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Educational segregation and the meaning of education to women in twentieth-century Sweden

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Abstract

This paper investigates educational segregation by gender in secondary and higher education and how it has changed over time in twentieth-century Sweden. An index of dissimilarity is constructed in order to measure educational segregation and plausible theoretical explanations are discussed as we try to explain women's educational choice and specialization in certain fields of study and why it still differs. The empirical data material used covers the major part of the twentieth century. A historical perspective enables us to identify the 1920s, 1940s, 1960s and 1970s and the 1990s as periods when desegregation occurred, mainly due to changes in relative attractiveness of different educational programs as well as in incentive structures, followed by a strong response among young women who, as a whole, have been more inclined to change their educational choice and orientation than have young men.

Introduction

Sweden is by many perceived as a country where equality rules and in international comparison it is often pictured a progressive paradise. High female labor force participation and the narrow gender wage gap are often cited as indicators of gender equality. However, gender inequality exists when it comes to education, work, and career and income development. The labor market is highly segregated by gender and the same goes for education, however less attention has been paid to the latter phenomenon. One field in which this is manifested is science and technology, which still is a field where gender as well as social differences persist. With the third industrial revolution and transformation into an information- and knowledge-oriented society, there is an apparent danger of such gender differentials and the exclusion of women due to their lower representation within prestigious and economically remunerative fields.

Several reasons justify the study of educational segregation. One is the concern for gender equality in the labor market since educational segregation perpetuates occupational segregation. Through educational segregation women and men follow different tracks, which affect their labor market opportunities. Segregation also has implications for the aggregate gender wage gap since women have a lower representation within fields that receive better pay and have better opportunities for advancement and career development. Another reason is that segregation eventually affects the working of the labor market as a whole negatively. Traditional attitudes internalizing a traditional gender division of labor and the coding of jobs, into feminine and masculine jobs suitable for women and men, may hinder employers from hiring the most skilled person. The strong coding of feminine and masculine knowledge and skills causes inflexibility because it reduces mobility between female and male jobs, which hampers economic efficiency.

This paper investigates educational segregation by gender. An index of dissimilarity is constructed in order to measure educational segregation, plausible theoretical explanations of segregation are discussed as we try to explain women's educational choice and specialization in certain fields of study and why it still differs from that of men. The data used derive mainly from aggregate educational statistics produced by Statistics Sweden. The importance of a

historical perspective is stressed since the study of time series covering rather long periods captures general and continuous development over time as well as discontinuities.

Educational segregation: previous research and theoretical considerations

Despite educational reform and explicit aim to increase equality in general during the entire post-war era, and gender equality in particular since the 1960s, the present situation can be characterized as follows. Gender differences in educational attainment are small in Sweden since they are more an issue of educational choice and specialization. Primary education, that is compulsory comprehensive school, is common to all throughout the country. However, secondary school, to which 98 per cent (in 2003) of all school-leavers make the transition, is highly gender segregated. A few theoretical programs, among which one is science, are gender neutral but in practice there is one female and one male branch of programs, especially when it comes to vocational education. A traditional gender division of labor is manifested in the students' educational choice as girls specialize in arts and caring, whereas boys specialize in crafts or technological programs (Stanfors, 2003: chapter 4 and 6). Since girls and boys make different educational choices in secondary school, their opportunities when it comes to higher education as well as to work and career are affected (cf. Bielby, 1978; Jacobs, 1986).

Although women's opportunities to pursue higher studies have been more restricted than men's, women have established themselves in higher education and ventured into male-dominated fields to a much larger extent than have men ventured into traditionally female-dominated fields. Over time gender equality has increased and today women make up more than 50 per cent of entrants in higher education. Women have also ventured into the male-dominated engineering programs and thereby into those traditionally male-dominated areas of the labor market that lead to better career and income opportunities. When it comes to increasing gender equality, it is worth noting that science and technology show two different patterns of development over time with science becoming more equal than technology. An increasing number of women is masked by a persistently low proportion of women, as men to a high degree continue to go on to science and technology, especially to engineering. A gender division of knowledge and labor is also manifested *within* the field of science and technology with women and men unequally distributed over scientific and technological programs and subjects.

From a historical perspective it can be inferred that change, when it comes to gender differences in educational attainment as well as in educational choice, has not been even and continuous, but rather confined to certain periods of change characterized by transformation and reform (Stanfors, 2003). Change in gender differences in education is closely related to general economic and social change. The 1920s, the post-war 1940s, the 1960s and 1970s as well as the 1990s can be identified as important periods of change. During these periods, Swedish women, more than men, responded to economic as well as institutional and social change and changed their education and labor market behavior and ventured into new subjects, new sectors and more qualified positions as gender relations and the meaning of gender and subject changed. In some cases desegregation led to gender equalization and in some cases it led to re-segregation. Although the advancement of women in science and technology is slow but persistent and women, since the late 1980s, have become increasingly interested in these subjects, they are still male projects and the last bastion of men in education and the labor market.

It may be noted that throughout the debates preceding educational reform in twentieth-century Sweden, issues of class appear much more often than gender in discussions of equity and efficiency, and in discussions of links between education and the labor market and economic development. There is a general tendency for educational reform to be oriented toward and relevant to male education than to female education, with far more concern for changing demand and supply conditions in traditionally male parts of the labor market (Jönsson, 1992:64).

Although there no longer are any formal bars, educational choice still differs and there is a tendency for students to follow educational programs on the basis of gender stereotypes, which lead to conventional female and male occupations. It is not clear to what extent gender segregation according to field of study reflects individual choice, tracking processes within the school system, sex-role socialization, or pressure from parents and peers. Moreover, it is not clear to what extent public policy or reform affects these patterns or whether educational segregation is the result of market forces. If educational segregation is analyzed within a framework of economic structural change with specific focus on the demand for female labor,

since periods of educational reform are also periods of economic and social change, we find that during periods of educational reforms, rising female-to-male relative wages as well as the emergence and growth of the service sector contributed to the alteration of the incentive structure, transformed the gender division of labor, and increasingly brought women into paid work (Stanfors, 2003).

Even though educational segregation is an apparent phenomenon, it is not nearly as investigated as occupational segregation yet the two phenomena can be understood by the analogy of each other. Several studies by their mere presentation of educational statistics describe educational segregation but few studies explain the origin of it. A couple of studies contribute to the understanding of educational segregation in Sweden by analyzing the effect of socioeconomic background on educational choice (e. g. Dryler, 1998; Jonsson, 1997; Statistics Sweden, 1991). Other studies show how sex role socialization takes place through interaction in the class-room and how boys and girls, as early as about age ten, show signs of systematic gender differences when it comes to educational orientation (e. g. Staberg, 1986, 1992; Wernersson, 1977). Elgqvist-Saltzman (1991a, 1991b) has looked into how Swedish women responded to educational reform and stresses the importance of the female life course to women's educational choice and participation in schooling and training (cf. Jacobs, 1986).

In order to explain gender differentials in education, theories of different rationales are applied (Simon, 1979, 1983). The concept of rationality can, according to Ve (1987), be characterized as a technical limited form of rationality, originating from male experience and expectations about male behavior. Whereas this kind of rationality originates from paid market work, the alternative kind of rationality originates from the caring for and considerations of dependent persons. Theories of different rationales and of bounded rationality are also applied in Thomas (1990), who examines the subject divide (arts/science) in higher education in Great Britain and how the divisions between femininity/masculinity interact as social constructions and generate educational segregation. In Thomas' study the issue of gender is highly important since educational choice is limited by expectations of a suitable behavior that is either feminine or masculine.

Since educational choice is affected and mediated by the perception of the contemporary situation in the labor market regarding discrimination and segregation, theoretical explanations of occupational segregation can be translated into terms of educational segregation. Thus, there are three major approaches to educational and occupational segregation: neoclassical economic theories, institutional theories and non-economic theories.¹

The neoclassical approach assumes that people make rational decisions and that educational investments as well as discrimination are based thereupon. People invest in education for future labor market participation considering their personal endowments, preferences and constraining conditions. Educational segregation is thereby the result of rational decisions made by women and men to invest in different amounts and types of education and training (e.g. Becker, 1993; Mincer & Ofek, 1982; Mincer & Polachek, 1974; Polachek, 1979, 1981). For women this means less education and less relevant and rewarding fields of study in comparison to men because they have different physical traits and expect less labor force participation and more career breaks over the life cycle because of household and childcare responsibilities. Rational women thus choose educational programs that give them an advantage, in relation to men, in terms of endowments. These programs lead to jobs with woman-friendly working conditions and little punitive effect on subsequent wages after a career break (Becker, 1985; Nordli Hansen, 1997).

Feedback and reinforcement effects are not taken account of in standard neoclassical theory but reactions from feminist economists have shed light on their importance and proved that there is a need to take account of feedback effects and reinforcing factors. Although girls and women in Sweden have the same access to education as boys and men, they choose different educational programs and receive less labor market relevant or career-oriented education. To a certain extent this depends on the existence of discriminatory practices, for example in the labor market, but also of cultural beliefs about a gender division of knowledge and work. Women's roles as well as beliefs about innate differences between the sexes and sex labeling of skills and work are examples of beliefs that are sticking to people's minds and implicitly affecting the decisions of people. Girls and boys are thus brought up and socialized into a traditional way of thinking and valuing both their own abilities and chances in a gender segregated labor market. Parents, peers, teachers, counselors and not least the media are all

agents, that in some way or the other, may treat boys and girls differentially and track them into different educational programs with different curricula and, in the end, different labor market opportunities (Leathwood, 2005; Marini & Brinton, 1984).

Whereas human capital theory focuses on the supply side, theories of discrimination focus on the demand side of the labor market in explaining segregation. The theoretical marker is Becker's (1957) model of racial discrimination, in which discrimination is seen as a preference and in some cases even a willingness to pay for the exercise thereof, for discrimination among employers, co-workers and/or customers (cf. Arrow, 1972; Bergmann, 1971; Epstein, 1981). If any of these groups have the taste for discrimination, women may meet resistance in certain jobs although there are no formal bars (Blau, 1984). If discrimination in the labor market is taken into consideration when planning for a career and choosing what educational program to follow, women will become concentrated in educational programs in which the taste for discrimination is weak and that lead to occupations in which discrimination is not prevalent. The same reasoning goes for the phenomenon of statistical discrimination (Arrow, 1972; Aigner & Cain, 1977; Phelps, 1972).

Institutional theories assume that labor markets are segmented and allows for the possibility of non-rational discrimination in the allocation of labor between segments. Among the approaches we find that of Doeringer and Piore (1971), which distinguishes between a primary and a secondary segment in the dual labor market. Since the sectors seem to work insulated from each other there is not much mobility between the two, either upward or downward. We also find Bergmann's crowding hypothesis (1974), which describes the labor market as a two-tiered hierarchy according to gender. This kind of segregation is more or less self-perpetuating as women will most likely follow the beaten track and become concentrated in traditionally female educational programs that lead to traditionally female occupations in which discrimination is not prevalent and their femininity is not seen as deviant. If young women take these aspects of working conditions and career opportunities into consideration, they may make a traditional decision and women will become concentrated in traditionally female educational programs. However, during the 1990s, there was a divergence in the educational orientation of women in which one group chose traditionally female-dominated educational programs such as teaching and nursing that led to typically female careers, and

another increasingly larger group chose to enter male-dominated fields of study. This took place, although not to the same extent, in the decades of the early twentieth century and in the late 1960s and early 1970s.

Feminist theory has gained a strong position since gender bias in traditional theory is commonplace. Some argue that segregation is a reflection of patriarchy and the general subordination of women in society as well as in the family that patriarchal structures generate (Hartmann, 1976). Patriarchy is thus, according to some authors, generating constraints on women's freedom of choice. The role of constraints on behavior of decision-making is also discussed in institutional theory of dual labor markets and in Bergmann's overcrowding model. Women and men are largely assigned to different segments of the labor market, and the overcrowding of women into certain educational programs and occupations is not merely the result of free rational choice but rather the result of employers exercising their taste for discrimination or the existence of statistical discrimination. The existence of these discriminatory processes, together with feedback effects from a highly segregated labor market, is perhaps the most important factor behind educational segregation. Educational and occupational choices are thereby seen as responses to a larger social context in which decisions are made and, due to structures of constraint, different decisions can be perfectly rational for different groups of people.

Feminist theory is often inter-disciplinary and makes use of interrelated explanations in order to complement economic explanations of, in this case, the process of educational segregation, the most important ones being sociological and psychological theories of construction of gender, socialization and sex stereotyping (Chodorow, 1978; Fischer, 1987; Marini & Brinton, 1984; Reskin & Hartmann, 1986). According to these theories, educational segregation is one effect of the constantly ongoing construction of gender, both in the labor market and in the everyday interaction between individuals (West & Zimmerman, 1987). The fact that girls and boys and women and men choose different educational programs and specialize in different fields of study may be also be the effect of sex role socialization (Leathwood, 2005). Throughout upbringing, children are bombarded with expectations about what is a suitable behavior according to gender. Parents, peers, teachers, counselors and the media effectively transmit these expectations. Sex role socialization can thus lead to educa-

tional segregation by creating gendered aspirations and goals, or by developing gender-specific preferences and tastes, in concert with the traditional gender division of labor and knowledge and in accordance with gender-specific tasks. Sex stereotypes about femininity and masculinity do not only label what is appropriate female and male work but also mirror the supposed abilities of women and men. The specialization of girls and women into educational programs that lead to jobs as teacher, nurse, secretary and receptionist can thus be seen as a result of female nurturing and caring characteristics, manual dexterity, a polite way and good looks. The lower representation of girls in science and technology is likewise the result of negative stereotyping, typifying male knowledge and suitable male work in a way that disqualifies girls and women and that even discourages them from entering into certain fields of study.

Finally, an alternative approach is that of Strober (1984), who developed the concept 'relative attractiveness' which explains occupational segregation by the fact that men have the first choice of attractive occupations and the rest is left for women. Changes in the gender division of knowledge and labor and in the sex stereotyping of jobs may occur if an occupation becomes relatively unattractive to men and they therefore resort to more attractive alternative careers. Strober has used this approach in several studies and has analyzed the desegregation and resegregation of several professions, for example, teaching and banking (Strober, 1984; Strober & Arnold, 1987). On the analogy, the desegregation and resegregation of educational programs can be analyzed.

Strober's theory improves the traditional economic approach since it takes into account non-economic aspects of how women and men rank educational programs and potential occupations, and how employers rank workers. Sex composition, career opportunities, tasks and working conditions are factors that influence the ranking of educational programs, whereas prejudices, sex stereotypes, social norms and ideology affect employers' ranking of workers. Thus, changes in educational segregation, mainly due to the fact that women have entered male-dominated programs since they have perceived them as relatively attractive alternatives and interesting paths to a potential career, are also due to the fact that men have moved on to other alternative programs and are simply not interested in entering arts (as was

the case in the early twentieth century), pharmacy and teaching (as was the case in the 1950s and 1960s) and architecture and dentistry (as was the case in the 1990s).²

Consequently, gender differences in educational attainment have equalized, whereas gender segregation, when it comes to educational choice and specialization in different fields of study, persists. In general, women have made rational choices, although rationality may not only be straightforward technical and instrumental but rather care-oriented and care-responsible. Female educational choice, has to a high degree, been a rational response to the female labor market situation, to structural change and the relative demand for labor. Thus, the gradual breakthrough into male-dominated fields of study can be seen as a gradual orientation toward relatively more attractive alternative programs and careers.

Change over time: an interpretation of index values

Educational segregation refers to the unequal distribution of women and men in different educational programs. Just like women dominate health and care services, education, and administration in the labor market, they also dominate the preparatory programs in secondary as well as higher education. In 1996, more than every fourth women had an education oriented toward the field of health services. The corresponding figure for men was four per cent. Just like men dominate industrial and technical occupations, they dominate programs oriented in this direction in secondary and higher education. In 1996, more than 50 per cent of all men aged 25-64 with secondary or higher education were oriented toward the fields of science and technology. The corresponding figure for women was six per cent.

The most marked differences are found in secondary education, especially in vocational education, where a majority of women specialize in programs oriented toward health services and trade and administration whereas a majority of men specialize in programs oriented toward industrial and technical work. In higher education, there are less marked gender differences. The most equal programs are the prestigious programs, with the exception of some engineering programs. Nevertheless, there is still a subject divide with women dominating arts and education, and men dominating science and technology.

In order to analyze change over time in educational segregation, an index of educational segregation is constructed. When it comes to occupational segregation, various measures have been proposed but the most frequently used measure is the index of dissimilarity defined by Duncan and Duncan (1955).³ The segregation index is calculated as the percentage of women (or men) that would have to change jobs with men (women) in order to get an overall equal distribution of men and women, keeping the occupational distribution intact. It can easily be translated into an index of educational segregation as follows:

$$ESI = 1/2 \sum |F_i - M_i|$$

F_i is the proportion of women that participates in a particular education, i , and M_i is the proportion of men that participates in education i . The value of the index can range between zero and 100. A value of 100 indicates total segregation whereas a value of zero indicates total integration and equality. It is worthwhile to note that the Duncan dissimilarity index uses the definition of integration as a situation of proportional representation. Thus, the value of the index of educational segregation should be interpreted as the percentage of women (or men) that would have to change educational program in order for the educational distribution of women and men to be identical.

It is not necessary to know the exact number of women and men in education, as the percentage distributions of women and men across different kinds of education make up the basis for computations. When it comes to the increasing number of categories of educational programs and subsequent change in the educational system, opinions differ whether standardization over time with fewer, more inclusive categories is better than a successive change in categorization. The change in categorization may, however, be seen as a reflection of segregation. The computations in this study rely on a highly standardized and consistent categorization. It is also important to note that by using broad categories that cover major fields of study, the intra-educational segregation that is apparent in most fields of study, but especially notable in science and technology as well as health science, is overlooked. In these fields of study, there are large gender differentials when it comes to specialization. In science and technology, men specialize in physics, mathematics and technology oriented toward electro-technology and computer science whereas women specialize in biology and chemistry

and more applied fields of technology such as architecture and road and canal construction. In health science, men specialize in the higher-status professional degrees in dentistry and medicine whereas women dominate the shorter lower-status programs leading to a career as nurse and occupational or physiotherapist.

Segregation in secondary education

In early twentieth century, educational choice took place in elementary education. Gradually, the school system was reformed into a unitary system. Reform of 1927 enabled girls to participate in public intermediate education on the same terms as boys. This improved girls' chances to go on to higher levels of education, and therefore we see a catching-up of girls in public upper secondary schools from the early 1930s and onward. Since there was a choice of arts or science orientation in programs, segregation was high in 1920, because the few girls who participated in public upper secondary education were exclusively orientated toward arts.

Segregation in secondary education diminished during the 1920s (table I). Interestingly, boys increased their share in arts whereas girls increased their representation in science. In the late 1920s, girls and boys were increasingly making gender-specific educational choices and desegregation turned into resegregation. During the early 1940s, there was again desegregation until the mid-1940s. The introduction of the general program increased segregation, since girls in particular left science in favor of the general program. By 1960, girls made up almost half the student body and in 1965 the number of girls outperformed the number of boys in upper secondary schools. With the increased participation of girls, segregation decreased somewhat, mainly due to the more equal representation of girls in all the three programs in relation to boys who were highly concentrated in science.

If index values of segregation by orientation of program on the basis of participation are compared to the index values on the basis of examination, similarities as well as differences can be seen (see tables I and II). The temporal pattern of desegregation is the same but there is more integration in the early part of the period when it comes to exams, explained by the fact that some privileged girls underwent higher certificate examinations as external candidates.

The index value is higher for examination than for participation until 1940 due to the fact that the share of girls examined in arts-oriented programs is larger than the share of girls participating in arts-oriented programs. The 1940s features desegregation both when it comes to examination and participation and, from the early 1950s, the index values are steady at about 33 to 35. The temporal increases in segregation during the early 1960s are mainly attributed to increased science-orientation among boys. In 1967, however, the index values of segregation decrease again due to more equal educational choice according to gender.

Table I about here

Table II about here

With the reform of 1971 and the introduction of a new upper secondary school, the categorization of field of study changed as theoretical and vocational secondary education merged and a number of new programs were introduced.⁴ This imparts an upward bias on the index values, which is most likely the explanation for the increased level of segregation in upper secondary school, from 34.5 in 1967 to 47.7 in 1971. The increasing number of categories is a reflection of segregation by field of study in the new school system. Since vocational education was highly segregated, the integrated upper secondary school became more segregated than the old purely theoretical school. When it comes to examination, or successful completion after 1968, the development pattern of segregation for 1971-2000 differs markedly from the pattern up to 1967. From 1971 to 1990 segregation increases and decreases in a wave-like pattern. From 1990 and onwards, there is, however, a trend toward desegregation. The sharp increase in segregation from 1971 to 1976 can be explained by an increase of young men in science and technology, together with their decreased representation in arts and social sciences. Students in vocational programs oriented toward industrial work mainly made up the increase of men in science and technology. The desegregation between 1976 and 1982 was the result of a more equal distribution of young men and women across educational programs. Since women started to discard arts in favor of other programs, the female-dominated programs are smaller and do not generate that big an effect on the index value. Since young men decreased their share in science and technology, examination became more equal with respect to field of study in the early 1980s. The same reasoning goes partly for the re-segregation in the mid-1980s as well. Again, young men and women graduated

from rather different fields of study, with more men in science and technology and more women in arts and social sciences.

A new pattern, that is an increasingly large share of women making untraditional educational choices and therefore successfully completing previously male-dominated or at least less integrated programs can explain a trend toward desegregation, emerging in the 1990s. One example is the increasing representation of women in science and technology, whereas men have not increased their representation in arts and social sciences correspondingly. When it comes to the divide between general and more specific knowledge and competence, women are still more prone to choose a generally oriented program even after the reform of the early 1990s when all programs were made three-year and came to include more general courses than before. One explanation for this is that women are more interested in general courses, and another is that they are more able when it comes to more general theoretical courses. A third explanation is that it may seem more rational for women to invest in general knowledge since they want to go on to higher education.

Table III about here

It is hard to discern whether persistent gender differentiation and segregation are the result of sex discrimination. Although girls in general do better than boys, post-school outcomes are even more gender differentiated than education. A survey undertaken in 1997, examined the educational and occupational destinations of graduates who completed secondary and higher education in 1995 (National Agency for Higher Education, 1999). The study shows that educational choice in secondary school live on and even narrow further. When it comes to science and technology, young women are less likely than young men to continue within the field of science and technology in higher education, although they have the intellectual ability and the necessary qualifications. This process is called attrition and has been documented in several countries (Blickenstaff, 2005; Glover, 2000). Not only mathematics but also science and technology seem to have a selection and sorting function that is greater for women than for men. By age 20, it is reasonable to assume that considerations about a future career and family are more important than earlier in life, and that interests may have reshaped or strengthened, not unlikely in a gender-specific way. Gender roles may have been strengthened

and so may ideas about what aspects of an occupation are important and valuable. This in combination with relatively more self-awareness, confidence and documented ability and credentials, makes it plausible to assume that more young women choose education or occupations that are compatible with interest and comparative advantages, more so than education and occupations that lead to higher wages and a career. It is also plausible to assume that future plans with respect to education, work and family and demand for labor will affect young women's choice of education and occupation after secondary school. This is all in line with theories of rational choice that have been launched in order to explain gender segregation in education. Among the explanatory factors, we find rational choice interacting with perceptions of demand-side factors, socialization and sex stereotyping of gender roles. To conclude with, many secondary school graduates, especially young women, that have the intellectual ability, drop out of science and technology at the time for transition from secondary to higher education or at the time for the school-to-work transition. Some, however, change their minds and take up science in adult education. Gender segregation in education as well as in the labor market thus persists, although long-term development shows a secular trend in gender equalization when it comes to young women's representation in science and technology.

Segregation in higher education

By 1960, higher education was rather exclusive and male-dominated. Many educational programs that women followed were not formally categorized as higher education. As can be seen in figure 1, there was an increase in the number of entrants in higher education during the 1960s. The increase was somewhat stronger for men than for women, but as it tapered off around 1968, the decrease was somewhat stronger for men than for women. The increased demand for higher education during the 1960s preserved the old pattern of gender segregation by field of study. The changes taking place were rather equally distributed with, for example, arts and science decreasing in relevance for both women and men. Social science was highly demanded but extremely equal when it came to relative attractiveness for women and men.

Figure 1 about here

Segregation changed dramatically with the reform of 1977. The inclusion of several female-dominated post-secondary programs was accompanied by a new way of categorizing higher education into five sectors and other courses with varied orientation. The latter category attracted a large part, almost half, of the student body that entered higher education. Women dominated education and health services and men dominated technology. These tendencies were persistent throughout the 1980s. It is interesting to note that male domination of technology was successively reinforced although women gradually moved into that field, whereas the relative attractiveness of education and health care at first increased for women but then decreased in favor of a more varied educational choice.

If the category 'other courses' with not known orientation is excluded, the index values change and so does the pattern of segregation. The pattern of segregation is one of increasing segregation throughout the 1980s and into the early 1990s. During the period in question, women were, yet on a small scale, diversifying their fields of study and making non-traditional choices. During the late 1970s and early 1980s, women increased their representation in traditionally female-dominated fields, but only little in comparison to the extent that men increased their representation in traditionally male-dominated fields of study. In general, the tendency among women to make non-traditional educational choices and move into more varied and sometimes male fields of study is striking. This tendency is apparent and definitely established in the pattern of desegregation in the 1990s.

Table IV about here

The demand for higher education was high during the 1960s, although in the late 1960s and early 1970s, demand decreased since the labor market was favorable for less qualified labor. By the mid-1970s, more people, especially women, demanded higher education as the labor market situation harshened. During the 1980s, the expansion of higher education stalled with fewer new entrants, but a retained proportion of women. Obviously, women and men were not only specializing in different subjects, they were also recruited from different subject areas and different programs in secondary education. More women than men were admitted to higher education on the basis of vocational education. Since programs in the fields of science and technology mainly recruit their students from science and technology programs in

secondary school, gender differences within the field of science and technology lived on in higher education. The proportion of women increased somewhat in some fields of study as there was an increased demand for higher education in the late 1980s that continued throughout the 1990s. Again, although more women than men entered higher education, gender segregation persisted especially within the field of technology. A number of longer prestigious programs, such as law and medicine, were gender equal, but technology and education and caring were highly gender segregated.

Even though women make up the majority at universities and are increasingly represented in prestigious fields and in general do better than men, men still dominate the fields and subject areas that lead to high positions and well-paid jobs. Obviously there are different ways of reasoning that lead women and men to separate choices and future opportunities. One explanation behind the ways of reasoning may be in line with Ve's different kinds of rationality and the fact that women and men dominate different kinds of education. Another explanation may be that women are more inclined to graduate and get a degree in order to document their ability, protect themselves from being discriminated and to place themselves further ahead in job queues as well as in gender queues.

Segregation in education by gender is persistent yet slowly changing over time, and women are clearly more inclined to change their behavior than men. The relatively slow increase when it comes to women in technology is very much a result of an increasingly larger number of women being concealed by an even larger number of men. The increase of women in science and technology has been secularly increasing throughout the years, but during certain periods of economic and industrial transformation the scientific and technological sectors have expanded in order to cater for industrial and societal demand. During these periods, not only women but also men have increased their participation in higher education and especially within the fields of science and technology.

Documented above is the process of women establishing and increasing their representation in science and technology, that is, what Glover (2000) calls the process of getting in (cf. Blickenstaff, 2005). Documented is also the process of women graduating and increasing their potential labor market opportunities within the field of science and technology, what Glover

calls getting on. However, women and men are definitely singled out, successively, for different future careers and different life projects. The 1990s indicated that women were inclined to change traditional gender-specific behavior and move into new subjects and new sectors. Increasingly, young women were inclined to invest in higher education oriented toward a prestigious and demanding career. The 1990s, to a high degree, bears similar traits with previous periods, above mentioned as important when it comes to educational expansion and gender equalization, that is, the 1920s, the 1940s, the 1960s and 1970s. Previous studies (e. g. Goldin, 1992) have shown that young women are highly dependent on having role models among older women when they are about to make a non-traditional and less gender-specific choice. Young women during the 1990s, born around 1970, had their role models among women born in the 1940s and 1950s. These women were pioneers in higher education regarding transition rates and non-traditional choice of education. Many of these women have successfully combined education and work, career and family and actively participated in the gradual expansion of the female labor market and experienced a relatively favorable income development. However, women and men specialize differently as a whole and women have, over time, become an increasingly heterogeneous group with different groups of women having different life projects (cf. Hakim, 1996, 2000).

Discussion on the meaning of education to Swedish women from a historical perspective

The expansion of education is closely related to the fundamental transformation of Swedish society that has occurred during the twentieth century. It is also related to economic structural change that implies a change in the relative importance of sectors together with major transitions from agricultural to industrial and further on to post-industrial society. With the increasing importance of new technology, knowledge-intensive production, and the growth of the service sector, there has been change in the relative demand for labor, with an increasing demand for skilled and educated people. The return to education has become stronger to individuals as well as to entrepreneurs and enterprises.⁵

The general trend is one of increasing demand for education and increasing educational attainment. The demand for different kinds of education and skills has, however, varied over time in accordance with business cycle fluctuations. According to the structural economic approach outlined by Schön (e. g. 1998), periods of rationalization and transformation follow

on each other in a cyclical pattern. Since, in brief, transformation means renewal and change in industrial structure in which resources are reallocated between sectors and branches, there is a demand for educated labor with skills that can take advantage of new innovations that are being integrated into the production process and enhance productivity. Rationalization, on the other hand, means a concentration of resources and measures are primarily taken in order to increase cost efficiency in the existing industrial capacity. Technological change is therefore mainly skill saving and there is thus a relatively high demand for unskilled labor. Autor, Katz and Krueger (1998) examine the effect of technological change on the relative demand for workers with different levels of education and on the development of wage differentials in the United States. They find that the demand for college graduates grew faster during the period 1970-1995 than during the period 1940-1970. As in the United States, there was also an increase in the supply of educated persons in Sweden during the 1970s and 1980s. However, in Sweden, wage compression between different educational groups was more institutionalized than purely an effect of market forces and the supply and demand of different educational groups.

Goldin and Katz (1998) provide more historical insights into the complex relationship between technological change and the demand for skilled and unskilled labor. They identify a capital-skill complementarity in American manufacturing industry from 1909 to 1929 both among production and non-production workers. In addition, during this period, the increased supply of high school educated labor prevented rising wage inequality with technological change (cf. Goldin and Katz 1995). In Sweden, as well as in the United States, wage inequality between blue-collar and white-collar workers decreased during the inter-war years. The wage compression was, to be noted, somewhat larger for women than for men. This highlights the fact that the relationship between technological change and the demand for labor not only has implications for different educational groups but also according to gender.

Goldin (1987) discusses the relationship between technological change and women's employment and highlights the characteristics that distinguish female workers from male workers, which are basically the reasons why women are differentially affected by technological progress. Throughout the twentieth century, women increased their presence and representation in areas where new technology was implemented and work organization was

altered. With these changes, productivity increased, and consequentially there was a demand for female labor in sectors and branches where wages were raised. Thus, technological progress and organizational change increased the work opportunities of women (cf. Baran, 1987; Braverman, 1974; Strom, 1987). Goldin also stresses that, in the post-war era, the increase in women's education is the most important determinant of the increasing female labor force participation rate.

The case of Sweden in comparison to Goldin's study on the United States shows that the long-term trends of structural change are similar. Swedish women exercised their right to educational advancement and improved their educational attainment during the twentieth century. Young women were to some extent concentrated in girls' schools with a special 'feminine' curriculum and to some extent concentrated in fields of study oriented towards arts and general human capital rather than science. However, with the expansion of the service sector, women's education was well in line with emerging job opportunities, for example in trade, administration and offices.

The distinction between periods of transformation and rationalization may however not be simple when it comes to the analysis of women's education and economic structural change. For example the 1920s, that within the structural economic framework according to Schön is characterized as a period of rationalization within the industrial sector, largely bears traits of transformation when it comes to women and the service sector that follow the pattern of structural change with a time lag. During the 1920s new job opportunities emerged with the expansion of the service sector and industrial branches that demanded female labor. Wages in the expanding sectors were, in general, higher than the average female wage and so the incentive structure changed and market work became increasingly attractive to larger groups of women and the gender division of labor thus transformed.

The changes taking place were more about transformation and an increasing demand for new and different skills. The feminization of the clerical sector was the result of the rational choice of many young women who wanted good jobs that were socially accepted and relatively well paid. The technological and organizational changes that took place in the offices were the implementation of innovations and new methods and not just a process of de-skilling. The

gender roles and the patterns of segregation that emerged reflected the different competence and skills held by women and men and the different remuneration thereof. The 1920s, characterized in this way, was an important period of change in the economy with implications for the gender division of labor, just as the 1940s and the 1960s and 1970s were. During the selfsame periods, important educational reforms, of significance especially for girls and women, were realized.

Also, the changes taking place during the 1960s and 1970s were more about transformation and demand for new knowledge and skills than simply about rationalization. From the 1950s and onward, the Swedish work force has increased. Since the mid-1960s the growth has been mainly attributable to the employment of women. In a situation of labor shortage, women were seen as a useful labor resource. Moreover, labor shortage was to some extent the case in industry but mainly in the expanding service sector, notably the public sector. According to contemporary census material, more women moved into white-collar positions than to less skilled manual work.

After the mid-1960s, the industrial sector contracted, whereas services and especially the public sector expanded. Retail trade, financial services, education, health services and care, together with public administration expanded greatly and demanded traditional female skills. The continuation of a traditional gender division of labor and occupational segregation can therefore be explained by the demand for female labor and the relative growth and displacement of sectors. Female labor supply was thus very much a rational response to the existing demand for labor. Increased female labor supply also had a reinforcing effect, since part of the growth of the service sector (in the case of Sweden, public sector services) was a result of increased female labor force participation due to an interplay between working women and the demand for services such as child care, restaurants, et cetera. This feedback loop is an example of the fact that complementarities were generated through the growth of the service sector just as had been the case at the time of growth of the industrial sector.

When it comes to education, parallel to structural change and the growth of the service sector, a number of more or less vocational courses and programs oriented toward health services and caring, education and retail trade were introduced both in the reformed secondary school

system (1971) and in higher education (1977). These courses and programs were, from the early beginning, female-dominated and the over-representation of women has since then been persistent.

Intuitively, the application of a structural economic perspective may hold the explanation for the seeming paradox when it comes to equalization in educational attainment, but persistent gender segregation when it comes to educational choice and specialization in different fields of study. Gradually, girls and women have been given the right to participate in public education in the same way as boys and young men. With the abolishment of discrimination in the educational system and bars in the labor market, women have been free to make whatever human capital investment. Thus, it is women's expectations about future labor market activities, together with perceptions about demand for female labor and tastes for discriminatory behavior, that are of central importance in their selection of an education and a career. The continuing educational segregation can therefore be explained by the expansion of the service sector and a high demand for female labor in this sector. Traditionally, the service sector offered better employment opportunities for women and women-friendly working conditions. Especially, work in the public sector has been seen as flexible and, since women still shoulder the main responsibilities for housework and family, it may have been rational to choose an education that leads to an occupation that allows the pursuit of a dual career.

Together with a large group of women following a typical female life course and specializing in female fields of study, there is another group of women making gender atypical decisions and breaking into male-dominated fields. This diverging pattern was notable in the 1920s, the 1970s and during the 1990s. However, there was little change in men's specialization during these periods. Few men responded to the demand for labor in the public sector during the 1970s, even when there was a structural crisis and industrial alternatives were restricted. In the 1990s, when young women made their definite breakthrough in science and technology in higher education, men clustered even more within traditional fields of study. Some argue that the lack of change in men's educational aspirations and career plans can be explained by the fact that they are not primarily interested in female fields of study and that they perceive women to have a comparative advantage within traditionally female fields of study. Some argue that men's educational choices are restricted both by gender stereotypical norms and by

lower grades. The lower remuneration of typically female employment and the existence of relatively more attractive alternatives seems a more viable explanation. But in sum, a structural economic approach as well as a gender perspective may serve as a complement to traditional economic theory and hold an answer to why gender differences in educational attainment have equalized, whereas gender segregation, when it comes to educational choice and specialization in different fields of study, persists.

Conclusion

Gender segregation and specialization persist in education as well as in the labor market, and one of the divides is that between arts and science and technology. The gradual increase over time of educational level made education more a question of age and gender than of gender *per se*. Educational orientation is still a question of gender and the differences are most pronounced when it comes to the point where education becomes relevant for labor market preparation. The different destinies of young men and women in the labor market may have served as warrants for different treatment in the educational system, and may still serve as warrants for traditional gender-specific educational choice. Girls are, to a high degree, found in study programs that lead to traditional female jobs and boys are, to an even higher degree, found in programs that lead to a traditional male career. For a long time, the increased education and labor market orientation among Swedish women were confined to traditionally female areas of economic activity but since the late 1980s more women have changed their educational and occupational orientation in a less traditional and gender-specific way. This makes the 1990s an important period of change together with the 1920s, 1940s, 1960s and 1970s.

There has been more change when it comes to gender-specific choice in theoretical education than in vocational education. As a whole, girls and women have been more inclined to move into traditionally male-dominated programs than boys and men have been to move into traditionally female-dominated programs. During the 1990s, there was a tendency towards polarity as one group of women moved into male-dominated programs, but at the same time a large group of women chose traditionally female-dominated programs.

It appears as if educational segregation can be explained by the introduction of equal educational opportunities regardless of gender and the expansion of educational programs that traditionally recruit women. However, over time, non-traditional educational choice increase among women, in concert with economic structural change and some measures of social change. The demand for female labor and knowledge and the increasing recognition of women's competence and qualifications turned segregation into a downward trend of desegregation, especially notable during the 1920s, the 1940s, the 1960s and 1990s. During some periods, the tendency was one of re-segregation, mainly due to a high demand for female labor from traditionally female-dominated fields of study, but also due to an increasing re-segregation of men mainly into the field of science and technology and lately only technology. It seems as if women are more heterogeneous when it comes to educational choice than men are, and whether this is based on more varied interests or higher or more diverse ability is a subject for further research. In many ways girls and women outperform boys and men when it comes to ability measured by grades, and perform equally well in ability tests. Nevertheless, female and male specialization differs at an early level that completes the picture of educational segregation. It may very well be that girls' and women's educational choice is mediated by the perception of the contemporary labor market. Thus, discrimination as well as other mechanisms behind occupational segregation are taken into consideration when planning for a future career and choosing what educational program to follow or what subject to specialize in. Female educational choice according to what is relatively the most attractive choice can then be seen as a rational response to the contemporary labor market for women, the relative demand for labor and the rewards thereof, determined by economic structural change. Thus, the gradual break-through into male-dominated fields of study can be seen as a gradual reorientation among women in twentieth-century Sweden toward relatively more attractive alternative educational programs and careers.

Table I. Index values for boys and girls in public upper secondary schools by orientation of course program (arts, science and, from 1953, general) 1910-1967.

Year	Index
1910	No girls at all
1915	No girls at all
1920	55.9
1925	23.8
1927	19.5
1928	20.7
1930	28.3
1935	33.0
1940	38.6
1945	35.1
1950	35.4
1952	35.8
1953	33.6
1955	32.3
1960	35.8
1965	35.5
1967	33.3

Source: Statistics Sweden, 1977: 127-132.

Table II. Index values for boys and girls regarding higher certificate examination by orientation of course program (arts, science, and from 1953, general) 1910-1967.

Year	Index
1910	28.7
1915	27.0
1920	40.0
1925	39.0
1927	32.4
1928	33.3
1930	31.6
1935	35.5
1940	38.2
1945	35.2
1950	29.7
1952	32.7
1953	32.4
1955	34.8
1960	35.4
1965	36.7
1967	34.5

Source: Statistics Sweden, 1977: 156-158.

Table III. Index values for boys and girls regarding successful completion of the integrated upper secondary school by field of study 1971-2000.

Year	Index
1971/72	47.7
1975/76	61.2
1981/82	48.9
1984/85	55.4
1989/90	48.3
1995/96	33.0
1999/00	32.6

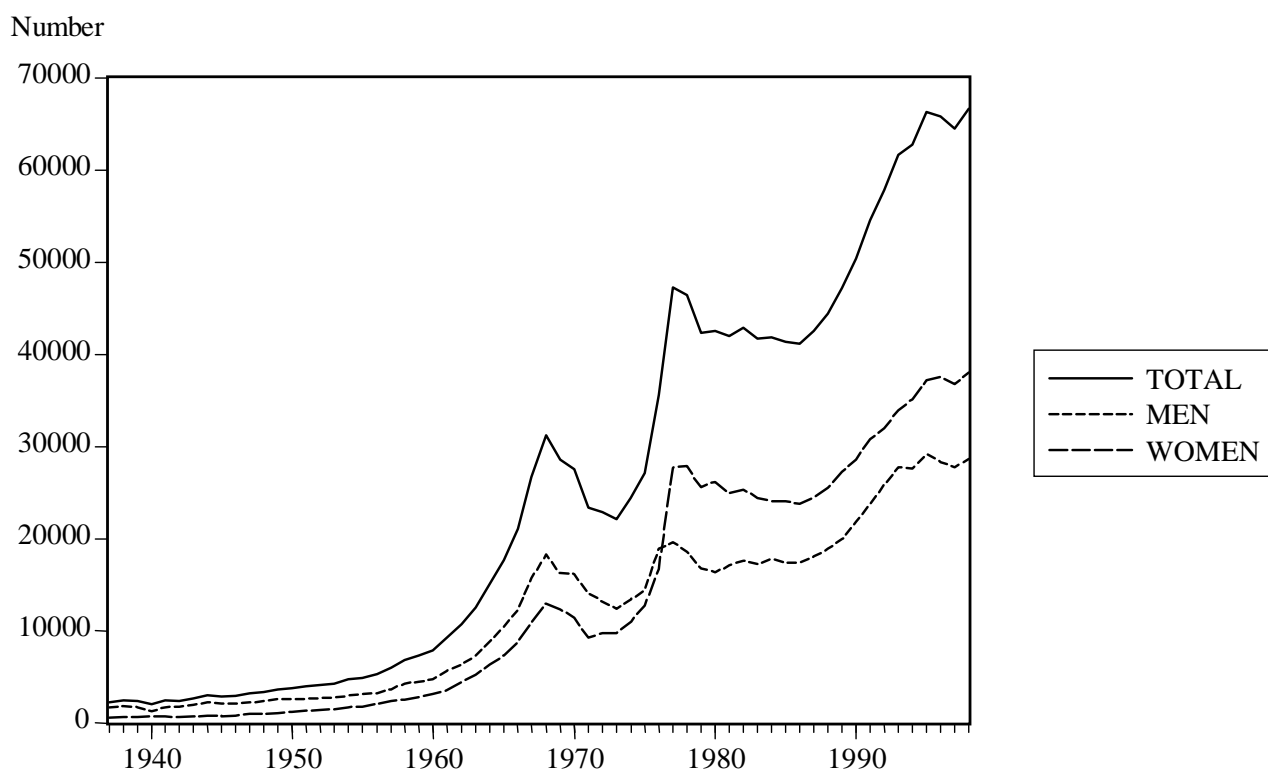
Source: Statistics Sweden, Statistical reports SM U (*Statistiska meddelanden Utbildning*), Statistical reports SM UF (*Statistiska meddelanden Utbildning och forskning*), Statistical Yearbook of Education (*Utbildningsstatistisk årsbok*), various years.

Table IV. Index values for female entrants in higher education by field of study 1960-2000.

Year	Index	
1960/61	33.8	
1965/66	36.6	
1970/71	29.0	
1975/76	22.6	Other courses with not known orientation excluded
1977/78	24.9	38.9
1980/81	27.1	39.6
1985/86	23.8	41.0
1989/90	26.1	44.7
1995/96	19.4	49.2
1999/00	18.3	47.8

Source: See table III.

Figure 1. Number of new entrants in higher education 1937/38-1998/99.



Source: See table III.

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¹ For a review that indicates the multitude of theoretical approaches to the issue of gender inequality and education, see Jacobs (1996).

² For a full account of the data material used in this study, see Stanfors (2003).

³ For a discussion on other measures, see articles by Fuchs (1975) and Jonung (1988).

⁴ Thus, it is not possible to make fully consistent time series. It is, however, not very problematic to make comparisons over time, but one should bear in mind the effects of re-categorization and the introduction of new categories in the index values of segregation.

⁵ This is in contrast to Braverman's de-qualification thesis (1974). Braverman's argument sheds light on important aspects of structural change, but is today insufficient, since there has been a gradual as well as a general improvement in educational attainment of the Swedish workforce, not least since the 1970s.