CHAPTER 15

Wages and Human Capital: Evidence from Switzerland

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1 Introduction[1]

The aim of the following study is to give an overview over the existing literature on research in the field of wages and human capital in Switzerland. As we are particularly interested in education related issues and private returns to education, we focus on the link between wages and human capital variables such as years or type of schooling and experience. Mainly we try to find out, if the results of different studies are similar, that is, if they are robust to different data sets, equation specifications and estimation procedures.

All reviewed studies report significant and positive rates of return to an additional year of schooling. The results are relatively robust across different specifications of earnings functions. The level of estimated returns, however, differ between men and women, ethnical groups and types of education. Estimations of returns to (potential) labour market experience are also quite robust across different studies. We find that returns are generally lower for women, i.e., that their age-earnings profiles are flatter. Tenure, which is an indicator of firm specific human capital, has a positive effect on wages.

The question of how to finance education in Switzerland has so far only rarely been adressed. Further research is certainly needed, in order to gain further insights about the link between the educational system as well as other institutional factors and the labour market.

The study is organised as follows. The second section outlines the aims of the reviewed literature. The third section gives a description of the data sets used. The fourth section explains the different estimation procedures that can be found in the literature. The main estimation results are summarised and compared in the fifth part. In section six we conclude, what we know and what we do not but should know about private returns to education in Switzerland.

2 Aims of the reviewed studies

In the context of wages and human capital most of the research in Switzerland so far has focused on wage discrimination. Wage differ-

[1] The authors would like to thank Aniela Wirz from the ETH-KOF in Zürich for helpful contributions.

entials by gender were for the first time analysed econometrically by Kugler (1988). His study consists of Mincer wage equations including the standard human capital variables *years of schooling* and *experience* as well as health. Kugler also corrects for sample selection bias due to unobserved wages of women not participating in the labour market. Diekmann and Engelhardt (D&E, 1995) have performed a similar estimation of female wage discrimination based on the first Swiss Labour Force Survey (SLFS) of 1991, also correcting for sample selection bias and additionally controlling for sector of employment. Bonjour (1997) has calculated a great variety of measures of wage discrimination using the SLFS of 1991 to 1993. In addition to the standard human capital variables, she controls for women's probability of *labour market participation*, for tenure, hierarchical level of the job and firm size. She also tests different estimation settings, for instance *endogenous experience*. The most recent estimations of wage differentials by gender have been carried out by Ferro-Luzzi and Silber (FL&S, 1998) and Henneberger and Souza-Poza (H&S, 1998a,b).

A second question which has been addressed by labour market economists in Switzerland is wage discrimination against foreign workers. (About 25% of the labour force in Switzerland are foreign workers.) Golder (1997) and De Coulon (1998a,b) have examined this question by estimating wage functions for different ethnical groups, controlling for human capital variables as well as individual and job related characteristics.

Curti (1998) in her study has tested, if *unemployment* causes wage losses after re-employment. In order to correct for selectivity biases, she controls for the risk of getting unemployment as well as the probability of being re-employed. Additionally, she includes several variables like tenure, nationality, region, sector of employment and plant size in her Mincer wage equations.

Ferro-Luzzi (1996) estimates earnings functions in order to quantify the impact of job related, personal and regional factors on gross wages of women and men in Switzerland.

Sheldon (1992) was the first to explicitly estimate private rates of return to *different types of education* in Switzerland. His econometric model consists of wage equations for people with different types and levels of education. To correct for the bias caused by *self-selection* into the (ex post) observed types of education, he simultaneously models the *process of educational choice*. He finds that

the consideration of this selection process substantially alters the estimation results obtained by the standard Mincer approach.

The profitability of education has also been estimated by Wolter (1994), Weber (1998) and Wolter and Weber (1999). They have chosen the so called *Cost-Benefit Approach* to calculate *net present values of lifetime earnings* as well as *private rates of return to education* (Psacharopoulos, 1987). Taking into account income taxes, direct educational costs, the risk of dropping out of school and the unemployment probability, they calculate rates of return for men and women and different types of education. Finally they discuss whether the after-tax wage premium for education is high enough to justify further financial contribution to educational costs by students. As these studies are based on a different approach, the main results as well as the applied method will be presented in the appendix of this chapter.

3 Data sets

The data used in Kugler (1988) and Sheldon (1992) are drawn from two merged data sets: the first representative *health survey* (SOMIPOPS) and the *Income and Wealth Survey* (SEVS).[2] The sample of 4,250 observations is representative for the adult population, permanently resident in Switzerland in 1981/82. For the mentioned studies, variables on the labour market status, type of occupation, education, wages, household incomes, health and socio-demographic characteristics have been used. The two data sets are the first ones to give a representative picture of wages and human capital in Switzerland at a micro level.

Today the main data source for labour market related questions is the *Swiss Labour Force Survey* (SLFS), which is annually produced by the Swiss Federal Statistical Office (SFSO) since 1991. By far the major part of the reviewed studies is based on this data set. The SLFS is a rotating panel survey, that allows analyses of cross-sections and – in somewhat lesser detail – panels of a maximum of five years. One major advantage of the SFLS is its great variety of information on in-

[2] SOMIPOPS: *Soziomedizinisches Indikatorensystem der Population der Schweiz*, NFP 8, Projekt 4.350.079.08. SEVS: *Schweizerische Einkommens- und Vermögensstichprobe*, NFP-Projekt 1.455.0.81.

dividual, household-specific and work-related issues. Many variables (e.g. the labour market status) are defined according to international standards, which allow for international comparisons. The sample of 16,000–18,000 observations per year is representative for the adult population (>15 years). The data are collected by telephone interviews.

Table 1 gives an overview over the data sets and sample sizes used in the reviewed studies.

Table 1. Data sets and sample sizes (wage earners)

	Data set	Year	Total	Female	Male	Foreigners
Kugler (1988)	SOMIPOPS/ SEVS	1981 /82	1865	580	1285	540
Sheldon (1992)	SOMIPOPS/ SEVS	1981 /82	656	-	656	-
D&E (1995)	SLFS	1991	4510	1967	2543	-
Ferro-Luzzi (1996)	SLFS	1991	6563	2944	3563	x
Bonjour (1997)	SLFS	1993	6125	2597	3528	x
FL&S (1998)	SLFS	1991	4528	2037	2491	x
FL&S (1998)	SLFS	1995	10728	4907	5821	x
H&S (1998a)	SLFS	1995	8565	1804	6761	x
H&S (1998a)	SLFS	1997	4852	1299	3553	x
Golder (1997)	SLFS	1995	5856	-	5856	974
De Coulon (1998a,b)	SLFS	1995	5878	-	5878	860
Curti (1998)	SLFS	1993-97	17374	x	x	x

Note: x = included, number not indicated.

4 Estimation procedures

4.1 Functional form

Almost all the reviewed of the following form [3] studies are based on more or less extended types of Mincer wage equations

$$\ln(w) = \alpha_0 + \alpha_1 EDUC + \alpha_2 EXP + \alpha_3 EXP^2 + \alpha_4 X_1 + \alpha_5 X_2 + \ldots + \varepsilon \qquad (1)$$

[3] Wolter (1994), Weber (1998) and Wolter and Weber (1999) use the so-called cost-benefit approach, which is described in the appendix of this chapter.

The wage variable *(w)* is defined as a gross hourly wage rate in Kugler (1988), Sheldon (1992), Ferro-Luzzi (1996), FL&S (1998), Bonjour (1997), De Coulon (1998a,b) and H&S (1998a,b). D&E (1995) use monthly gross earnings and Curti (1998) and Golder (1997) define their dependent variable as the log of annual gross earnings.

The human capital variable of education is defined as *years of schooling* except for Sheldon (1992), where rates of return are calculated for different types of education. None of the data sets, however, allows to observe years of schooling directly. The schooling variable was therefore estimated using the highest educational degree achieved as a proxy. Golder (1997) also includes a squared term of years of education in order to take into consideration decreasing respectively increasing returns to education.

The variable of *total actual experience* can neither be found in the original data sets. In most studies it is approximated by experience = age – years of schooling – 6.5 which is actually a measure of potential experience. Actual experience was approximated by a variable of experience without a break of 6 months in Bonjour (1997) and H&S (1998a,b). Contrary to potential experience, with this variable one risks to underestimate actual labour market experience, especially for women. D&E (1995) additionally use a corrected variable for women's experience by subtracting 3 years per child from potential experience. Curti (1998) and sometimes Bonjour (1997) have used the age variable instead of experience in their wage functions.

Ferro-Luzzi (1996), Bonjour (1997), Curti (1998) and H&S (1998a,b) further include *tenure* as a proxy for the accumulation of firm specific human capital. Kugler (1988) and Sheldon (1992), on the other hand, insert a human capital variable for *health* in their wage regression.

4.2 Additional control variables

Table 2 gives an overview of the control variables used in the different studies. Not all mentioned variables were included at the same time in one model. Some of them, especially those about household characteristics like the number of children, the household income and the martial status, were used to model the selection process of labour market participation and were typically not included in the wage equation itself.

Table 2. Wage functions: variables included

Wage concept	Kugler (1988) hourly gross	D&E (1995) monthly gross	Bonjour (1997) hourly gross	FL&S (1998) hourly gross	H&S (1998a) hourly gross	H&S (1998b) hourly gross	De Coulon (1998a,b) hourly gross	Golder (1997) annual gross	Curti (1998) annual gross	Ferro-Luzzi (1996) hourly gross	Sheldon (1992) hourly gross
Age			x		x	x			x		x
Age sq			x		x	x			x		
Experience[1]	x	x	x[2]	x	x[2]	x[2]	x	x		x	x
Experience sq[1]	x	x	x[2]	x	x[2]	x[2]	x	x		x	x
Years of schooling	x	x	x	x	x	x	x	x	x	x	
Years of schooling sq								x			
Type of education							x		x		x
Tenure			x	x	x	x			x	x	
Tenure sq										x	
Management function			x	x	x	x	x	x	x	x	
Log working hours		x			x						
Firm size			x	x			x	x	x	x	
Sector of activity		x						x	x		
Profession			x	x				x			
Region								x	x	x	x
Martial status	x	x	x		x	x	x		x		
Number of children	x	x	x		x	x	x				
Household income		x	x		x	x					
Selection bias correction[3]	x	x	x		x	x[4]	x		x[5]		
Other variables	assets, health		typical male/female professions			house owning	nationalities, years since immigration	nationalities, type of contract, training	training, experience with unemploym.	regional unemployment rates, working conditions	assets, health

Notes: [1] potential experience; [2] experience without a break of 6 months; [3] typically selection bias correction for labour market participation of women, sometimes for men; [4] additionally correcting for the selection bias due to non-response; [5] correcting for the risk of getting unemployed as well as the probability to find a job again.

4.3 Correction for selectivity biases

The estimations of Kugler (1988), D&E (1995), H&S (1998a) and Bonjour (1997) consist of two stages. In a first step the individual probability of labour market participation is estimated using a probit function.[4] The estimation results are used to compute the so-called inverse of Mills' ratio, a selection bias variable. This variable, in a second step, is included in the wage regression to correct for non-observed wages of people not participating in the labour market. This procedure is found to influence substantially the measures of female wage discrimination as well as the coefficients of the human capital variables for women (see estimation results). Golder (1997) and Sheldon (1992) focus on wages of men and therefore do not correct for the mentioned selection bias. De Coulon (1998a) estimates the wage equations simultaneously with the selection rule by maximum likelihood, in order to correct for the selectivity bias.

Curti (1998) uses a double selectivity approach to correct for the selection bias in her sub-sample of people affected by unemployment. In order to take into account the selection processes of job losses and reintegration into the labour market, she uses the same methodology as described above. Unlike the mentioned studies, however, she estimates *two* probit functions, one for the *risk of loosing a job* and one for the *probability of finding a job* after a certain period of unemployment. The selection bias variables derived by these models are both inserted in the wage regression.

H&S (1998b) also use a double selectivity approach. Additionally to non-participation in the labour market, they take into account the potential selection bias due to *non-response* in the wage question in the SLFS.

4.4 Different specifications

Bonjour (1997) in her work tests several model specifications. With the help of the so-called *Hausman test* she finds empirical

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[4] As the rate of labour market participation of men is very high (>96% between 1991 and 1993), D&E (1995) and Bonjour (1997) carry out this step for women only.

evidence indicating that in the case of women, experience is not independent of the wage. For that reason she treats experience as an endogenous variable that depends on the logarithm of the wage, the number of children, age and duration of marriage or number of years since an eventual divorce. The simultaneous wage and experience functions are then estimated by two- and three-stage least squares (2SLS, 3SLS). As a variation of this model, Bonjour uses an instrumental variable approach (IV) in order to account for endogenous experience. She uses the exogenous variables of the simultaneous model as instruments for experience and experience squared in the original wage function. Similar tests of different specifications can be found in H&S (1998a).

4.5 Rates of return to educational degrees

Unlike most other authors Sheldon (1992) does not estimate the rate of return of an additional year of schooling, but the rate of return to a *certain type of education*. The estimated rate of return is given by equation (2), where $(\alpha_0)_h$ and $(\alpha_0)_{h-1}$ correspond to the intercepts in two wage equations, for people having attained consecutive educational levels h and h–1, respectively. The variables S_h and S_{h-1} stand for the average years of schooling necessary to reach the respective educational level.[5]

$$E(r) = [(\alpha_0)_h - (\alpha_0)_{h-1}]/[S_h - S_{h-1}] \qquad (2)$$

Sheldon furthermore accounts for selection processes of the educational system. He models the allocation process to different types of education, in order to correct for the bias caused by self-selection into the (ex post) observed types of education. The direction of the selection bias shows whether the self-selection process is efficient, that is, if self-selection generates higher rates of return to education than a random selection process would.

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[5] Sheldon (1992) uses extended forms of Mincer equations without years of education. Equation (2) therefore holds for individuals with zero value in all other control variables.

5 Estimation results

5.1 Rates of return to years of schooling

All reviewed studies on wage discrimination contain several estimations of Mincer wage equations. The coefficients associated with years of schooling, which are often interpreted as an average rate of return to an additional year of schooling, are summarised in Tables 3a-e. Wage equations without or with only a few additional control variables are called standard, whereas equations with more than three control variables are called extended.

Table 3a. Standard wage equations: education

		Coefficients for years of education		
	Year	Females	Males	All
Kugler (1988)	1981/82	0.091	0.055	-
D&E (1995)	1991	0.080	0.075	-
Bonjour (1997)	1991	0.075	0.083	-
Bonjour (1997)	1992	0.078	0.082	-
Bonjour (1997)	1993	0.079	0.078	-
Bonjour (1997)*	1991	0.070	0.070	-
Bonjour (1997)*	1992	0.074	0.068	-
Bonjour (1997)*	1993	0.078	0.066	-

Note: * using age and age^2 instead of exp and exp^2

Table 3b. Extended wage equations: education

		Coefficients for years of education		
	Year	Females	Males	All
Ferro-Luzzi (1996)	1991	0.074	0.075	0.075
Ferro-Luzzi (1996) +	1991	0.067	0.068	0.070
D&E (1995)	1991	0.074	0.075	-
Bonjour (1997)	1991	0.073	0.073	-
Bonjour (1997)	1992	0.075	0.071	-
Bonjour (1997)	1993	0.076	0.067	-
FL&S(1998)	1991	0.103	0.096	-
FL&S(1998)	1995	0.090	0.091	-
H&S (1998a)	1995	-	0.066	-
H&S (1998a)	1997	-	0.061	-
Curti (1998)*	1993-97	-	-	0.064
Curti (1998)*+	1993-97	-	-	0.058

Notes: * using age and age^2 instead of exp and exp^2
+ Estimation setting with more additional control variables.

Table 3c. Standard wage equations corrected for selection biases: education

	Year	Coefficients for years of education		
		Females	Males	All
Kugler (1988)	1981/82	0.072	0.060	-
D&E (1995)	1991	0.075	-	-
Bonjour (1997)*	1991	0.065		-
Bonjour (1997)*	1992	0.070		-
Bonjour (1997)*	1993	0.075		-

Note: * using age and age^2 instead of exp and exp^2

Table 3d. Extended wage equations corrected for selection biases: education

	Year	Coefficients for years of education		
		Females	Males	All
D&E (1995)	1991	0.070	-	-
De Coulon (1998a)	1995	-	0.086	-
H&S (1998a)	1995	0.065	-	-
H&S (1998a)	1997	0.061	-	-
Bonjour (1997)*	1991	0.065	-	-
Bonjour (1997)*	1992	0.068	-	-
Bonjour (1997)*	1993	0.072	-	-

Note: * using age and age^2 instead of exp and exp^2

Table 3e. Extended wage equations with endogenisation of experience: education

	Year	Coefficients for years of education		
		Females	Males	All
Bonjour (1997)**	1993	0.079	-	-
Bonjour (1997)***	1993	0.065	-	-
Bonjour (1997)****	1993	0.077	0.071	-
H&S (1998a)**	1995	0.079	-	-
H&S (1998a)**	1997	0.077	-	-

Notes: ** simultaneous model estimated by Two-Stage Least Squares (2SLS), using age, approximated exp and exp^2

*** simultaneous model estimated by Three-Stage Least Squares (3SLS), using age, approximated exp and exp^2

**** extended wage equation with instrumented experience and experience squared (IV), using approximated exp and exp^2

A comparison of the coefficients associated with education obtained from different estimation settings reveals that ...

(1) rates of return to education estimated by Mincer equations are fairly robust across different studies in Switzerland.[6]

(2) extensions of the standard wage equation by the addition of control variables lower the rates of return to education.

(3) inclusion of age instead of experience lowers the rates of return to education.

(4) correction for selectivity biases of labour market participation lowers the rates of return to education for women.

(5) endogenisation of experience does not alter the rates of return to education when compared to results without selectivity correction. Hence the returns are higher than those obtained from extended wage equations corrected for selection biases.

Comparison of rates of return to education for men and women over time reveals that ...

(1) rates of return to education for men rose during the eighties and slightly declined in the nineties.

(2) rates of return to education for women declined in the eighties, rose from 1991 to 1993 (Bonjour, 1997) and declined again between 1995 and 1997 (H&S, 1998).

(3) differences in rates of return to education between men and women have declined since the early eighties. Whereas women had remarkably higher rates of return than men in the early eighties returns were very similar or only slightly higher throughout the nineties.

Golder (1997) is the only author to add a term of years of schooling squared to the wage function. With the corresponding coefficients, *marginal rates of return to education* can be derived. The marginal rate of return to the 10th year of schooling – which is the

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[6] It has to be mentioned, however, that with the exception of Kugler (1988), all studies are mainly based on the same data source (SLFS).

first post compulsory year in Switzerland – amounts to 0.071 in the first estimation setting and to 0.077 in a setting with additional control variables for men. For the 18th year of schooling – for instance the last year at university – there results a marginal rate of return of 0.005 and 0.016 depending on the number of control variables included.

De Coulon (1998a,b) and Golder (1997) as well as Kugler (1988) find evidence, that rates of return to education remarkably differ between Swiss and foreign workers. All three authors find, that rates of return to schooling are lower for the foreign population than for natives. With a further analysis De Coulon can show that for all immigrants, education acquired in their home country is less rewarded than education obtained in Switzerland, which on the one hand could reflect differences in the quality of the education between countries or simply the fact that human capital is not a perfectly mobile asset.[7]

5.2 Rates of return to different educational degrees

Somewhat different measures of rates of return to education are given by Sheldon (1992). Unlike the above cited studies, he estimates the rate of return to a certain type of education compared to the next lower educational degree. Not correcting for selectivity biases he finds rates of return between –8.2 and 19.4%, depending on the type of training.[8]

Correcting for the bias caused by self-selection into the ex post observed types of education, Sheldon finds substantially higher rates of return compared to standard estimations. His corrected rates of return amount to 6.4 – 38.8%, depending on the type of education. The direction of the selection bias shows, that the self-selection process is efficient in all but one case, i.e., that self-selection leads to higher rates of return to education than a random selection process would.

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[7] Rates of return to education abroad 0.040–0.076 vs. 0.052–0.118 for education in Switzerland, depending on the region of origin.

[8] The results for higher vocational colleges, university and university entrance certificates are based on a weak database (between 23 and 51 observations). This might partly explain the rather extreme results.

Table 4. Private rates of return to different levels of education for men (in per cent)

	Sheldon (1992)	
Year	1981/82	1981/82*
Apprenticeship (3-4 years after compulsory schooling)	11.7	14.8
Higher vocational college (2 years after apprenticeship)	-8.2	38.8
Higher business or technical college (3 years after apprenticeship)[a]	12.8	35.7
University entrance certificate (4 years after compulsory schooling)	19.4	6.4
University (5 years after university entrance certificate)	1.5[b]	23.4

Notes: * corrected for self-selection bias

[a] Since 1998 Universities of Applied Science.

[b] Corrected result by replication.

The rates of return in Table 4 reveal, that returns to different types of education are very heterogeneous. This heterogeneity of returns is overlooked when measuring human capital by years of schooling only, because the same amount of schooling might lead to completely different returns depending on the type of schooling.

5.3 Returns to experience

The coefficients associated with experience can approximately be interpreted as the return to on-the-job training. The disposable estimates for Switzerland, with the exception of some small subpopulations, show the commonly found pattern of decreasing returns to experience, i.e., the coefficient of EXP is significantly positive, that of EXP^2 significant and negative. Tables 5a–e give an overview of the coefficients associated with years of potential and approximated labour market experience. Again wage equations without or with only a few additional control variables are called 'standard', whereas equations with more than three additional control variables are called 'extended'.

Table 5a. Standard wage equations: coefficients for experience/age

		Experience /age			Exp. / age sq. $\times 10^{-2}$		
	Year	Females	Males	All	Females	Males	All
Kugler (1988)	1981/82	0.026	0.049	-	-0.017	-0.070	-
D&E (1995)	1991	0.039	0.054	-	-0.074	-0.090	-
Bonjour (1997)**	1991	0.024	0.025	-	-0.05	-0.03	-
Bonjour (1997)**	1992	0.026	0.030	-	-0.05	-0.04	-
Bonjour (1997)**	1993	0.023	0.031	-	-0.04	-0.05	-
Golder (1997)	1995	-	0.044	-	-	-0.066	-
Bonjour (1997)*	1991	0.047	0.051	-	-0.05	-0.05	-
Bonjour (1997)*	1992	0.041	0.059	-	-0.04	-0.06	-
Bonjour (1997)*	1993	0.041	0.061	-	-0.04	-0.06	-

Notes: * age and age^2 instead of exp and exp^2
** exp = approximated by experience without a break of 6 months

Table 5b. Extended wage equations: coefficients for experience/age

		Experience /age			Exp. / age sq. $\times 10^{-2}$		
	Year	Females	Males	All	Females	Males	All
Ferro-Luzzi (1996)	1991	0.035	0.044	0.039	-0.067	-0.074	-0.070
Ferro-Luzzi (1996)+	1991	0.032	0.042	0.037	-0.058	-0.070	-0.063
D&E (1995)	1991	0.038	0.054	-	-0.072	-0.089	-
Bonjour (1997)**	1991	0.018	0.020	-	-0.04	-0.03	-
Bonjour (1997)**	1992	0.021	0.024	-	-0.04	-0.04	-
Bonjour (1997)**	1993	0.018	0.025	-	-0.04	-0.04	-
FL&S (1998)	1991	0.032	0.036	-	-0.067	-0.060	-
FL&S (1998)	1995	0.026	0.037	-	-0.051	-0.062	-
Golder (1997)	1995	-	0.034	-	-	-0.051	-
H&S (1998a)**	1995	-	0.028	-	-	-0.043	-
H&S (1998a)**	1997	-	0.026	-	-	-0.040	-
Curti (1998)*	93-97	-	-	0.054	-	-	-0.055
Curti (1998)*+	93-97	-	-	0.044	-	-	-0.045

Notes: * age and age^2 instead of exp and exp^2
** exp = approximated by experience without a break of 6 months.
+ Estimation setting with more additional control variables.

Table 5c. Standard wage equations corrected for selection biases: coefficients for experience/age

		Experience /age			Exp. / age sq. $\times 10^{-2}$		
	Year	Females	Males	All	Females	Males	All
Kugler (1988)	1981/82	-0.012	0.057	-	0.060	-0.080	-
D&E (1995)	1991	0.037	-	-	-0.067	-	-
Bonjour (1997)*	1991	0.047	-	-	-0.05	-	-
Bonjour (1997)*	1992	0.039	-	-	-0.04	-	-
Bonjour (1997)*	1993	0.040	-	-	-0.04	-	-

Note: * age and age^2 instead of exp and exp^2

Table 5d. Extended wage equations corrected for selection biases: coefficients for experience/age

		Experience /age			Exp. / age sq. $\times 10^{-2}$		
	Year	Females	Males	All	Females	Males	All
D&E (1995)	1991	0.036	-	-	-0.065	-	-
De Coulon (1998a)	1995	-	0.038	-	-	-0.06	-
H&S (1998a)	1995	0.020	-	-	-0.036	-	-
H&S (1998a)	1997	0.015	-	-	-0.025	-	-
Bonjour (1997)*	1991	0.042	-	-	-0.05	-	-
Bonjour (1997)*	1992	0.037	-	-	-0.04	-	-
Bonjour (1997)*	1993	0.039	-	-	-0.04	-	-

Note: * age and age^2 instead of exp and exp^2

Table 5e. Extended wage equations with endogenisation of experience: coefficients for experience/age

		Experience /age			Exp. / age sq. $\times 10^{-2}$		
		Females		Males	Females		Males
	Year	exp	age	exp	exp sq	age sq	exp sq
Bonjour (1997)**	1993	0.025	0.032	-	-	-0.005	-
Bonjour (1997)***	1993	0.022	0.032	-	-	-0.005	-
Bonjour (1997)****	1993	0.048	-	0.039	-0.009	-	-0.006
H&S (1998a)**	1995	0.024	0.035	-	-	-0.001	-
H&S (1998a)**	1997	0.033	0.036	-	-	-0.001	-

Notes: ** simultaneous model estimated by Two Stage Least Squares (2SLS), using age, approximated exp and exp^2

*** simultaneous model estimated by Three Stage Least Squares (3SLS), using age, approximated exp and exp^2

**** extended wage equation with instrumented experience and experience squared (IV), using approximated exp and exp^2

Analysis and comparison of results reveal, that ...

(1) the returns on labour market experience are quite robust across different studies in Switzerland. With very few exceptions all authors find highly significant coefficients with the expected signs (i.e. positive coefficient for experience, negative for experience squared).

(2) returns to experience are generally lower for women than for men (i.e. age-earnings profiles are flatter for women than for men).

(3) women reach the maximum of their wage profile earlier in their career than men.

(4) returns to experience are lower for foreign workers. Experience acquired in their country of origin is less rewarded in the Swiss labour market than experience obtained in Switzerland.[9]

(5) correcting for the selection bias of women's labour market participation slightly lowers the returns to experience and shifts the maximum of female wage profiles to the right.

(6) the inclusion of additional control variables lowers the returns to experience slightly.

(7) returns to experience seem to have decreased for women and increased for men throughout the nineties.

(8) in the case of women's wage functions experience is an endogenous right-hand variable. In a simultaneous estimation of a Mincer wage function experience, age and age squared have a significant influence. As compared to a least squares estimation of the same specification the endogenisation of experience increases the rate of return to experience while the coefficients of age and age squared remain unchanged and quite high.

(9) instrumenting experience and experience squared in a Mincer wage equation more than doubles the returns to experience for women and increases them significantly for men. Additional job related variables, on the other hand, lose part (managerial position, size of the firm) or all (tenure) of their explanatory power.

5.4 Returns to tenure

Table 6 gives an overview of the estimated coefficients of tenure in different studies. Tenure can be taken as a proxy for firm specific human capital and is therefore of interest here. On average men in Switzerland have a tenure of 10 and women of around 7 years (Bonjour, 1997).

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[9] Coefficients of 0.0405–0.0052 for experience obtained before immigration and 0.0535–0.0115 for experience obtained in Switzerland, depending on the region of origin.

Table 6. Extended wage equations: coefficients for tenure

	Year	Tenure / Tenure sq.×10^{-2} (%)		
		Females	Males	All
Ferro-Luzzi (1996)	1991	0.019/-0.039	0.007/-0.016	0.013/-0.024
Ferro-Luzzi (1996)$^{+}$	1991	0.013/-0.026	0.005/-0.014	0.010/-0.019
Bonjour (1997)	1991	0.004	0.003	-
Bonjour (1997)	1992	0.007	0.004	-
Bonjour (1997)	1993	0.008	0.004	-
FL&S (1998)	1991	0.007	0.004	-
FL&S (1998)	1995	0.008	0.003	-
H&S (1998a)	1995	0.007	0.005	-
H&S (1998a)	1997	0.006	0.005	-

Note: $^{+}$ Estimation setting with more additional control variables.

All authors who include the variable in their setting, find significant and positive effects of tenure on wages. The estimations of Ferro-Luzzi (1996), moreover, reveal that the returns to tenure are decreasing. Curti (1998), using two dummy variables, also finds a significant positive effect of tenure on wages.

5.5 Returns to training

A dummy variable for people who had on-the-job or off-the-job training in the last 12 months is included in the estimation of Golder (1997). He finds that men with training earn about 6% more than others, indicating that human capital obtained by training is positively rewarded on the labour market in Switzerland. Curti (1998) finds that the probability for unemployed to reintegrate into the labour market positively depends on training.

6 Discussion of the disposable results

In Switzerland from 1991 onwards many estimations of rates of return to education have been carried out. Most research, however, has focused on wage discrimination of certain subpopulations (i.e. men/women, foreigners, unemployed). Nevertheless the studies contain interesting information also on rates of return to human capital.

All estimations confirm the standard human capital theory hypothesis, that an additional year of schooling causes significantly positive returns. Experience in almost all estimates leads to positive but decreasing returns, which confirms the hypothesis of concave age-earnings profiles. Furthermore, the following results seem to be quite stable across studies:

(1) Women have slightly higher returns to education than men, but clearly lower returns to potential labour market experience. Consequently the age-earnings profiles are much flatter for women than for men. This finding reflects differences in typical professional careers of men and women.

(2) Foreign workers have significantly lower returns to education as well as to experience. It can furthermore be shown, that education and experience obtained by foreigners in their country of origin are less rewarded in the Swiss labour market than education and experience obtained in Switzerland. Given the high percentage of foreigners in Switzerland (about 25% of the workforce), the distinction between foreigners and natives is of particular importance also in the context of returns to education.

(3) The inclusion of additional control variables reduces the estimated returns to schooling as well as to experience.

(4) Correction for selectivity biases of labour market participation lowers the rates of return to education for women, whereas the returns to experience are only marginally influenced.

(5) There is empirical evidence that in the case of women experience is an endogenous variable. As compared to a least squares estimation the endogenisation of experience increases the rate of return to experience while the coefficients of age and age squared still exert a significant and unchanged influence. Estimating wage functions by instrumenting experience and experience squared more than doubles the returns to experience for women and increases them significantly for men.

Even though we have learned quite a lot about rates of return to education in Switzerland, many questions remain open.

In general research that explicitly investigates returns to human capital is rather scarce in Switzerland. Most research so far has focused on wage discrimination. Questions relating to the financing

of education have been only rarely addressed. One of the exceptions is Sheldon (1992) who has estimated returns to different educational degrees. Moreover, Wolter (1994), Weber (1998) and Wolter and Weber (1999) have estimated private rates of return to educational levels with the help of the so-called cost-benefit approach (for a description of the method and results, see appendix).

Unfortunately micro data for the labour market in Switzerland are available only since 1991. There is but one data set that covers 1981/82, which allows earnings functions to be estimated. Only few studies contain inter-temporally comparable results. Comparisons between different studies and years are very difficult, since the specification of the earnings function as well as the observed population vary remarkably. More research is therefore certainly needed in order to gain insight into the evolution of rates of return over time, at least in the nineties.

Concerning the inclusion of control variables we do know that they have an impact on the estimates of rates of return. More research, however, is needed to find out which types of variables have the strongest impact on returns to human capital.

None of the reviewed studies has taken into account income taxes. Wolter and Weber (1999) show that the progressive tax system in Switzerland is a non-negligible factor in the estimation of private rates of return.

The effects of an endogenisation of experience and educational decisions should be further analysed. There is evidence suggesting that endogeneity of right-hand variables like experience and schooling can alter returns substantially.

In order to learn more about private rates of return to human capital in Switzerland, it will be important to examine systematically the influence of different model specifications on private rates of return. Moreover, institutional factors as for instance the organisation and financing of the educational system as well as the nature of the tax system, have to be taken explicitly into account. Particular attention has to be given to different sub-groups like men and women or foreign workers.

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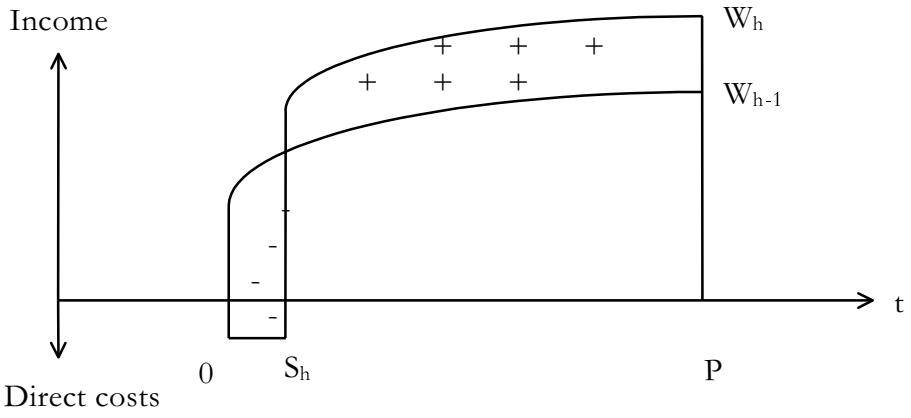
Appendix

The Cost-Benefit Approach

An alternative method to estimate private rates of return to education that can be found in the literature is the so-called *Cost-Benefit Approach,* described in Psacharopoulos (1987) and Alsalam and Conley (1995). Figure A1 shows a simple cost-benefit model for a type of education that leads to qualification level *h*. Training starts at point 0 and lasts S_h years. S_h is the point at which the individual begins professional activities in the labour market. In the educational period, there are direct costs (C_h) which include all expenditures that relate to education. There are, however, also indirect costs to be taken into account, in the form of lost earnings. In the literature these are usually assessed as the effective earnings by persons of the same age at the educational level just below (W_{h-1}). The actual wage difference between persons of different qualification levels $(W_h - W_{h-1})$ is regarded as a wage advantage determined by education. Wage advantages are obtained from the beginning of professional activities (S_h) and last to the age of retirement (P).

Figure A1. The cost-benefit model



Source: Psacharopoulos (1987, p. 343)

There are a number of ways in which to evaluate information about the costs and benefits from education. *Rate of return analysis* is a way of determining the rate r at which discounted costs and discounted earnings cancel each other out. The corresponding equation is given in equation (A1) in discrete form. The so-called internal rate r corresponds to the average interest on capital invested in education. If the internal rate is higher than the rate of return of alternative investment projects, then the education may be considered as profitable.

$$\sum_{t=1}^{S_h} \left(C_h + W_{h-1}\right)_t \cdot (1+r)^{-t} = \sum_{t=S_h+1}^{P} \left(W_h - W_{h-1}\right)_t \cdot (1+r)^{-t} \qquad \text{(A1)}$$

The *present value method* is based on comparisons between the discounted life-time incomes of individuals with different levels of educational attainment. The discount rate i enters the calculation as an exogenous measure of the alternative rate of return. Educational investments that increase the present value of the life-time income may be considered profitable. Equation (A2) shows how to calculate the *net present value* on an investment in education on level h.

$$NPV_h = \sum_{t=S_h+1}^{P} \left(W_h - W_{h-1}\right)_t \cdot (1+i)^{-t} - \sum_{t=1}^{S_h} \left(C_h + W_{h-1}\right)_t \cdot (1+i)^{-t} \qquad \text{(A2)}$$

Estimations for Switzerland

Wolter (1994) has for the first time in Switzerland used a cost-benefit approach to calculate net present values of lifetime earnings for people with different educational attainments. Besides age-earnings profiles and direct education costs, he also takes explicitly into account *taxes* and a special *risk premium for the risk of dropping out of school*. His argument to include the latter is the following: as with any type of investment so with investments in one's own human capital, compensation should be allowed for the risk of failure, in the form of a risk premium. The method of calculating the risk premium proposed by Wolter assumes that the capital invested, in the form of direct and indirect costs, is lost when studies are interrupted. The loss probability is estimated in terms of drop-out quotas. An assumption is also made that dropping out of school occurs on average half way through the course of studies.

Wolter and Weber (1999) have used the same kind of analysis to calculate private rates of return to education (see equation A1). Taking into account income taxes, direct educational costs, the risk of dropping out of school and the unemployment probability, they calculate rates of return as well as net present values of lifetime earnings for men and women with different types of education.

The estimations of Weber (1998) and Wolter and Weber (1999) are based on a relatively new data source. The *Wage Structure Survey* (WSS) offers a very precise and detailed picture of the wage structure in Switzerland. From 1994 on 10,500 firms provide information on wages and individual characteristics of about 550,000 employees every two years. Wolter (1994) has used a pilot survey of the WSS, which was carried out in the canton of Geneva.

Table A1 summarises the estimates of private returns obtained by the cost-benefit approach. The figures indicate rates of return to a certain type of education, compared to the next lower educational degree.

Table A1. Private rates of return to different levels of education (in per cent)

Year	Wolter (1994)[a]	Weber (1998)		Wolter and Weber (1999)	
	1990	1994		1996	
	All	Men	Women	Men	Women
Apprenticeship (3-4 years after compulsory schooling)	10.7	8.4	11.9	8.6	11.7
Higher vocational college (2 years after apprenticeship)	11.1	8.8	8.5	7.7	7.5
Higher business or technical college (3 years after apprenticeship)[b]	6.8	10.3	8.1	10.0	7.8
University entrance certificate (4 years after compulsory schooling)	11.6	8.9	10.2	10.2	9.9
University (5 years after university entrance certificate)	5.5	5.7	4.6	3.6	4.5
Teacher training college (4-5 years after compulsory schooling)	-	5.8	9.0	5.0	10.0

Notes: [a] The results of Wolter (1994) have been transformed into rates of return by Sheldon (1996).

[b] Since 1998 Universities of Applied Science.

The estimations reveal that there are remarkable differences in rates of return between different types of education and gender. The lowest rates of return are found at the university level.

Table A2 contains results on net present values of lifetime earnings for people who have attained different levels and types of education. It can be shown that initial wage differences beween people with different levels of education (a gross wage premium of 41–147% depending on the type of education) are substantially reduced when time preferences, taxes, direct educational costs and the risk of dropping out of the educational system are taken into account. The remaining differences in net lifetime incomes vary between 18% and 34%. These results suggest that education is profitable in Switzerland, from a purely individual and pecuniary point of view. No significant differences in net-life-incomes can, however, be observed between higher types of education.[10]

Table A2. Life-income differences, relative to people with compulsory schooling (in per cent)

Year	Wolter (1994)	Wolter and Weber (1999)	
	1990	1996	
	All	Men	Women
Apprenticeship (3-4 years after compulsory schooling)	18.5	9.2	17.1
Higher vocational college (2 years after apprenticeship)	33.8	14.5	22.2
Higher business or technical college (3 years after apprenticeship)[a]	25.0	24.7	26.0
University entrance certificate (4 years after compulsory schooling)	30.2	27.3	23.2
University (5 years after university entrance certificate)	33.8	21.3	20.9

Note: [a] Since 1998 Universities of Applied Science.

[10] Calculations with a discount rate of 5%.