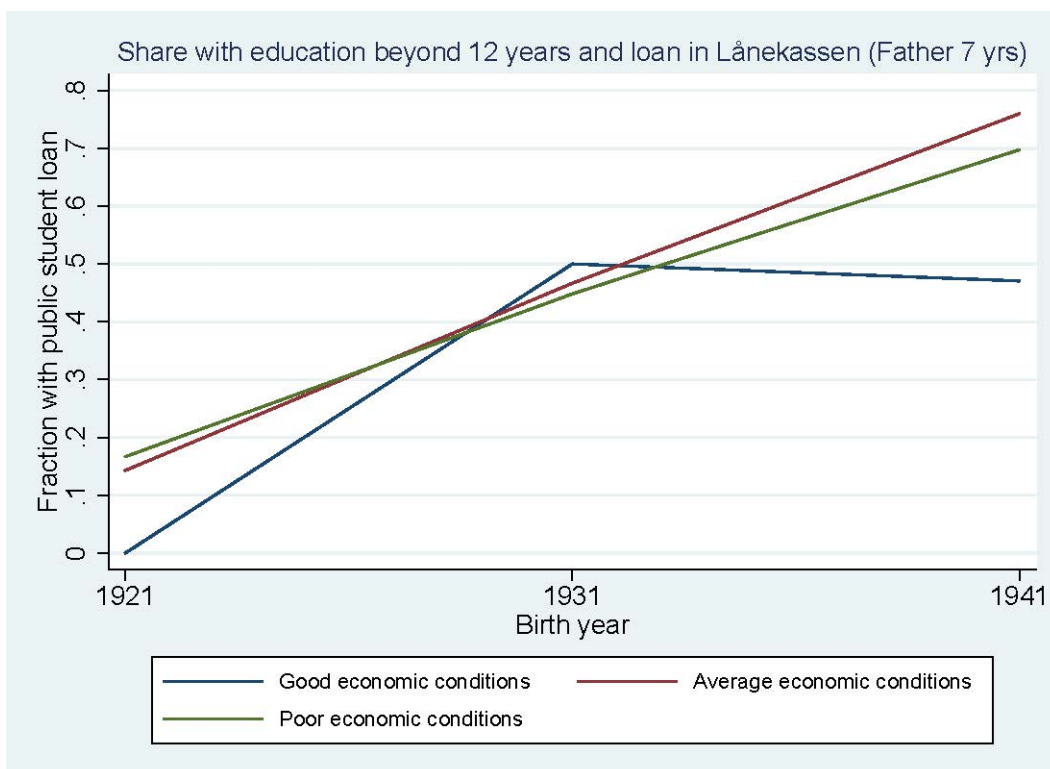
This indicated that there seems to be some association between relaxation of credit constraints through governmental interventions, and increased mobility into college and university. However, this is a purely descriptive association, an no claim of causality.

### 6.3.3  Job market effects

Another driving force behind increased education for sons of lower educated fathers, is what I've called job market effects. The job market is another important channel which affects persistence between parent and child, and there are several types of mechanisms related to occupations. One way of conceptualizing these effects is that they in some way or another affect the marginal returns of investing in education. If some new high productive occupations arise and demand specialized knowledge, this would increase the marginal returns of investing in that particular kind of knowledge. Leading to increased investment from parents into their children's human capital through education. Thus, there's an increased incentive to continue schooling beyond primary school for children who previously found it optimal to leave school after seven years and continue to a (in this case relatively low productive) occupation. A third mechanisms would be pure demand effects. If for some reason there's a large increase in the demand for specialized occupations, for example due to the discovery of oil, one would except mobility into these occupations from all social levels. Thus, providing increased mobility in occupations due to son ending up in different occupations than their fathers, and in education as these new occupations demand specific skills.

Another example is that the demands for education rises within a given occupation. A good example is that of the education of teachers, which increase from 2 years to 3 years in the early 1900s, before rising to 4 years around 1930. This example also illustrates the different perspectives on intergenerational mobility given by education and occupations. One would expect increasing educational requirements in the education of teachers to lead to intergenerational mobility in education, even though there's no changes in the intergenerational mobility in occupations. In this section, I will analyze the possibility of job market effects as a driving force behind increased intergenerational mobility in education. This analysis will continue in the next chapter, where I'll look at intergenerational mobility in occupations in general.

In the figure below, I've split educational attainment into general education (primary school, lower secondary school and high school) and vocational education (Including college and university). We exclude survey 2, as this survey doesn't directly divide between general and vocational education. On the y-axis we have the mean level of education above 7 years in red, and the mean years of vocational training above general education in blue.

**Figure 12:** Mean years of general education beyond seven years vs mean years of vocational education beyond general education, by fathers' education level

a)



b)



c)



d)
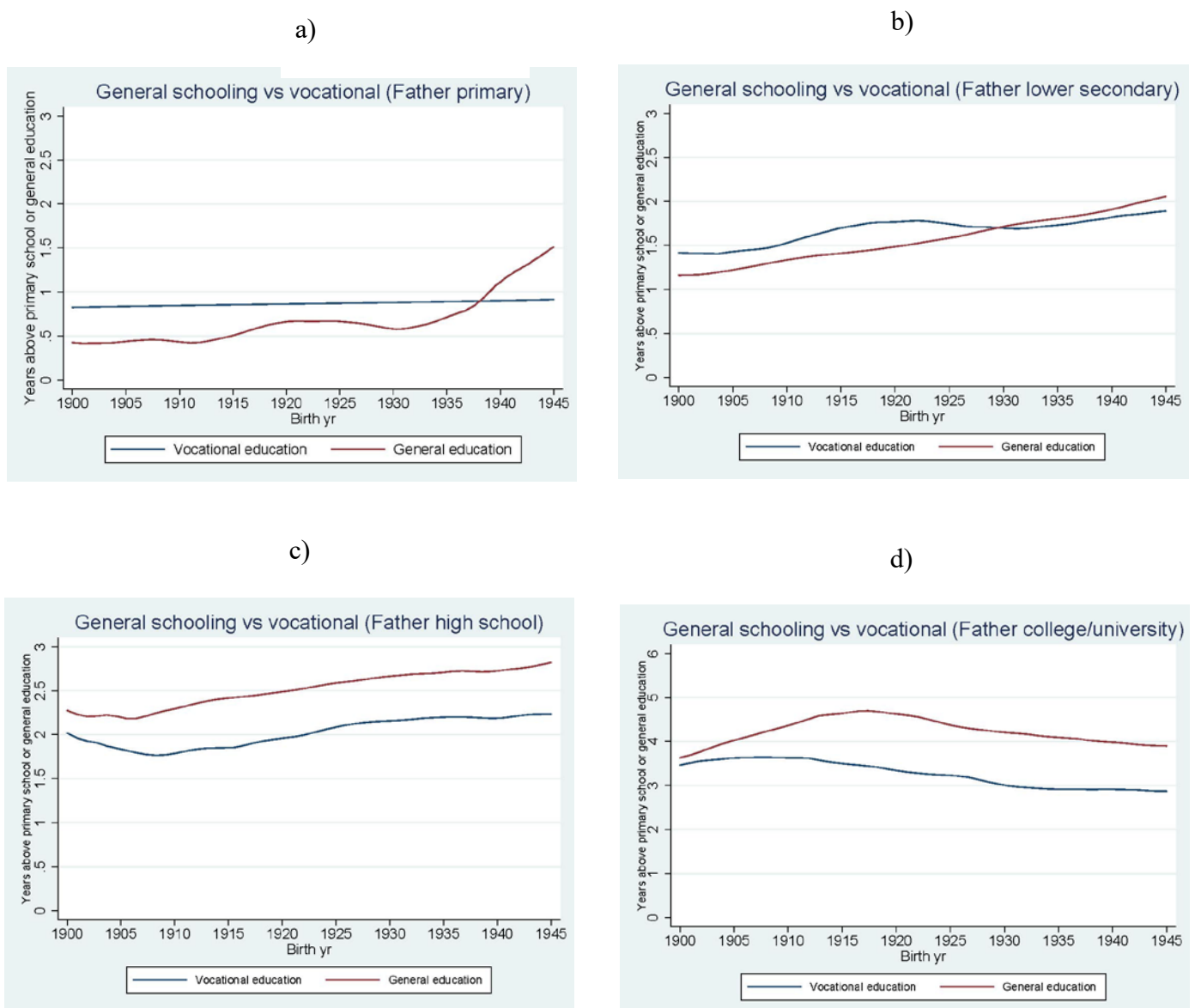
In figure 12a), we see educational attainment at general and vocational level for sons of fathers with seven years of education. We clearly see that the increase in educational attainment is driven by higher levels of general education, rather than increasing duration of vocational education.  For sons of father in lower secondary, we see an increase in both general and vocational education, however the increase in general education is about twice as large. Interestingly, the trends in general and vocational education is about equal for both sons of high school educated and college/university educated fathers. However, for sons of college and university educated fathers, the earliest years are dominated by increasing levels of general education, before we see a steady decline in both general and vocational education from 1915 and onwards.

An interesting aspect of these graphs is the trends of increasing attainment of general education. For sons of fathers with seven years of education, the trend is seemingly constant for the first 30 years, before we see a sharp increase beginning in the early 1930s. While for sons of fathers who have more than seven years of schooling, we see a steady increasing trend over the entire period, except for sons of fathers with college or university level where we see at decreasing trend over the last period.

For sons of fathers with educational below college and university, we see increasing trends in both attainment of general education and vocational education, however the increase in general education is larger for all of the three groups. Thus, there's no evidence for the argument that increasing educational attainment for sons of fathers with seven years of education is driven by recruitment into occupations that demand higher levels of vocational education. However, there might still be the case where new occupational demands are related to higher levels of general education, a good example being white-collar jobs preferring high school educated over lower secondary educated.

Another argument relating to job market is that of selection effects. As the general level of education expands in the society, one might argue that the use of education as a selection mechanism increases in importance. For example, if the educational system is weak in rural places, employers are unable to distinguish between two types of job seekers. The first is that of high ability individuals with low educational attainment because of a lack of possibilities. The other, are low ability individuals who lack in ability, and wouldn't find it optimal to attain education even though there are possibilities. However, as the educational system expands, the first type become more visible, thus education becomes a more valid selection mechanism on abilities. Hence, we would get the scenario where people with lower levels of general education would be neglected by employers, thus incentivizing everyone to attain higher levels of general education.

In the three last sections, we've looked at three different broad mechanisms that might explain the increase in intergenerational mobility in education. All of these mechanisms are related and are probably all involved in explaining the increased mobility over the first half of the 20th century. In the next chapter, I will consider another perspective on changes in intergenerational persistence by looking at occupations. This will broaden the picture of intergenerational mobility over the 20th century and provide valuable information both on its own and in relation to intergenerational mobility in education.

# 7. Intergenerational mobility in occupations

Beginning in the late 19th-century an onwards, the Norwegian society went through remarkable changes when it comes to the occupational distribution among its population, especially in relation to the industrialization beginning in the late 1800s.

Figure 13 shows the evolution in occupational distribution for men born between 1900 and 1945. We see that for men born in 1900, 35% of them ended up working in semi-skilled/skilled manual jobs. Around 24% ended up working in white-collar jobs, 20% as farmers, and 20% ended up in unskilled manual jobs. 45 years later, the share who ended up as farmers and unskilled manual workers decreased to 5 and 10 percent respectively. While around 85% ended up in either white-collar or skilled manual jobs. Throughout the entire period, we see that the share of both farmers and unskilled manual workers declines steadily. Skilled manual workers increased substantially between the 1900 and 1910-cohorts and stays at this level for later cohorts. Thus, we see that turning point in the shift from secondary to the tertiary sector seems to be cohorts born around 1910. For this cohort, the general increase in skilled manual jobs starts to stabilize, while the share of men in white-collar jobs starts to increase. Hence, up until the 1910-cohort, we have a shift from farming and unskilled manual jobs to skilled manual and manufacturing jobs, while for younger cohorts, we see that the decrease in farmers and unskilled workers are offset by increases in white-collar workers.

**Figure 13:** Evolution of occupational distribution over the first half of the 20th century
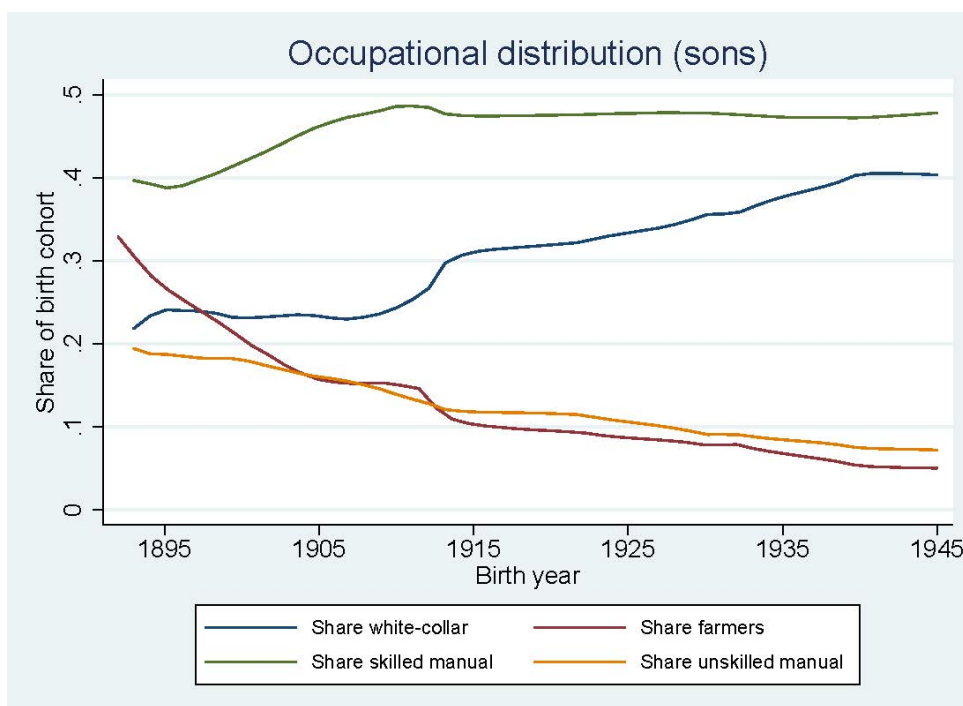
This increase illustrates the second wave of industrialization in Norway, which started around 1905 with the utilization of water power for chemical industries. Throughout the entire period we see an increasing trend in the share of men working in white-collar jobs, which together with the decline in skilled manual workers illustrates the sectoral shift from the secondary to the tertiary sector of the economy. Interestingly, we also see a sharp increase in the share of white-collar workers born in 1914. These cohorts would enter the work force in the 1930s-1940s, which coincides with large increases in education attainment as seen in the previous chapter.
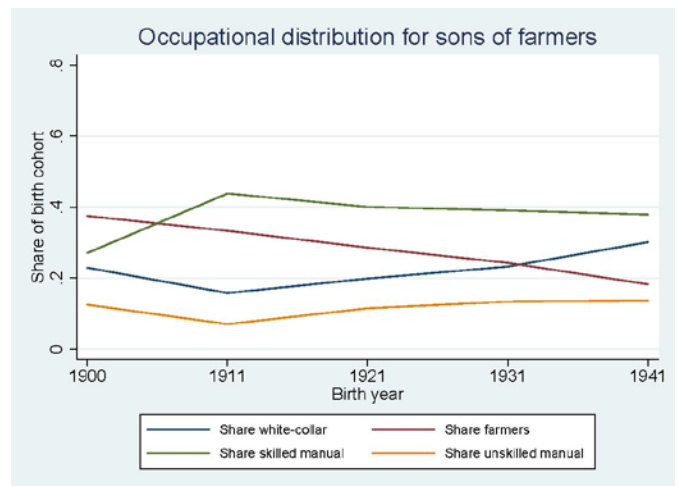
### 7.1.1 Transition probabilities

A first measure of the degree of intergenerational occupational mobility in the Norwegian society is to look at transition probabilities. This measurement helps us answer questions such as, are the son of a farmer more or less likely to themselves become farmers as the 20th century progresses?

**Figure 14:** Evolution of occupational distribution by fathers' occupational class
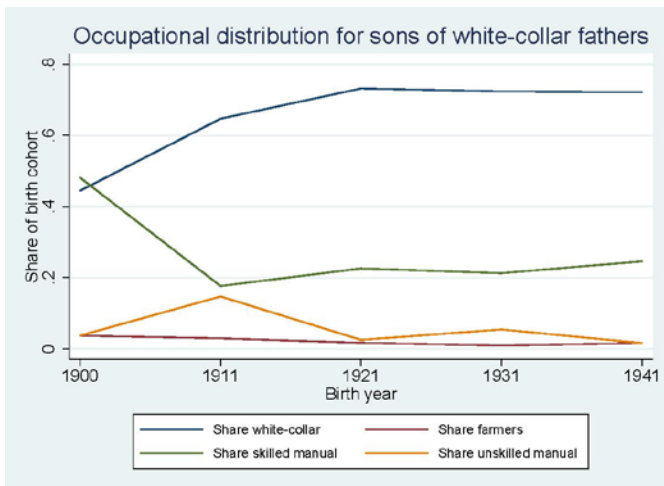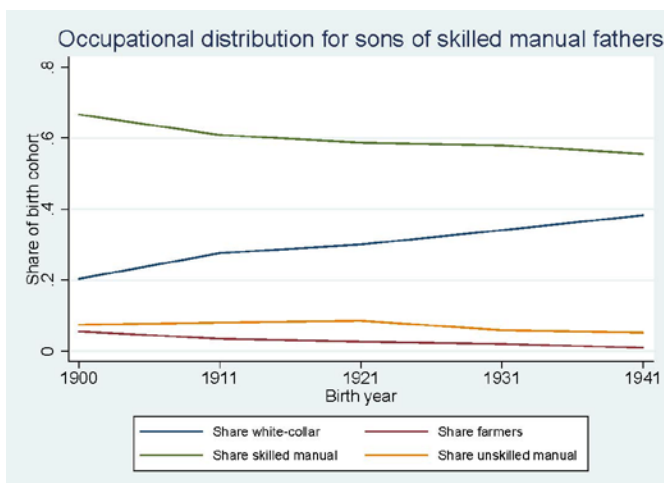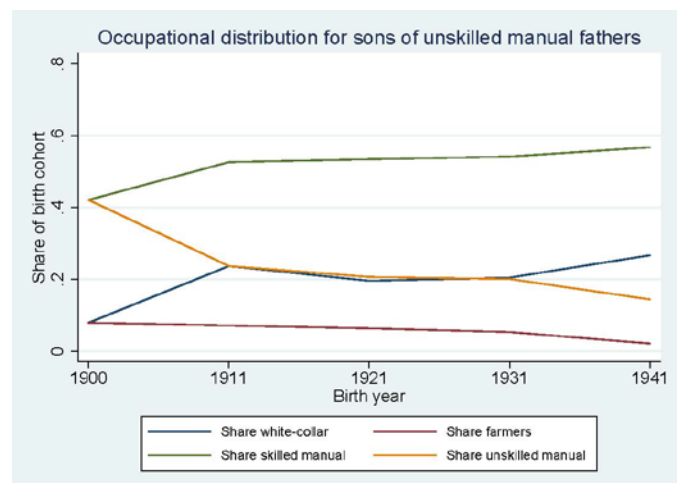
a)            b)

c)            d)

Figure 14 shows the transition probabilities for sons of fathers in different occupational classes. 14a) tells us that for most of our period, the probability of ending up in a white-collar occupation given that your father was a white-collar worker, is around 70%. This probability was around 50% for cohorts born between 1900 and 1910, and stabilizing at 60 to 70 percent from the 1911-cohort and onwards. Thus, there's a clear persistence in occupational class between fathers and sons in white-collar occupations. We also see that the share of white-collar sons who enter farmer or unskilled manual work is decreasing the entire period, however, it remains low for the entire period. Interestingly, this figure indicates that the sharp increase in white-collar occupations between the first two cohorts coincides with a similar decrease in the share of sons of white-collar workers who enters skilled manual jobs. This runs contrary to the main trend for the first half of our period, when there's a large increase in skilled manual workers.

In the upper-right panel, we have the occupational distribution for sons of farmers. We see that the share of farmer sons who themselves becomes farmers are steadily decreasing the entire period. For the oldest cohorts, this decline is countered by increased probabilities of becoming skilled manual workers. However, from the 1911/1920-cohort and onwards we see that sons of farmers increasingly ends up in white-collar jobs.

For sons of skilled manual workers, we see a clear trend in sons ending up in the same occupational sector as their father. For the 1900/1910-cohorts we see that close to 70% themselves end up in skilled manual occupations. This persistence is decreasing over time, however, is still as high as 50% in for those born between 1941 and 1945. We also see that the share of white-collar workers is also increasing throughout the period for this group as well.

In the lower-right panel, we have the transition probabilities for sons of unskilled manual workers. The trends here mimics much of the other groups, where we have increasing probabilities of entering skilled manual jobs and white-collar jobs and decreasing probabilities of entering farming or unskilled manual jobs.

We see that for all occupational groups expect white-collar occupations, the trend is decreasing persistence in occupational choice of sons and fathers. For sons of farmers and unskilled manual workers, this decreasing persistence is offset by a larger and larger share of these sons working in skilled manual or white-collar jobs. Similarly, there's a remarkable large share of sons of skilled manual workers who enters the same occupations as their father. However, this

share is decreasing over the entire period, and offset by more and more sons entering white-collar jobs. On the one hand, this picture reflects a story of less persistence in occupational choice between fathers and sons. On the other hand, the trends also mirror society wide trends as the availability of different occupations varies over time. For example, a person entering the workforce post-industrialization has a different set of occupational choices in the skilled manual group, relative to a person entering the workforce pre-industrialization. Thus, the trends of less persistence don't necessarily mean increased mobility across occupations, as it can be due to a loss in the availability of farming jobs and an increase in the availability of skilled manual jobs. In order to take account of these changing availability, our second measure looks at the relative probability for sons of entering their father's occupation.

## 7.1.2 Two-way odds ratios

The second measure of intergenerational mobility in occupations is thus to look at two-way odds ratios. This measure looks at the probability that a son of a father with occupation i, has of entering occupation i, relative to the probability that a son of a father with occupation not-i, has of entering occupation i. In other terms, we look at the development of the "advantage" sons of fathers with the given occupation has of entering that occupation, relative to other sons. Thus, this is a measure of the degree of movements in and out of specific occupational groups, and the trend of these ratios tell us how this degree of mobility changes over time.

Figure 15 below show odds ratios-plot for all of the four occupational groups. For white-collar sons, we have that their advantage in terms of becoming a white-collar, relative to sons of fathers with non-white-collar occupations, is increasing for the first half of our period, before it decreases. For our oldest cohort, the son of a white-collar father is about $\exp(1.3) = 3.5$ times more likely to themselves end up in white-collar jobs, than sons of fathers with different occupations. This advantage increases to 8.5 times for the 1921/1930-cohort, before it decreases to about 5 times more likely for the youngest cohort. Thus, we have a decreasing mobility in terms of movement into white-collar jobs from sons of fathers in different occupations for men born in the first 30 years, with a sharp reversal during the next 15 years.

For sons of skilled manual workers, we see a decreasing trend throughout the entire period. As sons of skilled manual workers starts of by being 3 times more likely to themselves become manual skilled workers relative to sons of fathers in other occupational groups, this advantage has halved during our period to 1.5 times for the youngest cohort. We see a similar decreasing

trend for sons of unskilled manual workers, however, the advantage is higher for this group throughout the period. This means that throughout our period, there's an increasing share of movement into manual occupations, from sons of fathers outside manual occupations

**Figure 15:** Evolution of two-way odds ratios, by fathers' occupational class
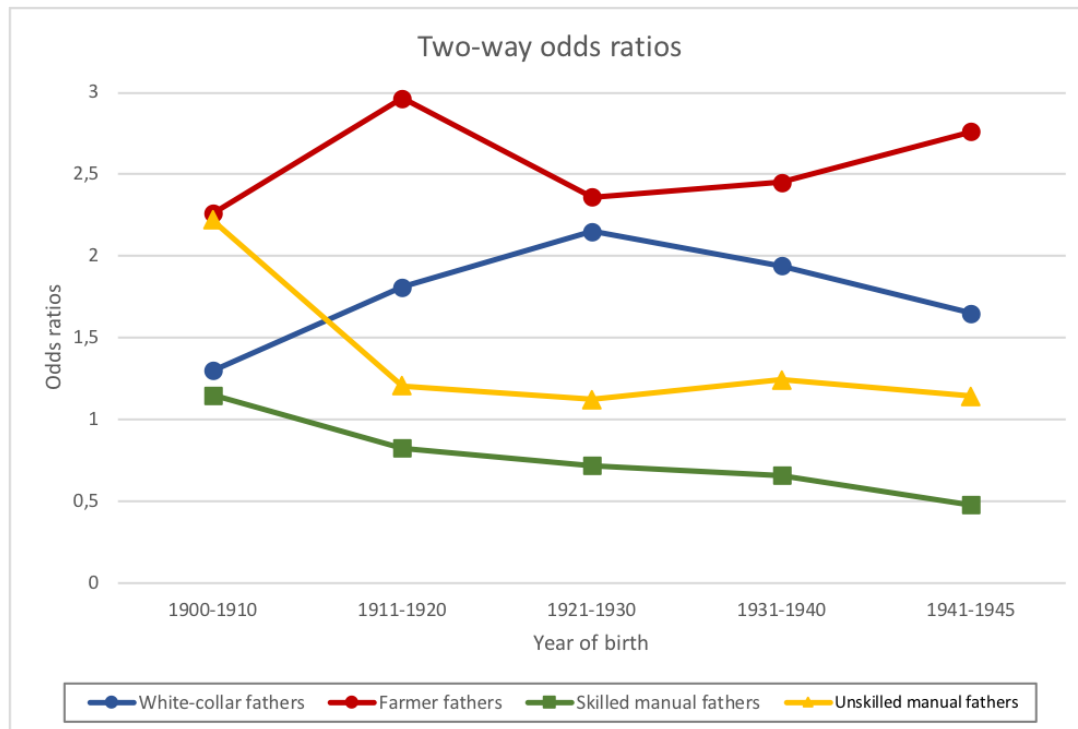


When we look at sons of farmers, it's clear that these sons have the greatest relative advantage in entering their fathers' occupation, starting off by being 9.5 times more likely to become farmers than sons of other occupational groups. By the youngest cohort, this have increase to an advantage of close to 16 times that of other groups. However, there's a less clear trend for the cohorts in between. Moreover, the overall trend seems to be less mobility into farming jobs during our period.

All in all, there seems to be increased mobility into unskilled and skilled manual occupations from sons of fathers from different occupations throughout our period. Indicating increased intergenerational mobility in occupations. For white-collar occupations, the first half of our period witness increasing persistence between fathers and sons, while the second half show increased mobility into this occupational class. Though this measure of relative mobility gives us valuable information, there's a drawback in at least one important area. Namely, it doesn't capture all information on mobility between groups. This measure incorporates how much of

an advantage a son of a white-collar worker has on entering white-collar occupations, relative to sons of all other occupations. However, it doesn't incorporate possible trends in the advantage a son of a skilled manual worker has of entering a white-collar job, relative to say a son of a farmer. That is, it's restricted to look at movements into and out of the diagonal of our 4x4 occupational matrix. In order to get a more nuanced picture of intergenerational mobility, we turn to calculating the Altham statistic. This statistic incorporates information from all 144 two-way odds ratios in the 4x4 matrix, and thus includes all forms of movement between occupations.

### 7.1.3 Altham statistic

In this section, I present the estimates of the Altham statistic for men born in the first half of the $20^{th}$ century. This statistic provides an overall measure of the mobility for the whole occupational distribution, by comparing the distance between the given occupational distribution and the matrix of perfect mobility.

As we can see from the column (1) in the table below, the Altham statistic is 22.12 for the first cohorts, and decreases to 20.52 for those born between 1925 and 1934, before it increases to 20.94 for the youngest cohort. Interestingly, we see a jump in intergenerational mobility between the two first cohorts. If we use the $\chi^2$- test proposed by Altham & Ferrie (2007), we get that the probability that the distance between the two first matrices is zero, equals 8.72%. Hence, we can conclude that the increase in intergenerational mobility between the two cohorts is significant at the 10%-level. Furthermore, none of the other changes are significantly different at any acceptable level.

**Table 3:** Estimates of Altham statistics

| Birth cohort | d | $d^n$ | $d^f$ |
| | (1) | (2) | (3) |
| --- | --- | --- | --- |
| 1900-1914 | 21.76*** | 14.85 | 15.90 |
| 1915-1924 | 20.70*** | 14.44 | 14.84 |
| 1925-1934 | 20.66*** | 13.30 | 15.81 |
| 1935-1944 | 20.87*** | 13.71 | 15.74 |

*Notes: (1) Altham statistic, whole set, (2) non-farm Altham statistic, (3) farm Altham statistic*

*\*\*\* = significantly different from 0 at the 1 percent level, using $\chi^2-test$ proposed by Altham & Ferrie (2007)*

Following these results, my analysis points in the direction of an increase in intergenerational occupational mobility for men born in the first 25 year of the 20th century, then flattens out for those born the next 20 years. However, it important to keep in mind that the size and structure of survey 2 affects the results. For birth cohort 1925-1934, we have that about 85% is born in 1931, while close to 2% are born in each of the other years.

In line with Modalsli (2017), I estimate a non-farm Altham statistic and a farm Altham statistic. This is a way of taking account of the potential biases that arises because specific occupational groups are given too much weight. As we saw in figure 15, there a large "advantage" for sons of farmer in becoming farmers themselves. This large persistence between fathers and sons in the farming sector, might drive up the persistence rate, even though farmers only constitute a small fraction of the economy (5% of sons in the youngest cohort ends up as farmers, compared to 14% for the oldest cohort).

From column (2) and (3) we see that there are different trends regarding the two statistics. For the non-farm Altham statistic, we see a clear increasing trend in intergenerational mobility for the three first cohorts, then a reversal for the last cohort. For the farm Altham statistic, the trend is more unclear. There's an increase in mobility between the two first cohorts, however this increase is completely reversed by the third cohort, where it seems to stabilize around its initial level for the youngest cohort. There's also a clear difference in levels for the two statistics, where the non-farm statistic shows a greater intergenerational mobility than the farm statistic. This is as expected, following the large persistence between fathers and sons in the farming sector above.

## 7.1.4 Comparison to other studies

These results are not directly comparable to those of Modalsli (2017) as I calculate occupational mobility at specific birth cohorts, while he looks at population wide mobility (men between 30 and 60 years) based on census data. However, by looking at the distribution of different age cohorts in the census data, I'm able to adjust my estimates in order to compare with other studies.

Two of Modalsli's estimates corresponds to our period, namely that of the 1910-1960-cohort and that of the 1960-1980-cohort. For the first estimate, Modalsli looks at the occupations of sons between the age of 30 and 60 in the 1960 population census, and pairs these with fathers' occupation in the 1910 population census. Thus, the sons are born between 1900 and 1930. Similarly, for the 1960-1980 estimate, he looks at sons born between 1920 and 1950. By looking at the population distribution for the 1960 and the 1980 census, we have that for the first period 47% where born between 1901 and 1915, 37% were born between 1916 and 1925, and 16% were born between 1926 and 1930. The adjusted Altham statistic is thus $21.3$[1]. We have conducted this exercise for all estimates, and report the comparison to other studies below

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[1] (=22.12*0.47 + 0.37*20.68 + 0.16*20.52)

**Table 4:** Comparison of Altham statistics

| Birth year (sons) | d | $d^n$ | $d^f$ |
|---|---|---|---|
| | (1) | (2) | (3) |
| **Our estimate** | | | |
| 1900-1930 | 21.2*** | 14.5 | 15.5 |
| 1920-1950 | 21.1*** | 14.1 | 15.9 |
| **Modalsli** | | | |
| 1900-1930 | 20.4*** | 15.5 | 13.3 |
| 1920-1950 | 22.3*** | 12.7 | 18.3 |
| **US** | | | |
| 1855-1880 | 14.6*** | 9.6 | 11.0 |
| 1927-1952 | 20.8*** | 8.5 | 18.9 |
| **UK** | | | |
| 1826-1851 | 22.7*** | 12.4 | 19.0 |
| 1927-1952 | 24.0*** | 10.7 | 21.5 |

*Note: Estimates are taken from Modalsli (2017). Birth year is based on sons between 30 and 60 years in Modalsli, and sons between 30 and 55 years in Long & Ferrie (2013).*

Overall, we see that our results are consistent with the previous estimates for Norwegian men born between 1900 and 1945. Interestingly, I find no evidence for any decrease in intergenerational mobility between the 1900/1930-cohort and the 1920/1950-cohort, as Modalsli does. This is probably due to my estimates of no trends in the non-farm and farm statistics. As one can from the table above, there are discrepancies between my estimates and Modalsli's estimates for column (2) and (3), however, the levels seem to be somewhat consistent. However, it's important to note that our results could be biased by the fact that the years 1921, 1931 and 1941 are given undue weights.

# 8.  Conclusion

Ever since the beginning of the formal schooling system in Norway there's been a widely held ideal of equality of educational opportunity. In the schooling act from 1739, its stated that the school *"shall unite all children independent of their parent's social position"* (Dokka, 1967). However, the degree to which this ideal has been satisfied since 1739 are open to debate. In this thesis I've looked at two different, but related, aspects of equality of opportunity, through the lens of intergenerational mobility for men born in the first half of the 20th century. My analysis show that for those born two hundred years after the formulation in 1739, great changes were made in terms of opening up the landscape of opportunity. Men born in the early 1930s and 1940s were raised up in a vastly different society than those born just 30 years earlier. The average education level had risen by two years, an increase that is mostly driven by children of lower educated fathers attaining more years of schooling. For sons of fathers with only primary school born in 1900, 60% attained no more than 7 years of schooling. For those born 40 years later this percentage was down to 11%. While the share with a college degree increased from 2.5% to 12%.

During most of the first half of the 1900s, the intergenerational coefficient on educational attainment lies between 0.67 and 0.75. This is a substantially larger level than what are known from Norway in the late 1900s, which typically lies between 0.3 and 0.4. However, in the span of 10 years between the early 1930s and the early 1940s, the IGE falls to about 0.44. We thus have that the relatively low levels of intergenerational mobility in educational attainment for Norway in modern times (at least compared to the early 1900s), were reached over a remarkably short time span. Any empirical investigation of the causes for this drop is beyond this thesis, however I've identified some potential underlying mechanisms. First, we find that much of the increase in mobility seem to be driven by increased upward mobility into lower secondary, high school and college by sons of lower educated fathers. The importance of having a higher educated father in terms of attaining high school almost disappears over our period, while the importance in relation to college education reduces. At the university level, there still seems to be of great importance whether or not your father is well educated.

Coinciding with the sharp increases in the level of general education, are several educational expansions, especially the reforms of higher education in 1935, reform on primary school in 1936 and the law on continuation school in 1947. There are also large increases in public educational spending in these years, especially in the years after WW2, together with the

establishment of better credit mechanisms, such as the Norwegian lending agency established in 1947. Along with these changes, we also see an increasing welfare level for most of the population. Another important aspect of the reduced persistence in educational attainment is related to the job market. We see large structural changes in the composition of occupations, mainly increased shares of skilled manual workers and white-collar workers. Interestingly, I find that both the educational and occupation perspective on intergenerational mobility show clear signs of increasing mobility during our period. For the educational perspective, the main increase was in the 1930s. However, for occupational mobility, the main increase was between the oldest cohorts. This increase mobility in occupations fits nicely with educational expansions, mainly reduction in the share who attain seven years of schooling between 1920.

This thesis delves into a partly unexplored terrain in looking at the early evolution of the persistence in education and occupations. Early indications are that those born in the mid-1900s seems to have been born somewhat "freer" than those born 50 years earlier, however the chains are still highly visible in certain areas, and much their complex innerworkings still to be uncovered.

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