

CHAPTER 14

# Returns to Human Capital in Sweden

Mahmood Arai

&

Christian Kjellström

National Institute of Economic Research

Stockholm, Sweden

ma@ne.su.se    christian.kjellstrom@konj.se

## 1 Introduction<sup>1</sup>

The purpose of this chapter is to highlight the economic incentives for investments in human capital in Sweden. It reviews the current state of the literature concerning returns to education, work experience and seniority. Our interest in this topic is motivated by our belief in the importance of human capital for growth and employment. The role of human capital and the importance of maintaining high educational standards have received a great deal of attention in the public debate. The endogenous growth literature has stressed the importance of human capital for growth and the empirical research on the determinants of growth offers results indicating that economic growth is positively correlated with education across countries.<sup>2</sup>

Investment in human capital depends on many factors. Social background, for example, seems to have a substantial influence on an individual's choice of schooling.<sup>3</sup> This can be seen as evidence for individuals' educational levels being highly correlated with their parents' educational levels. Standard human capital theory<sup>4</sup> states that an individual's choice of education is determined mainly by the costs of and returns to education. From this perspective, the positive impact that social background has on educational attainment, can be interpreted as indicating that individuals with highly educated parents might have lower costs of education and, therefore, invest more in education.

When considering the economic incentives for investment in human capital, the main components highlighted in the literature are: direct returns to schooling in terms of higher future earnings, fringe benefits, more agreeable working conditions, decreased risk of unemployment, and financial costs associated with education, which include opportunity costs in terms of foregone wages.

If we examine earnings differentials associated with different educational levels, we find that Sweden is among the countries with the lowest returns to education. On the other hand, the direct financial

---

<sup>1</sup> We wish to thank Anders Björklund, Matthew Lindquist and Carl le Grand for helpful comments and discussions.

<sup>2</sup> See Barro and Sala-i-Martin (1995), Krueger and Lindahl (1999).

<sup>3</sup> Ericsson and Jonsson (1993, 1998).

<sup>4</sup> See Becker (1962).

costs associated with schooling are very low. It is easy in Sweden to obtain substantial loans for financing higher studies and almost all studies are free from tuition. Returns to work experience and firm-specific human capital measured as seniority are also low in Sweden.

One must keep in mind that Sweden is characterised by small wage differentials along a number of other dimensions as well, such as the male-female wage gap and inter-industry wage differentials. A number of studies report results that wage differentials were compressed during the seventies along almost all dimensions in Sweden. Roughly speaking, the wage differentials with respect to schooling, work experience, firm seniority, gender and industry affiliation were reduced by one-half during the seventies. These changes can be attributed to egalitarian wage policies practised after the sixties. Wage differentials have increased somewhat since the mid-eighties.

An important question is to what extent these changes are compatible with changes in the supply of and the demand for education. One hypothesis is that the fall in the returns to higher education can be explained by an increased supply of individuals with higher education.<sup>5</sup> The decrease in returns is clearly pronounced for the period 1968–1974, while undergoing only minor changes after 1974. A corresponding change in the relative supply of labour with university education cannot be observed, though. The increase in the relative supply of individuals with higher education is smooth and reflects a general trend of increased education as in many other industrialised countries. It is not only the supply of labour with higher education that increased during this period, however. The demand for skilled labour also increased rapidly. The growth in the public sector was mainly dominated by growth in occupations which require post-high school education. Another major change in the Swedish labour market was the increased female labour supply promoted by an expansion in publicly provided child-care.

The sharp fall in wage dispersion during 1968–1974 is compatible with the view that the narrowing wage differentials in Sweden are primarily generated by the institutions of wage setting. The increased supply of education opportunities, resulting from expansion and decentralisation of the university system, in combination with generous subsidised loans to students during the sixties is another part of the

---

<sup>5</sup> Edin and Holmlund (1995) investigate this question.

overall institutional change in the Swedish society. The fall in returns to schooling in Sweden is possibly partly due to the lower quality of education in times of great expansion in the educational institutions. The recent development in Sweden in terms of a sharp increase in unemployment is accompanied with a pronounced increase in student enrolment and, consequently, a higher supply of individuals with higher education. Our impression is that more studies are needed to explain the pattern of changes in the returns to schooling in Sweden.

Here we report existing results on returns to human capital and also summarise the findings on the variation in these returns over time and across groups of workers and sectors of activity. Previous studies examine returns to human capital for different groups and sectors, as well as the sensitivity of these results with respect to measurement error in the education variable, omitted variable bias and heterogeneity in ability. Very little research is available on the variation in returns to schooling with respect to different types of education. Education of various types – technical, humanities, social sciences – as well as various types of training most probably have different impacts on economic activity and also systematically face different demands.

The remainder of the chapter is organised as follows. Section 2 presents the main data sources used in most of the studies reviewed here. Sections 3, 4 and 5 deal in turn with returns to education, work experience and seniority. Section 6 concludes.

## 2 Data sources

The two most widely used data sets in the studies reviewed here are the *Swedish Level of Living Surveys* (LNU) from 1968, 1974, 1981 and 1991, and the *Household Market and Non-market Activities Surveys* (HUS) from 1984, 1986, 1988, 1991, 1993 and 1996. The data consist mainly of information from interviews, but also of information from different registers that is matched with these samples. Both surveys have a panel design. The panel from LNU is not age-representative due to the long time period between the waves. Using two or more waves implies that the youngest and oldest cohorts are not covered. In addition, some other data sets have been used to examine various specific issues. A short description of the main micro-data sets used in previous studies is presented in the Appendix.

### 3 Returns to education

#### 3.1 General results

The relationship between earnings and schooling can be measured in different ways. In the reviewed studies, this relation is measured as the wage premium of a specific education or educational level, and as the return to an additional year of schooling. A third measure of returns to schooling is the internal rate of return. The internal rate of return is the discount rate that equalises the present value of life-time earnings associated with two different educational levels.

We start with results from the studies that focus on the return to an additional year of schooling. Thereafter, we present the empirical findings of the wage premiums for various levels of schooling in Sweden. Results from previous studies are summarised in Table 1.

Björklund (1986) reports results from estimations of a wage equation including a gender dummy, years of schooling, years of work experience and work experience squared as well as age and age squared. The estimated returns to schooling fall from around 8 per cent in 1968 to around 4 per cent for the period after 1974. Running separate regressions for men and women, le Grand (1994) reports a decline in

**Table 1. Return to schooling (log-%)**

	Year	TOTAL			PRIVATE			PUBLIC		
		Total	Men	Women	Total	Men	Women	Total	Men	Women
Asplund et al. (1996)	1991		4.9	4.3		6.0	5.4		4.9	3.9
Björklund (1986)	1968	7.8								
	1974	4.3								
	1981	3.5								
	1984	3.9								
Blau & Kahn (1995)	1980		4.3	4.3						
Le Grand (1994)	1968		8.9	8.7	7.8			8.4		
	1974		5.3	5.5	5.1			5.5		
	1981		5.1	4.1	5.1			4.3		
	1991		5.0	4.0	5.5			4.2		

the return to schooling from 8.9 (8.7) per cent<sup>6</sup> for men (women) in 1968 to 5.0 (4.0) per cent in 1991, with the main fall in the early 1970s. This means that the decline in returns to education has been larger for women than for men, but the gender gap in returns to schooling is significant only for 1981 and 1991. Asplund et al. (1996) use post-compulsory schooling instead of total years of schooling and report somewhat lower figures for 1991 (4.9 and 4.3 per cent, respectively).<sup>7</sup> Blau and Kahn (1995) also present the estimated return to an additional year in post-compulsory schooling in 1980, but they do not find any gender differences. The return to an additional year is 4.3 per cent for both males and females.

The differences in the estimated returns to education over time and across gender may partly be due to differences in the return to schooling across sectors. The proportion of women (men) in the public sector has increased from 46 (22) per cent in 1968 to 61 (31) per cent in 1981.<sup>8</sup> Both le Grand (1994) and Asplund et al. (1996) report estimated returns to schooling by sector.<sup>9</sup> Whereas Asplund et al. present estimates by gender and sector, le Grand reports returns by sector with a dummy for gender. Le Grand (1994) finds that the returns to education in the private sector are significantly higher than in the public sector in 1981 (5.1 versus 4.3 per cent) and 1991 (5.5 versus 4.2 per cent). For the years 1968 and 1974, the returns to education are insignificantly higher in the public sector. Asplund et al. (1996) also show that the gender differential in returns to schooling in 1991 is larger in the public sector than in the private sector. The return to schooling in the public (private) sector is 3.9 (5.4) per cent for women and 4.9 (6.0) per cent for men.

The human capital variables explain better the variation in the logarithm of hourly wages in 1968 than in the following years. Furthermore, the human capital variables explain better the variation in log hourly wages in the public sector than in the private sector in 1968. The adjusted R-square is as large as 0.51 in the public sector compared to 0.39 in the private sector. The differences for the other years

---

<sup>6</sup> The returns are expressed in log percentages.

<sup>7</sup> Asplund et al. (1996) show that the returns to schooling are more or less the same for Denmark and Norway, but much higher in Finland. The gender gap, however, is largest in Denmark.

<sup>8</sup> See le Grand (1994).

<sup>9</sup> See also Zetterberg (1988).

are much smaller, but still in the public sectors' favour. That the highest R-square is found for 1968 and for the public sector might reflect the decreasing importance of administrative criteria based on individual education, experience and seniority in the public sector after 1968.

Regarding the variation in returns to education across sectors, there are a couple of studies that investigate the variation in returns to schooling across employer size classes and industries. Albæk et al. (1998) report for Sweden that there are no significant differences in returns to education across different employer sizes, and allowing for different returns to education across various size groups leaves the size effects basically unchanged. Arai and Skalli (1996) estimate a standard Mincer equation where the schooling variable is interacted with industry dummies. Their results imply that the rate of return to education is systematically correlated with industry affiliation, and that the gender gap varies largely across industries. The lowest return to schooling is 3.4 per cent in the wood and wood product industry and the highest is 6.1 per cent in insurance followed by financial institutions with a rate of 5.5 per cent. These industry differentials in returns are similar to those observed for France, although the French estimates are somewhat higher. The gender wage gap varies significantly and largely across Swedish industries. It is as high as 30 per cent in the metal industry and as low as 8 per cent in real estate. These variations most likely reflect the occupational segregation and the fact that the female–male wage gap is to a large extent a result of between occupation differentials.<sup>10</sup>

These results are based on the relatively small sample of LNU, which sets limits for the flexibility of the estimated models. The cross-sector variations in returns to schooling nevertheless indicate some degree of heterogeneity in schooling. There might exist heterogeneity both with respect to type – technical, humanities, social sciences etc. (horizontal heterogeneity) – and/or returns to years of schooling at different educational levels (vertical heterogeneity). There is very little done with respect to horizontal heterogeneity. Wadensjö (1991) compares earnings for workers with technical, medical and social sciences background. He reports that annual earnings systematically vary

---

<sup>10</sup> For analysis of the gender wage-gap, see e.g. Jonung (1984), le Grand (1991), Edin (1992), Löfström (1992), Zetterberg (1994), Meyerson et al. (1996), Arai and Thoursie (1997), Persson and Wadensjö (1997), Edin and Richardsson (1997), Richardsson (1997) and Thoursie (1998).

across these groups as well as across universities where the education is attained.<sup>11</sup>

Considering vertical heterogeneity, there are a number of studies that allow for more flexible functional forms. The earnings function that relates the log of earnings to years of schooling, years of work experience and experience squared presumes that one additional year of schooling leads to the same returns at all levels of education. Non-linearities in the years of schooling have been the focus of several studies. Edin and Holmlund (1995) use a dummy variable for each year of schooling above nine years to capture shifts in the return to schooling. They report results indicating that those with 15 years of education in 1968 had 67 per cent higher wages compared to those with 9 years of education. In 1981 the difference had declined to 27 per cent, and increased to 35 per cent in 1991.

Palme and Wright (1998) show that the decline in the return to schooling between 1968 and 1981 is mainly concentrated to college education. The wage premium for high school relative to compulsory schooling reported by Palme and Wright is for men (women) 21 (22) per cent in 1968 and 13 (9) per cent in 1991. The premium for university education relative to compulsory schooling is about 150 (161) per cent for men (women) in 1968, whereas the premium in 1991 is 47 (44) per cent.<sup>12</sup> Björklund and Kjellström (1999) show that the standard Mincer equation predicts a fall in the internal rates of return for men from 8.6 in 1968 to 4.5 per cent in 1991 for all types of education. A more flexible functional form in schooling predicts a fall from 4.6 to 4.4 per cent for high school and from 13.8 to 5.5 per cent for college education.

### 3.2 Problems with interpreting returns to schooling

There is an extensive debate in the schooling literature about the failure to control for ability and measurement error in the schooling vari-

---

<sup>11</sup> See also Hemström (1995).

<sup>12</sup> These estimates are corrected for sample selection bias, which does not change the results substantially. Moreover, in contrast to Björklund and Kjellström who allow for a more flexible functional form in schooling, Palme and Wright also experiment with the functional form in experience. But estimating quadratic wage functions and splines gives approximately the same results as before.



able. The general opinion is that the schooling coefficient is biased upwards due to omitted variables (ability). But the situation is more complicated if schooling is measured with error. Then the coefficient on schooling would be biased towards zero. So the total effect of omitted variables and measurement error in schooling on earnings is uncertain. Kazamaki-Ottersten et al. (1996) find that the measurement error in the schooling variable leads to greater bias as compared to omitted ability. Accounting for measurement error results in an increase in the estimated return to schooling; from 3.7 to 4.1 per cent in 1984. Isacsson (1999) shows that the measurement-error-adjusted estimate of returns to education in a sample of MZ twins is slightly biased upwards, due to omitted variables on ability. He also demonstrates that the conclusion about a potential ability bias in conventional estimates of returns to education depends crucially on the magnitude of the reliability ratio. Isacsson presents an estimate of the reliability ratio of approximately 0.88 in his sample. At that reliability ratio, the ordinary least squares estimate is 4.6 per cent, whereas the within-pair estimate of returns to education is 4.2 per cent.

Two complications arise when interpreting results from twin data. First, we cannot be sure that the estimates correspond to effects representative for the global population. The empirical findings in Isacsson, however, show that the sample of twins seems to be representative, and he cannot reject the assumption of equal within-pair abilities. Second, variations in the twin data stem from different educational attainment within twins. This, however, begs the question, why “identical” individuals, as assumed in these studies, obtain different education. This leaves room for differences in preferences across twins. Allowing for heterogeneity in preferences complicates the estimation of returns to schooling. We usually do not have good measures for controlling this heterogeneity.

Another approach is to use direct indicators of ability. Kjellström (1999a) reports that the estimated wage premiums for schooling fall considerably when ability is controlled for. For example, including scores from three intelligence tests in the earnings function reduces the coefficient on imputed schooling from 0.049 to 0.043 for those born in 1948 and from 0.044 to 0.039 for those born in 1953. So the decline in the return to schooling is about 16 per cent for the 1948 cohort and 13 per cent for the 1953 cohort. He also shows that the magnitude of the ability bias becomes only somewhat lower when also accounting for measurement error in the schooling variable. The

measurement-error-adjusted ability bias is only somewhat lower than previous research. The omitted ability bias is 13 and 10 per cent, respectively. Similar results are reported in Eriksson and Jonsson (1998), but they use grade point averages as an indicator of ability.

Palme and Meghir (1999) obtain basically similar results as those reported in Kjellström (1999a) when using the Swedish 1950-education reform (extension of the compulsory school from 7 to 9 years) as an instrument for educational choice. Their results imply that the point estimates increase when using explicit measures of ability as compared to using the school reform as an instrument.

Belzil and Hansen (1997), using another technique, report that controlling for ability and endogeneity bias leads to a higher rate of return. They estimate an optimal stopping model of the decision between continuing schooling and entering the labour market using a cross-section of Swedish labour force participants. Their model incorporates unobserved ability both at school and in the labour market. The estimates of returns to schooling for workers aged between 36 and 45 are around 4.9 per cent for males and 3.8 per cent for females. Corresponding ordinary least squares estimates are 3.5 per cent for males and 3.6 per cent for females.<sup>13</sup>

Björklund and Kjellström (1994) examine how sensitive the estimates on returns to education are for different measures of wages. In addition to hourly wages, they also use annual earnings before and after taxes, with and without self-employed individuals. The main finding is that returns to education depend strongly on which measure of earnings is being used. For instance, the estimate on returns to education for men in 1968 is 8.5 per cent when using hourly wages, whereas it amounts to 9.0 per cent and 7.2 per cent when using annual earnings before and after taxes, respectively. The estimate is somewhat higher when self-employed individuals are included.

Some studies investigate the internal rate of return. Björklund and Kjellström (1994), Edin et al. (1993), and Edin and Holmlund (1995) show that accounting for taxes and subsidised loans has a substantial effect on the calculations of the private internal rate of return to university education. For example, Edin and Holmlund (1995) find that

---

<sup>13</sup> However, the unstable reported empirical findings suggest that the estimates are very sensitive to model specification.

the internal rate of return to university education is 7 per cent in the absence of taxes, stipends, and loans, and over 11 per cent when one accounts for this. The internal rates reported in Björklund and Kjellström are lower, but due to the design of the student aid system, the calculated internal rate of return to education is quite sensitive to different assumptions about inflation, wage growth and interest rates.

Another aspect, which is important in interpreting the evaluation of returns to human capital, is the existence of rents in the labour market. If education attainment is correlated with variables such as industry affiliation, profits and capital intensity, it is not easy to separate the effects of rents associated with employer characteristics and returns to schooling. Arai (1994a) reports that industry wage premiums are strongly correlated with the average level of education within industries. Arai and Skalli (1996) find that inter-industry differentials turn insignificant when controlling for variation in returns to education across industries.<sup>14</sup> They offer two explanations. One interpretation for this result is that it indicates heterogeneity of education and thus differentiated returns to various types of education. Another explanation is that industry wage premiums are not evenly distributed across workers and that workers with higher education capture a higher share of these premiums compared with those with lower education. Arai (1999) reports that wages are correlated with the firms' profit level and capital-labour ratio. The correlation with profit drops to a half but remains significant when controls for human capital are introduced. This indicates a high correlation of human capital variables and profits.

Moreover, working conditions, fringe benefits and job characteristics are important components of jobs associated with different types of education. Individuals with the same educational level might be assigned to jobs that vary both in pay and job characteristics, according to tastes and technology. This means that job characteristics might have different impacts on wages in different sectors of the economy.<sup>15</sup>

---

<sup>14</sup> For studies of inter-industry differentials see Edin and Zetterberg (1992) and Arai (1994a).

<sup>15</sup> Arai (1994b) reports results indicating that workers who are able to set their work pace and working time (autonomous) have significantly higher wages in the private sector while these workers earn significantly lower wages in the public sector.

To sum up, previous studies indicate that the various sensitivity results do not modify the general picture obtained from the OLS estimates. An important finding is that returns to education fell sharply during 1968–1974 to persist at this level afterwards.

### **3.3 Explaining the fall in returns to schooling**

The fall in the returns to schooling has been interpreted as the result of the egalitarian wage policy. The overall wage differentials fell sharply from 1968 to 1974 and decreased slightly from 1974 to 1981 to increase slightly up to 1991. The changes in returns to schooling are similar to the changes in the overall wage structure.

Edin and Holmlund (1995) investigate whether this fall can be explained by an increase in the supply of skilled labour. They relate the estimated premium of university education based on seven cross-sections from 1968 to 1993 to the fraction of the labour force with university education during the period 1971–1993. They impute data for 1968 assuming the same development between 1968–1971 as in 1971–1974. They also use another data, i.e. university premiums for university education for white-collar men in manufacturing, mining and construction. This series displays a slightly different overall pattern. The fall in the beginning of the period is less sharp as compared with the corresponding change according to estimations from the LNU data. The rise in the university premium is steeper at the end of the period as compared to estimations based on the HUS data. The negative correlation between the university premium series and the fraction of university educated labour is interpreted as an indication that the fall in the wage premium during this period is compatible with an increased supply of labour with university education.

The major fall is during the period 1968–1974 and the changes after this period are not well pronounced. The corresponding change in the fraction of labour with university education is characterised by an increase in the entire period. The negative correlation reported by Edin and Holmlund (1995) seems to be critically dependent on the inclusion of the beginning of the period, i.e. 1968–1974. Another important aspect is that the increase in supply does imply a fall in university wage premiums only when the demand for labour with university education changes less. There are, however, indications that the demand for post-high school education has increased in the Swedish economy. The expansion of the public sector, schools, health care

and public administration are examples of sectors that have recruited labour with university education.

Edin and Holmlund (1995) as well as Fredriksson (1997) examine the relation between the university wage premium and student enrolment. In both cases, student enrolment is related to the university wage premium for white-collar men in manufacturing, mining and construction. They report that the changes in student enrolment are in line with the changes in the wage premiums. Three basic questions arise when trying to interpret these results. First, student enrolment must be related to the expected university premium rather than the actual premium given the wage structure. Second, the estimates for the university premium are taken from a non-representative sample. The university premium used in these studies does not differ much from results based on representative micro-data in the beginning of the period 1968–1985. The sharp rise in the university premium for the period 1987–1991 for white-collar men in manufacturing, mining and construction is not compatible with results from micro-data, however. The university premium in 1991 had reached the same level as in 1971 in this restricted sample. Results from LNU imply that the university premium in 1991 was at the same level as in 1974, implying no significant increase in the university premium from 1974 to 1991. Third, student enrolment corresponds to education of all types, while the university premium from mining, manufacturing and construction mainly applies to studies in engineering and business administration.

The increased supply of education opportunities through expansion of universities and schools as well as generous subsidised loans to students during the sixties is another part of the overall institutional change in the Swedish society characterised by a growing public sector and expanding welfare state. During the 1960s the traditional universities soon reached their capacity limits, and in 1977 the government decided that admission to higher education should be based on high school grade-points averages and on work experience. So, more persons compete for every educational slot, which means that the demand for higher education is not necessarily affected by the return to schooling in the short run.

Further research is needed to explain the changes in the return to education in Sweden. The developments in the nineties characterised by high unemployment, sharp increase in student enrolment and, consequently, increased supply of skilled labour along with increased

demand for this type of labour are important changes in demand and supply that influence the wage structure and the returns to education.

## 4 Returns to work experience

Returns to work experience can be divided into two components: returns to general human capital and returns to firm-specific human capital. This section deals with the returns to general human capital, and the next section with seniority. Le Grand (1994) reports results on changes in wage profiles by gender and sector of employment (see Table 2). The curvatures differ greatly over the years – to be the highest in 1968 and thereafter to be less pronounced; i.e., the coefficients on work experience for 1968 imply a much faster wage growth during the first years of work than the parameters for later years. These patterns are valid for both men and women.<sup>16</sup> For example, the return to five years of work experience for men is about 20 per cent in 1968 and about 10 per cent in 1991, with the main fall between 1968 and 1974. The return to 40 years of work experience is about 60 in 1968 and just under 50 per cent in 1991. Corresponding figures for women are lower.<sup>17</sup> Furthermore, the estimated parameters of work experience imply that in the years 1968, 1974, 1981 and 1991, wages peaked in the range 29–37 years of work experience for men and between 27–35 years for women. The peaks over time tend to occur at later stages in working life.

The estimates reported in Edin and Holmlund (1995) cover more years than the above-mentioned studies. By using information from both LNU and HUS they are able to estimate the earnings function for the following years; 1968, 1974, 1981, 1984, 1986, 1988 and 1991. The three first years refer to LNU and the other years to HUS. So they are able to examine more closely how the wage profiles devel-

---

<sup>16</sup> The coefficient on experience is significantly different across sexes only for the years 1981 and 1991. Experience squared is never significantly different across sexes.

<sup>17</sup> Björklund (1986) presents lower returns to experience due to the inclusion of age in the earnings function. Furthermore, his samples include both men and women, and a gender dummy captures any gender differences.

**Table 2. The return to work experience (log-%)**

	Year	Experi- ence	Total			Private			Public			
			Total	Men	Women	Total	Men	Women	Total	Men	Women	
Asplund et al. (1996)	1991	5	9.9	11.9	8.1		12.9	10.7		11.6	6.8	
		40	35.6	42.0	27.2		46.0	29.6		44.8	26.8	
Edin & Holmlund (1995)	1968	5	16.9									
		40	44.0									
	1974	5	12.8									
		40	36.8									
	1981	5	10.6									
		40	34.4									
	1984	5	10.3									
		40	43.2									
	1986	5	8.9									
		40	39.2									
	1988	5	8.8									
		40	34.4									
	1991	5	11.1									
		40	36.8									
	Le Grand (1994)	1968	5		20.1	17.2	18.3			16.9		
			40		56.0	38.4	51.2			45.6		
		1974	5		15.2	14.2	15.1			12.4		
			40		45.6	37.6	42.4			36.0		
1981		5		13.0	9.7	12.4			9.3			
		40		46.4	32.8	40.8			36.8			
1991		5		12.1	8.4	11.6			8.4			
		40		48.0	30.4	42.4			35.2			

oped during the 1980s. They capture any gender differences by a dummy for gender in the earnings function. They find that the curvature became more pronounced in the late 80s, with the profiles for 1981 and 1991 being more or less identical. This contradicts previous results. One explanation is that they do not have explicit information on work experience for all years, but have to rely on potential work experience for some years. Furthermore, the samples of HUS data for some of the years are quite small.

Le Grand also shows that the return to work experience is significantly higher in the private sector than in the public sector for the years 1981 and 1991, but the gap is quite small. For example, the return to five years of work experience is 12 (12) per cent in the private sector for 1981 (1991) and 9 (8) per cent in the public sector for 1981 (1991). Moreover, wages reached their maximum later in the public sector than in the private sector; after 37 to 39 years in the public sector and after 32 to 35 years in the private sector. Furthermore, the wage profile in the public sector is somewhat flatter than in the pri-

vate sector. Asplund et al. (1996) present similar estimates for 1991, but they also report the return to experience in the two sectors across gender. Regardless of the sector of employment, men have a somewhat higher return to work experience than women. They also show that the wage effect of experience is stronger in Sweden than in Denmark and Finland.

The work experience literature is not as sophisticated as the schooling literature. For example, little has been done to examine the consequences of measurement errors. Most likely, work experience is measured with errors, more severe ones than the errors in schooling. Moreover, the empirical specification of the earnings function, as proposed by Mincer (1974), implicitly assumes that all workers invest the same amount in on-the-job training. Because jobs are likely to differ in the amounts of on-the-job training, the effect of a change in work experience will not be the same for all individuals. According to the human capital theory, people who invest in human capital have lower initial earnings after school, but higher earnings growth than those who do not invest. Kjellström (1999b) estimates an earnings function, where the parameters are allowed to vary (stochastically) across individuals. The results show that ignoring this unobserved heterogeneity has minor consequences for traditional human capital variables, i.e. the coefficients on education and work experience. A natural question to ask is whether wage profiles vary systematically across occupations. Arai et al. (1998) show that the experience profile is steeper in high-wage occupations, and flatter in low-wage occupations. This result remains unchanged when controlling for selection into various occupations, indicating that heterogeneity in experience is closely related to occupational affiliation.

## 5 Returns to seniority

By including both work experience and seniority in the earnings equation, it is possible to get an indication on the importance of general and firm-specific human capital for wage determination.

Asplund et al. (1996) report that seniority is more important in Finland (1987) than in Sweden (1991). For example, 10 years of seniority raises wages by 2.5 (6) per cent in Sweden (Finland), while 10 years of work experience raises wages by 17 (13) per cent. So, the returns to total experience is about 20 per cent in both countries. Fur-



thermore, seniority seems to be more important in the public sector than in the private sector, and also more important for women than for men. Regnér (1997) also examines the relationships between seniority, experience, on-the-job training and wages. But in addition to seniority he includes seniority squared in the earnings equation. Again, the results indicate that seniority has a modest effect on hourly wages in Sweden. Cross-section wage equations predict that 10 years of seniority raises wages by 2.8 per cent, while 10 years of experience raises wages by almost 16 per cent. Fixed effects models predict significant effects of experience only, and the estimated wage effects are about the same as the cross-sectional estimates. He also presents results suggesting that a direct measure of on-the-job training has large and positive effects on the level of wages. Cross-sectional estimates suggest that workers who have participated in on-the-job training lasting more than 12 months earn significantly more (about 20 per cent) than workers who have participated in training lasting less than one month.

Björklund and Regnér (1996) report much higher returns to seniority, and lower returns to work experience. For example, the return to 10 years of seniority varies between 6 and 15 per cent depending on gender and sector of employment. This is due to their definition of experience. The experience variable in their study is the years of labour market experience before starting the current job.

Arai and Skalli (1996) analyse the cross-industry variation in returns to seniority in the firm, a variable usually interpreted as a measure of firm-specific human capital. Human capital theory predicts a positive seniority effect; stayers learn, increase productivity and are thus paid higher wages. This is not confirmed for all industries in Sweden, where the coefficient for seniority is negative for 10 out of 24 industries and negative and significant in the textile and services industries. The positive coefficients are significant in financial institutions, insurance and real estate industries. These results are unchanged when controlling for blue-collar status in the wage equation. No industry-specific seniority effect is rejected at conventional levels. While the mean seniority effect is 0.001, this estimate varies from -0.007 to 0.012, implying that the low overall returns to seniority in Sweden reflect the variation in the nature of this effect across industries. Negative effects of seniority on wages are theoretically compatible with a case where high-paid jobs are characterised by high turnover (lower mean seniority) compared with low-paid jobs. When selection and

internal promotion are not important, the low-paid jobs are occupied by low productivity workers who stay in because of the lack of better opportunities, and high-paid jobs are only open to outside candidates who might leave for more productive jobs. In such cases there is a negative relation between seniority and wages. On the other hand, in industries where selection and internal promotion are important, higher ability workers are promoted and hence stay, and less productive workers have to leave or stay in low-wage positions. This means higher turnover in low-paid jobs compared with high-paid jobs and thus a positive seniority-wage relation.

Finally, the low overall effect of seniority on wages might reflect the strong employment protection legislation in Sweden. Employment protection leads to a situation where unskilled workers stay longer time at the firm compared with a situation without employment protection. Many years at the same job does not then mean increased productivity and increased wages. However, only further empirical examination can highlight the sources of these different seniority effects.

## 6 Conclusions

There are numerous studies investigating the returns to human capital in Sweden and there is a considerable amount of research on sensitivity analysis of estimating returns to schooling. The basic message of these results is that accounting for potential problems associated with OLS estimation of a standard Mincer equation only leads to minor modifications of the results. We also observe that while many studies examine returns to education, far less studies deal with on-the-job training. Moreover, very little research is done on returns to various types of education. Economic pecuniary incentives for education in different subjects – technical, humanities etc. – might vary in importance. Moreover, these incentives most likely have different implications for economic growth. Another neglected area is the importance of fringe benefits and whether there is reason to revise the results on returns to human capital on the basis of variations in fringe benefits.

Returns to human capital are low in Sweden. The major changes in returns to human capital took place during the late sixties and

early seventies. During the same period, wages were compressed in almost all dimensions in Sweden. There has been a minor tendency towards increased returns to human capital after 1981. We know less about the impact on wage structures and returns to human capital of the recent developments in the Swedish labour market. During the nineties unemployment and student enrolment increased rapidly and a general impression is that education requirements for employment have increased.

## References

- Albæk, K., Arai, M., Asplund, R., Barth, E. and Strøjer, E.M. (1998), Measuring Wage Effects of Plant Size, *Labour Economics*, 5, pp. 425-448.
- Arai, M. (1994a), Empirical Analysis of Wage Dispersion and Efficiency Wages, *The Scandinavian Journal of Economics*, 96, pp. 31-50.
- Arai, M. (1994b), Efficiency Wages Versus Compensating Wage Differentials, An Empirical Study of Job Autonomy and Wages, *Industrial Relations*, 33, pp. 249-61.
- Arai, M. (1999), *Rent Sharing in the Swedish Labor Market*. Working Paper 99:3, Department of economics, Stockholm University.
- Arai, M. and Skalli, A. (1996), The Structure of Wages: A French-Swedish comparison of cross-industry variation in the impacts of observable wage determinants, in *Comparaisons Internationales de Salaires*. DARES-INSEE, Actes du colloque.
- Arai, M. and Thoursie, A. (1997), Individ- och yrkesskillnader mellan kvinnor och män: Hur påverkar de lönen?, in Persson, I. and Wadensjö, E. (eds), *Kvinnors och mäns löner - varför så olika?* SOU 1997:136, Fritzes, Stockholm.
- Arai, M., Asplund, R. and Barth, E. (1998), Low Pay, A Matter of Occupation, in Asplund, R., Sloane, P. and Theodossiou, I. (eds), *Low Pay and Earnings Mobility in Europe*. Edgar Elgar Publishing.
- Asplund, R., Barth, E., Smith, N. and Wadensjö E. (1996), The male-female wage gap in the Nordic countries, in Wadensjö, E. (ed.) *The Nordic labour markets in the 1990's - Part 1*. North-Holland, Amsterdam.
- Barro, R.J. and Sala-i-Martin, X. (1995), *Economic Growth*. MacGraw-Hill.
- Becker, G. (1962), Investment in Human Capital: A Theoretical Analysis, *Journal of Political of Economy*, 70, pp. 9-49.
- Belzil, C. and Hansen, J. (1997), *Estimating the returns to education from a non-stationary dynamic programming model*. Dissertation thesis at the Department of Economics, Göteborgs University.
- Björklund, A. (1986), A comment on the wage structure and the functioning of the labor market, in Siven, C-H. (ed.), *Unemployment in Europe: analysis and policy issues*. Timbro.

Björklund, A. and Kjellström, C. (1994), Avkastningen på utbildning i Sverige 1968 till 1991, in Eriksson, R. and Jonsson, J. (eds), *Sorteringen i skolan*. Carlsons.

Björklund, A. and Kjellström, C. (1999), Estimating the return to investments in education: how useful is the standard Mincer equation?, in *Essays on Investment in Human Capital*, The Swedish Institute for Social Research, Dissertation Series 36, Stockholm University.

Björklund, A. and Regnér, H. (1996), Humankapital-teorin och utbildning på arbetsplatserna, in le Grand et al. (eds), *Sveriges arbetsplatser*. SNS förlag.

Blau, F. and Khan, L. (1995), The Gender Earnings Gap: Some International Evidence, in Freeman, R. and Katz, L. (eds), *Differences and changes in wage structures*. The University of Chicago Press.

Edin, P-A. (1992), *Swimming with the tide: Solidarity wage policy and the gender earnings gap*. Unpublished manuscript. Department of Economics, Uppsala University.

Edin P-A., Fredriksson, P. and Holmlund, B. (1993), Utbildningsnivå och utbildningsavkastning i Sverige, in Björklund, A. and Forslund, A. (eds), *Studier av svensk utbildning*. Ekonomiska Rådets Årsbok 1993.

Edin, P-A. and Holmlund, B. (1995), The wage structure: the rise and fall of solidarity wage policy?, in Freeman, R. and Katz, L. (eds), *Differences and changes in wage structures*. The University of Chicago Press.

Edin, P-A. and Richardsson, K. (1997), Lönepolitik, lönespridning och löneskillnader, in Persson, I. and Wadensjö, E. (eds), *Kvinnors och mäns löner - varför så olika?* SOU 1997:136, Fritzes, Stockholm.

Edin, P-A. and Zetterberg, J. (1992), Inter-Industry Wage Differentials: Evidence from Sweden and a Comparison with the United States, *American Economic Review*, 82, pp. 1341-1349.

Eriksson R. and Jonsson, J. (1993), *Ursprung och utbildning*. SOU 1993:85, Fritzes, Stockholm.

Eriksson, R. and Jonsson, J. (1998), Social origin as an interest-bearing asset: family background and labour-market rewards among employees in Sweden, *Acta Sociologica*, 41.

Eriksson, R. and Åberg, R. (1987), *Welfare in Transition. A Survey of Living Conditions in Sweden 1968-1981*. Clarendon Press, Oxford.

Fredriksson, P. (1997), Economic Incentives and the Demand for Higher Education, *Scandinavian Journal of Economics*, 99, pp. 129-142.

Fritzell, J. and Lundberg, O. (eds) (1994), *Vardagens villkor – Levnadsförhållanden i Sverige under tre decennier*. Brombergs förlag.

le Grand, C. (1991), Explaining the male-female wage gap: Segregation and solidarity wage bargaining in Sweden, *Acta Sociologica*, 34, pp. 261-278.

le Grand, C. (1994), Löneskillnaderna i Sverige: förändring och nuvarande struktur, in Fritzell, J. and Lundberg, O. (eds), *Vardagens villkor – Levnadsförhållanden i Sverige under tre decennier*. Brombergs förlag.

Hemström, M. (1998), *Salary Determination in Professional Labour Markets*. Department of Economics, Economic Studies 36, Uppsala University.

Härnqvist, K. and Svensson, A. (1973), A Swedish Data Bank for Studies of Educational Development, *Sociological Microjournal*, 7, pp. 35-42.

Isacsson, G. (1999), Estimates of returns to education in Sweden from a large sample of twins, *Labour Economics*. (forthcoming)

Jonung, C. (1984), Patterns of occupational segregation by sex in the labour market, in Schmid G. and Weizel, R. (eds), *Sex discrimination and equal opportunity*. Gower.

Kazamaki-Ottersten, E., Mellander, E., Meyerson, E. and Nilson, J. (1996), *The measurement of the return to education revisited*. Working paper, the Industrial Institute for Economic and Social Research, Stockholm.

Kjellström, C. (1999a), Omitted ability bias and the wage premium for schooling: new Swedish evidence, in *Essays on Investment in Human Capital*. The Swedish Institute for Social Research, Dissertation Series 36, Stockholm University.

Kjellström, C. (1999b), Heterogeneous on-the-job training: Implications for the specification and estimation of the human capital earnings function, in *Essays on Investment in Human Capital*. The Swedish Institute for Social Research, Dissertation Series 36, Stockholm University.

Krueger, A. and Lindahl, M. (1999), *Education for Growth: Why and for Whom?*. Mimeo, Princeton University.

Löfström, Å. (1992), *Diskriminering på svensk arbetsmarknad*. Umeå Economic Studies, nr. 196, Umeå University.

Mincer, J. (1974), *Schooling, Experience, and Earnings*. Columbia University Press, NY.

Meyerson, E., Petersen, T. and Snartland, V. (1996), *The within-job gender wage gap: The case of Sweden*. IUI Working Paper No. 470, Industriens utredningsinstitut, Stockholm.

Palme, M. and Meghir, C. (1999), *Assessing the Effect of Schooling on Earnings Using a Social Experiment*. Working paper, Stockholm School of Economics.

Palme, M. and Wright, R. (1998), Changes in the rate of return to education in Sweden 1968-1991, *Applied Economics*, 30.

Persson, I. and Wadensjö, E. (eds) (1997), *Kvinnors och mäns löner - varför så olika?* SOU 1997:136, Fritzes, Stockholm.

Regné, H. (1997) *Training at the job and training for a new job: two Swedish studies*, Dissertation thesis at the Swedish Institute for Social Research, Stockholm University.

Richardsson, K. (1997), Estimating the Impact of Wage Structure on Wage Differentials between Two Groups of Workers, in *Essays on Family and Labor Economics*. Swedish Institute for Social Research, Dissertation Series 28.

Svensson, A. (1971), *Relative Achievement – School Performance in Relation to Intelligence, Sex and Home Environment*. Almqvist & Wiksell, Stockholm.

Thoursie, A. (1998), Individual and Occupation-Specific Differences between Women and Men: How Do They Affect the Gender Wage Gap?, in *Studies on Unemployment Duration and the Gender Wage Gap*. Swedish Institute for Social Research, Dissertation Series 35, Stockholm University.

Wadensjö, E. (1991), *Högre utbildning och inkomster*, in Expertrapport till Produktivtetsdelegationen SOU 1991:82, nr 4.

Zetterberg, J. (1988), *Lönestruktur i privat och offentlig sektor*. National-ekonomiska Studier, 98:2, Uppsala University.

Zetterberg, J. (1994), Effects of changed institutional conditions on male-female wage differentials in the Swedish public sector, *Public Administration, an international quarterly journal*, 18(3), pp. 342-358.

## Appendix: Main data sources

### *The Level of Living Surveys (LNU)*

LNU contains about 6,000 randomly sampled people between ages 16 and 75 (18–75 for 1991), where the primary sample from 1968 constitutes the base for these surveys: 1974, 1981 and 1991. The non-response rate has increased over time; from 9 per cent in 1968 to roughly 20 per cent in 1991.<sup>18</sup> Examples of the available variables in LNU are: years of schooling, highest educational level and programme, work experience, tenure, gross and net hourly wage (constructed from weekly, monthly or annual earnings), working conditions, sector of employment, occupational status, parental occupation and education.

LNU data from 1991 are also matched with data on firms' annual accounting data. The firm data contain information on profits, firm size, capital etc. on a yearly basis for the period 1987–1991. The sample includes private sector non-agricultural employees in 1991. Combining 1991 *Swedish Establishment Survey (APU)* and *Sweden Statistics (SCB) data*, yields information on plant size for the workers in 1991. County and municipal unemployment is from the *Swedish Labour Market Board (AMS)*. The matched sample includes 726 individuals in 689 firms.

### *The Household Market and Non-market Activities Surveys (HUS)*

HUS contains information on both the household and the individuals who make up the household. The 1984 survey was based on a stratified cluster sample of people aged 18–74, and of over 2,300 households to which these individuals belong. The data contain information on years of schooling, highest educational level completed, work experience, hourly wage, parental occupation and education, etc. This survey was followed by smaller surveys in 1986, 1988 (considerably smaller), 1991, 1993 and 1996. As a complement to those who were re-interviewed, a supplementary sample was added. This supplementary sample consists partly of those who become adult members of existing households, partly of a new random sample of households. For some of the years, only individuals in the new supplementary samples were asked questions on, for example, work experience and years of schooling. For the

---

<sup>18</sup> See Eriksson and Åberg (1987) and Fritzell and Lundberg (1994).



rest, we have to construct these variables by using information from previous years. The non-response rate is about 20 per cent.

*The Individual Statistics project (IS)*

These data consist of two nationally representative samples (age cohorts) of pupils born in 1948 and 1953. The samples cover basically all individuals born on the 5<sup>th</sup>, 15<sup>th</sup> and 25<sup>th</sup> of each month during these years. The data sets include information on scores on achievement tests in Swedish, English and mathematics, school marks in Swedish, English and mathematics, scores from three intelligence tests representing the verbal, spatial and reasoning factors of intelligence. There is also information on the respondents' attitude to higher education, parents' attitude to higher education and parental education and occupation. Data were collected in 1961 and 1966 when the respondents were between 12 and 13 years of age.<sup>19</sup> Information on the highest educational level and yearly earnings are from SCB registers (*utbildningsregistret and ÅRSYS*) in 1993.

*The Twin registry*

This is a large sample of twins (monozygotic and dizygotic) born in Sweden between the years 1886 to 1967. This sample has been linked to the educational registry (1990 and 1993) and to ÅRSYS. Data on earnings are available for three years: 1987, 1990 and 1993.

*Project on Class Structure and Class Consciousness (CSCC)*

This data set includes information on before-tax income, educational status, age, working conditions, occupation and seniority for a number of countries. The Swedish survey of 1980 represents its employed population aged 18–65. A sample of households was selected. Thereafter, one respondent in each household was chosen to answer questions about their own work characteristics, those of their spouses, household composition, etc. The response rate was 76 per cent. The sample for Sweden includes information on income in previous years (different sources), kind of education obtained, but information on work experience and tenure is missing. The total sample size is 1,145.

---

<sup>19</sup> See Svensson (1971) and Härnqvist and Svensson (1973).

Table A1

	Arai & Skalli (1996)	Asplund et al. (1996)	Björklund (1986)	Björklund & Regnér (1996)
Data (year)	LNU (91)	LNU (91)	LNU (68, 74, 81), HUS (84)	LNU (91)
Dependent variable	Log (gross hourly wage)	Log (gross hourly wage)	Log (gross hourly wage)	Log (gross hourly wage)
Age and age squared			X	
Years of education	X	X	X	X
Levels of education		X		
Experience	X	X	X	X
Experience squared	X	X	X	X
Experience of higher order				
Tenure	X	X		X
Tenure squared				X
Job qualification, occupation		X		
Public/private sector		X		
Firm/plant size	-/X			
Region	X			
Sector of activity	X			
Civil status	X			X
Sample size in hundreds	Private: 16	33	26(1968), 31(1974), 34(1981), 16(1984)	32
Estimation technique	OLS	OLS	OLS	OLS

Table A2

	Blau & Kahn (1995)	Edin & Holmlund (1995)	Le Grand (1994)	Regnér (1997)
Data (year)	CSCC (80)	LNU (68, 74, 81), HUS (84, 86, 88, 91)	LNU (68, 74, 81, 91)	LNU (81, 91)
Dependent variable	Log (annual earnings)	Log (gross hourly wage)	Log (gross hourly wage)	Log (gross hourly wage)
Age and age squared				
Years of education	X (calculated)	X	X	X
Levels of education				
Experience	X (potential)	X (potential for some years)	X	X
Experience squared	X (potential)	X (potential for some years)	X	X
Tenure				X
Tenure squared				X
Occupation	X			
Public/private sector			X	
Sector of activity	X			
Civil status				X
Sample size in hundreds	8	30 (1968), 30 (1974), 34 (1981), 16 (1984), 18 (1986), 15 (1988), 13 (1991)	29(1968), 30 (1974), 33 (1981), 33 (1991)	Men: 10 (Panel 81-91), 16 (1991)
Estimation technique	OLS	OLS	OLS	OLS, Fixed effects and Random Growth

