

WAGE ELASTICITY OF THE TEACHER SUPPLY IN SWITZERLAND¹

STEFAN C. WOLTER*

(SWISS COORDINATION CENTRE FOR RESEARCH IN EDUCATION, UNIVERSITY
OF BERNE, CESIFO & IZA BONN)

STEFAN DENZLER

(SWISS COORDINATION CENTRE FOR RESEARCH IN EDUCATION)

ABSTRACT:

In order to learn more about the teacher supply in Switzerland, this paper analyses eleven surveys of graduates of all Swiss universities for the period of 1981-2001. We estimate wages for teachers and non-teachers with the help of selection models. The predicted individual wage differentials between teaching and all other jobs indicate a positive self-selection of teachers into teaching. Furthermore the reaction of teachers supply on the wage differential shows a wage elasticity of 0.41. As in other studies, the wage differential is counter cyclical, due to the static wage setting of the public. As a consequence, the public sector itself is creating at least a part of the cyclical pattern of teacher shortages and oversupplies.

JEL CLASSIFICATION: I2, J24, J45.

KEYWORDS: wage elasticity, labour supply, teachers, university graduates, Switzerland.

¹ The authors would like to thank the Federal Statistical Office of Switzerland for the provision of the data and the support that came with it. A first version of this paper circulated under the same title as IZA discussion paper No. 733. The authors gratefully acknowledge comments on this earlier version, especially by Torberg Falch, Samuel Mühlmann and Jürg Schweri. The usual disclaimer holds.

* Address of the communating author: Stefan C. Wolter, Swiss Coordination Centre for Research in Education (SKBF), Entfelderstrasse 61, 5000 Aarau Switzerland. Tel.: 0041(0)62 835 23 90 - Fax: 0041(0)62 835 23 99 - E-mail: stefanwolter@yahoo.de

INTRODUCTION

Reports of teacher shortages in most of the OECD countries have accumulated in recent years (see OECD, 2002 or Santiago, 2002). This problem raises questions that we all too often are unable to answer without greater knowledge of the labour market for teachers, knowledge that is generally not at hand outside the English-speaking countries.

One easily available avenue for eliminating the shortage of teachers, or for better balancing supply and demand, is via wage formation. Although not many but a number of studies have been conducted on wages and teacher quality (see Waterreus, 2003 and Santiago, 2004 for an overview), and teachers' unions never tire of emphasizing that better salaries would result in better teachers, less has been said about whether higher wages would also motivate more people to choose teaching as a profession. The relationship between teachers' salaries and their quantitative supply has never been researched in most countries, primarily because the statistics needed to do so are often lacking.

The labour market for teachers in those countries for which we do have such studies (primarily the United States and Great Britain) is not directly comparable with the market in Switzerland; it is thus questionable how far the results of these studies hold for other countries. The main difference is that in English-speaking countries, teachers normally tend to earn less than people who have a similar education, but are employed in other occupations. Since this is not the case in Switzerland, it is interesting to examine whether the purely quantitative high wage elasticity of the teacher supply found by these studies also applies here.

The goal of this study is to empirically test the wage elasticity of the supply of upper secondary school teachers in Switzerland. To do this, we use data collected between 1981 and 2001 on graduates of all of Switzerland's traditional academic university institutions. The paper is divided into six sections. We begin with a theoretical analysis of supply and demand in the labour market for teachers, and derive from this the importance of the wage elasticity of the teacher supply. We then briefly describe the state of research as set forth in the international empirical literature. This is followed by a description of the data, presentation of the model employed, and a discussion of our findings. The last section summarizes the results.

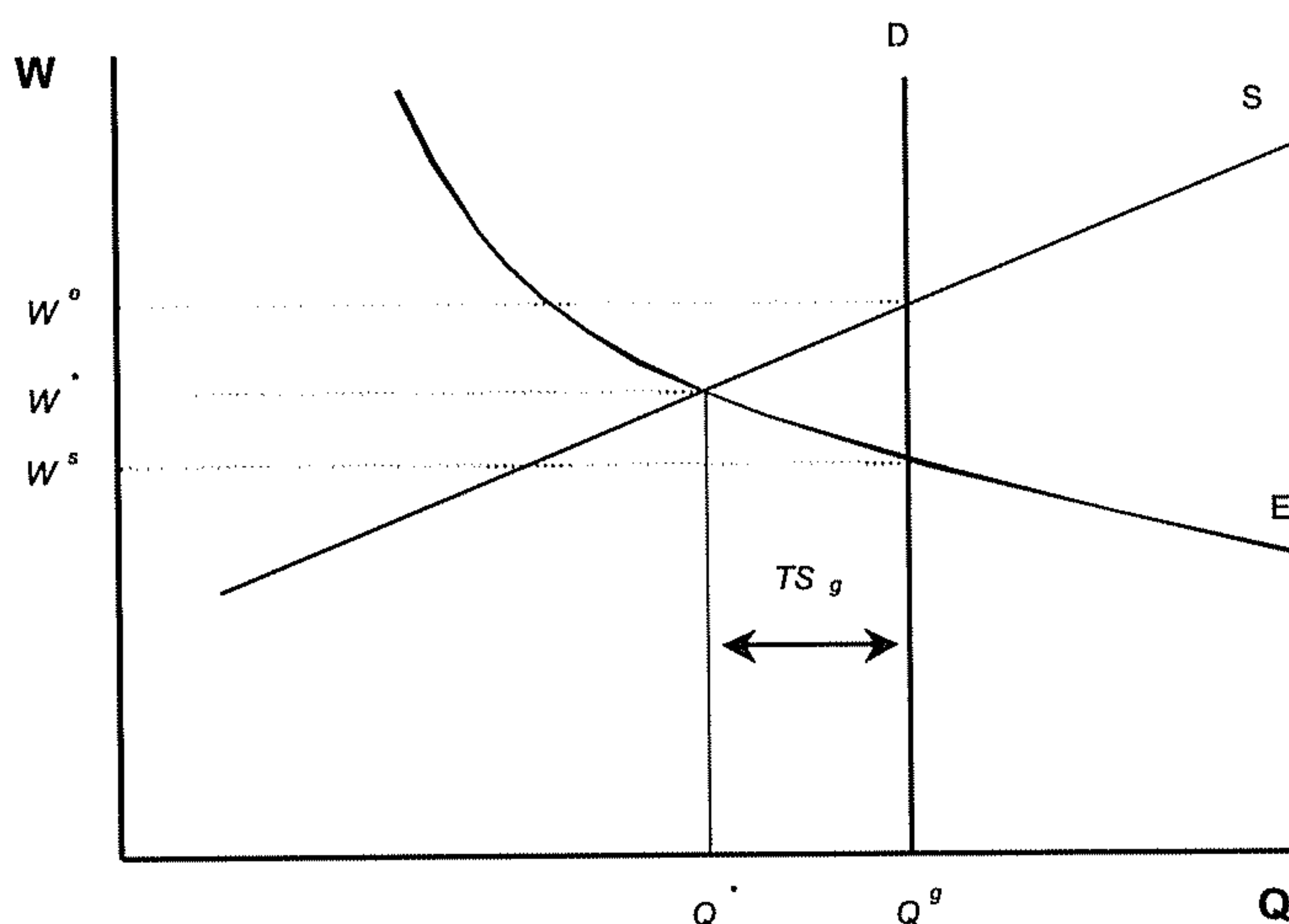
THE TEACHER SUPPLY AND WAGES

An educational system's demand for teachers (D) is determined by two factors primarily (see Figure 1). The first is the assumption that the number of teachers sought will depend in the short term on the number of school classes, so that the number of pupils at a given moment, combined with the standard class size set by the educational authorities, gives us a more or less predetermined level of demand for teachers (Q^g). The second factor is the amount of money (E) that the political process provides for the overall educational system in the budget. This budget allocation enables varying numbers of

teachers to be hired if their salaries are not fixed in advance. However, the educational system's quantitative demand for teachers (D), in combination with its budget allocation (E), implies a wage (W^S).

A normal teacher supply curve (S) does not, of course, automatically mean that the supply and demand curves will intersect at equilibrium wage (W^e) that would result solely from the two curves, because the government's budget restrictions would not permit this. In the case shown in Figure 1, budget restrictions would produce a wage of W^* , which would lie below the equilibrium wage W^e . Under the given circumstances, the equilibrium wage would be located at the intersection of S and E , i.e. at W^* . However, substantially fewer teachers (Q^*) would be employed at this salary than originally planned (Q^g). The difference would be a shortage of teachers, TS_g . Such a shortage could, of course, be eliminated by raising the wage, but this is only possible if the educational system's budget is increased from E to E' (see also Figure 2; which would yield equilibrium EQ^1).²

FIGURE 1. TEACHER SUPPLY AND DEMAND (1)



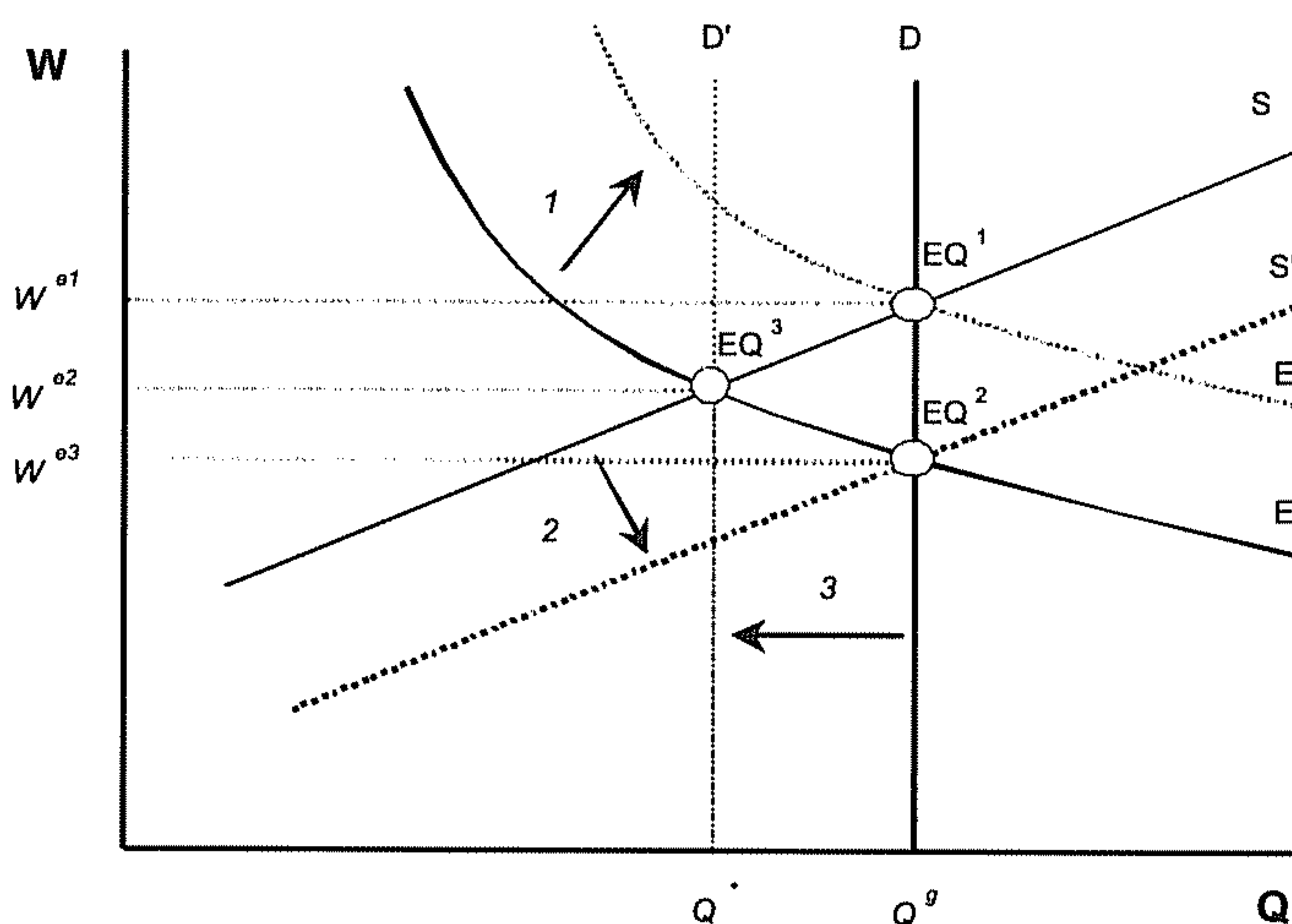
Since this is probably a rare occurrence even in times of teacher shortages, educational policymakers have resort to other means to alleviate the problem. Another possibility is to look for more teachers while keeping the wage at W^e . However, this will only succeed, partially, if there is a supply (S') of potential teachers who are prepared to work for a lower wage (equilibrium EQ^2). These people cannot be the same as those described by the usual supply curve (S). It also means that the new teachers normally will not be able to provide the same quality of instruction as the original group of teachers.

² The way education systems would react to teacher shortages depends on the national institutions and cannot be generalised to all countries.

Finally, educational policymakers can, of course, use still other means to lower the demand for teachers (new D'), by increasing class size, for example. The smaller demand that results from this organizational measure enables equilibrium EQ^3 to be achieved with the same budget (E).

Thus policymakers have various means at their disposal to eliminate an initial disequilibrium (TSg in Figure 1), but they will only be able to do so without damaging the quality of the educational system, if they increase the budget and thus teachers' wages. The two other solutions described above will cause the quality of instruction to deteriorate.

FIGURE 2. TEACHER SUPPLY AND DEMAND (2)



If one decides to raise wages in order to eliminate a shortage of teachers, the next question that immediately arises is: How elastically will the supply of teachers respond to changes in the wage? Without this knowledge, policymakers are unable to judge how much the budget has to be increased in order to eliminate a shortage.

A BRIEF REVIEW OF LITERATURE

A number of authors, primarily in English-speaking countries, have demonstrated the existence of wage effects on what people decide to study and their choice of occupation.³ Thus, the relative incomes of teachers also strongly influence whether a student decides to go into teaching. Manski (1987) has calculated a wage elasticity for the supply of teachers in the range of two to three. Dolton (1990) has shown in various analy-

³ The present paper could also be seen as a thematic extension of the models already used by Willis and Rosen (1979).

ses using graduate data from England that the relative income of teachers and relative wage growth are both determining factors when choosing a profession. The higher teachers' wages are relative to other occupations, the more likely graduates will go into teaching (Dolton, 1990; Dolton and Makepeace, 1993; Chevalier et al., 2002). Falch (2003) estimated a wage elasticity of labour supply of Norwegian teachers that was close to unity when analysing the choice of teachers for different schools, which is not exactly comparable to the question analysed in this paper. Hanushek and Pace (1995) find that in addition to the length of the educational training programme and the certification examination, relative wages⁴ also influence the supply of teachers, but they dispute whether this effect has a strong influence on the choice of studies (which is in this paper equated with occupational choice).

Most authors agree that income influences, how long a teacher remains a teacher. Almost all studies show that increasing teachers' wages would result in a significantly lower turnover and/or exit rate⁵ (Chevalier et al., 2002; Hanushek et al., 2001, 1999; Dolton and Van der Klaauw, 1995, 1996, 1999; Gritz and Theobald, 1996; Mont and Rees 1996; Murnane, 1991; Murnane and Olsen 1990).

However, Hanushek et al. (1999, 2001) argue that local school factors and pupils' characteristics (origin, social class, performance, etc.) have a stronger influence on the mobility of teachers than the wage or wage differential.⁶

The literature cited shows that, in general, teachers and students seem to react to income differences as well as to non-monetary incentives in the same manner as people in other occupations, and that they also take financial factors into consideration when deciding whether to become or remain a teacher.

However, this does not mean that higher wages automatically also attract better teachers. The effect of income on teaching quality is a controversial issue in the literature and difficult to test methodologically. Little empirical evidence has been offered one way or the other up to now; most studies have not been able to demonstrate an effect (Hanushek, 1997 and 1999; Manski, 1987). In theory, general wage increases expand the supply of teachers in the labour market, but the quality of instruction will only improve if the employment process is selective.⁷ Loeb and Page (2000) argue that because different

⁴ Using probit estimates, the authors find that relative income has a weak but still significant effect: a wage increase of 10% would result in a rise of 0.7 percentage points among graduates of universities (Hanushek and Pace, (1995), pp. 112.).

⁵ Chevalier et al. (2002), for example, have calculated that a 10% rise in the relative teachers' wage would increase the probability of the average UK university graduate still teaching after six years in the profession by 10 percentage points. This means that a good 24% (or approximately 11,000 more) of the 1990 graduate cohort would still have been teaching in 1996 instead of the 14% that in fact remained in the profession. A 10% relative wage increase would also reduce the likelihood of quitting by 9% (Dolton and Van der Klaauw 1995, p. 442).

⁶ Hanushek et al. 2001, p. 12: "Teachers systematically favour higher achieving, non-minority, non-low income students." Work by Bonesrønning et al. (2003) for Norwegian teachers points in the same direction.

⁷ Regarding the problem of teacher selection, see primarily Ballou and Podgursky (1995), (1998); and Miles and Darling-Hammond (1997).

school districts show different teacher supply curves, the lack of empirical evidence is due to the methods employed being inadequate. They go on to say that we thus have to control for alternative occupational opportunities and for non-pecuniary school-related parameters (profiles of the pupils, their parents, the school, community, etc.), if we want to be able to estimate the relevant wage elasticities. Using an appropriate model (a wage-quality diagram), the authors find that teachers' incomes have a significant effect on their pupils' school performance (as measured by the high school dropout rate and the proportion who go on to college).⁸ Because teachers' qualifications correlate strongly with school characteristics and the demographic makeup of a student body,⁹ Loeb proposes specific incentives (such as targeted wage increases and/or improving the facilities of less attractive schools) to offset such discrepancies (Loeb 2000, p. 15).

Temin (2002) relates the sharp drop in teachers' relative wages that took place in the United States in the 1970s and 1990s to both changes in the labour market for women and cutbacks in the public funds available to local communities. Women's wages have gone up as their employment opportunities have broadened, so that non-teaching occupations are now much more attractive to them.¹⁰ This means, however, that relative teacher wages have declined especially for female teachers, a factor that partially explains the shrinkage in the supply of women in teaching. Temin defines the demand for teachers as a function of both price (wage) and quality,¹¹ arguing that a market in which quality depends on wages (among other factors) will not exhibit a single equilibrium but rather multiple equilibria of differing degrees of stability (see also Figure 2 of this paper).¹² The problem is how to move from a stable low-wage, low-quality equilibrium to an equilibrium of high wages and high quality.

THE DATA

Since there is little statistical material available on teachers and their wages in Switzerland, and what exists is often inadequate. It was not easy to find a data set suitable for answering our questions. The data material employed here is thus limited in various respects. Because it is longitudinal in nature, the data enables us to separate some of the economic influences from the structural ones.

⁸ A 10% wage increase (which would offset the relative decline in wages that occurred in the 1980s) would reduce the high school dropout rate by more than 3%, and lift the number of those enrolling in college by 8% (Loeb and Page, 2000, p. 406).

⁹ Teachers in urban schools are substantially less qualified than those in suburban and rural areas; the same is also true for schools with a high proportion of poor, black, or Hispanic pupils (Loeb, 2000, pp. 12.).

¹⁰ The wage premium of women with some graduate education compared to female teachers was less than 20% at the end of the 1970s, versus more than 40% today. Women with only a college education but no graduate education (i.e. comparable to primary school teachers) earn about 10% more (Temin, 2002, pp. 13.).

¹¹ Analogously to Akerlof's "lemon" model.

¹² Direct wage effect: declining demand. Indirect effect: rising demand. If the indirect effect is stronger than the direct, we have a rising demand curve with multiple equilibria (Temin, 2002, p. 5).

The first limitation concerns the type of teacher for whom data is available. Since educational policies in Switzerland are within the responsibility of the cantons, the training that teachers receive is not uniform, a fact that tends to influence negatively the statistics collected. The situation is slightly better for upper secondary teachers, because teachers at this level are normally required to have a traditional university education.

Switzerland has conducted a full census of graduates of traditional universities every two years for more than 20 years, and of graduates of the universities of applied science, for about 10 years. Our study focuses on the data collected for the former group, whom we will refer to as “university graduates”, and for whom we use the complete series of surveys conducted from 1981 to 2001.¹³ The 2003 survey had been completed by the time of our study, but the data not yet released. Since the data set available to us contains eleven waves of cross-sectional data for university graduates, we are thus able to combine the advantages of cross-sectional and longitudinal observation by means of a pooled cross-section analysis. In particular, the ability to observe the same question over a period of 20 years allows us to supplement the data set with other longitudinal data like economic indicators. We can also test the influence of systemic changes such as the impact of educational reforms and similar measures.

The data describing systemic changes were gathered by surveying the traditional universities. They were first sent a written questionnaire; we then followed up in many instances with oral interviews. The questions asked concerned any reforms of the study programmes, changes in admission requirements, or other similarly far-reaching modifications of their institution’s organization that had taken place during the previous 20 years. For changes which we thought might have an effect on the question of interest to us - the occupations chosen by their graduates - we constructed dummy variables for the institution starting from when the change was expected to have influenced the graduates.

The data of the graduate surveys provides us important data to model the supply of potential teachers but contains no information about public hiring policies. Although it is not possible to observe hiring policies directly¹⁴, we gathered information on data, which might influence these policies. The data we tested in our models included information on the number of upper-secondary pupils, the public spending in upper-secondary education in absolute terms and relative to the overall public spending as well as the change in the gross domestic product of cantons. The number of pupils evidently should have an impact on the demand for teachers although we know from research (see Baum and Seitz, 2003) that the reaction to changing numbers of pupils is rather inelastic. The latter variables were used, assuming that high growth rates would be an indication for higher teacher salaries. The data at hand should at least allow us to ascertain that a

¹³ Descriptive statistics can be found in the appendix.

¹⁴ For the period 1980-2000 there exists no data on the number of teachers, on class-sizes or other important data that could indicate the demand for teachers. Only recently the cantons have begun to monitor job-vacancies in a standardised way.

measured correlation between wage differentials and the number of graduates becoming teacher measures the wage elasticity of teacher supply and not the elasticity of teacher demand.

WHY SHOULD ENTRY WAGES MATTER ?

One disadvantage associated with this data set was that we had to limit our analysis to the first job held after graduation. Based on the human-capital theory, we would, however, expect that not only the relative entry wage level influences the decision to become a teacher but also the net-present value of an option (the discounted income stream over the whole lifespan). How can we, therefore, assume that (changes in) the relative entry wage affect teacher supply? Two arguments come to our mind when answering this question. Firstly, the entry wage level would matter, if it were a representative indicator for the net-present value of the whole income stream over the lifespan. Calculations on the rates of return to the choice of becoming teacher show (see Wolter et al., 2003) that the general higher level of entry wages for teachers is also reflected in higher net-present values of life income for teachers compared to the (net-present) life income of alternative jobs for university graduates. Secondly, from earlier research on students wage expectations we not only know that students are rather accurate when it comes to forecast entry salaries (see e.g. Wolter and Zbinden 2002), but also that there are some deviations from the assumption of pure rationality of expectations which speak in favour of our analysis. In Wolter and Weber (2003) it was shown that changes in the entry wage level (provoked by business cycles) are correctly assessed by students but wrongfully extrapolated to all future incomes. This means that if students expect that changes in the entry wage levels have a lasting impact on all future salaries, the entry wages can be assumed to exert a higher influence on the decision to become a teacher or to choose another occupation than we would expect under the assumptions of pure rational expectation formation.

THE LABOUR MARKET FOR UPPER-SECONDARY TEACHERS IN SWITZERLAND

In general, teachers at the upper-secondary level in Switzerland are required to have a university certificate (with the exception of some teacher categories in the vocational training branch) and that graduates of universities, when choosing to become a teacher, usually teach at upper-secondary level. Teachers for primary and lower secondary schools are trained in specialised teacher training colleges. The reform of teacher training that took place in the late nineties does not affect the time span that is analysed in this paper. Beside a qualification in one or more scientific subjects, teachers are expected to have a special pedagogical qualification in order to have a full and long-term contract as a teacher at an upper-secondary school. This qualification, the so-called higher teaching certification (*HLA*) was, however, in many cases not a prerequisite to enter the profession and in those cases, where teachers entered the profession without such a diploma, they were permitted to gain this diploma at a latter stage of their professional career, following the necessary courses besides teaching. In our data set roughly 55% of all graduates that became teach-

ers were already in possession of this diploma when entering the profession. For our purposes it is therefore important to note that over the time-period covered in this analysis practically every university graduate who had studied a subject of relevance for upper-secondary schools could be regarded as a *potential* teacher. In most cases the wage level was affected by the fact of holding or not holding the higher teaching certification. Therefore we used dummies in all our calculations for this certification and in some cases we used this variable in interaction with other variables such as the field of study (see also table 2).

Although schools are cantonal and the entry regulations vary from one canton to another, the regulations do not prevent the mobility of teachers at upper-secondary level. However, in order to control for canton-specific and university-specific effects we used dummies for cantons and universities in all our calculations.

In general it can be said, that the wage setting for teachers follows the rather static public sector pay scales. Once the level of qualification, age or experience is known, the salary for a teacher can be calculated from the relevant cantonal pay scales. Teachers draw the same salary at schools independently of the subject they teach. There have been minor deviations from this rule but in general subject related disequilibria's, which can be observed quite often, did not provoke a differentiation of salaries between teachers. In this respect teacher salaries do not take into account the different outside options of different teachers.

THE EMPIRICAL MODEL

The empirical procedure employed is a relatively simple and classical one, well adapted to the data. In the end, the proposition of interest to us, and which we want to test, is whether the wage differential between teaching and other occupations influences the likelihood of becoming a teacher. For this, we estimate a probit model that includes, in addition to personality characteristics, place of work, demand for teachers variables, etc. (vector X), an individually estimated wage differential for each person observed ($\ln W^T - \ln W^O$) as an independent (i.e. explanatory), variable for the probability of the person choosing teaching as a profession after graduation (T). The wage differential should reflect the wage elasticity of teacher supply.

$$T_i = \beta_0 + \beta_1 (\ln W_i^T - \ln W_i^O) + \beta_2 X_i + u_i \quad (1)$$

The individual wage differential can be estimated in various ways. We chose the following method, which is in line with those employed by Dolton (1990) and by Chevalier et al. (2002).¹⁵ It can be broken down into three stages.

¹⁵ Chevalier et al. (2002) also employ matching, which we do not use in this paper.

We first estimate a structural equation (equation 2), which we then use to calculate the selection correction in the subsequent wage equations (equations 3 & 4). The purpose of the equation is to capture the composition of the teaching population and of non-teaching university graduates so that we can account for wage effects related to differences in the makeup of the two groups. Since one does not become a teacher by sheer accident, we cannot assume that the wages of non-teachers are a good predictor for teachers' wages if the latter do not choose to go into teaching, and vice versa.

We estimate a reduced form probit model and calculate from this (equation 2) the inverse Mills ratio (λ), which we insert into the wage estimates (equations 3 & 4) to correct for selection bias.

$$T_i = \beta_0 + \beta_1 X_i + u_1 \quad (2)$$

$$\ln W_i^T = \delta_0^o + \delta_1^o X_i' + \delta_2^o \lambda + u_2 \quad (3)$$

$$\ln W_i^o = \delta_0^o + \delta_1^o X_i' + \delta_2^o \lambda + u_3 \quad (4)$$

One of the most important points concerning this selection correction is, that the vector (X) in equation 2 must not be identical with the vector (X') in equations 3 and 4 (identification problem). In other words, we need to have factors that only influence the likelihood of becoming a teacher and which we can assume do not directly affect teachers' wages. Whether this identification process succeeds is entirely dependent on how well we choose which personality characteristics and other variables are to be included or excluded.

In our empirical analysis we now take account of one variable in vector X' of equation 2 that does not form part of vector X' in the subsequent equations: graduates who had been admitted to university with a lower-secondary teacher certificate. We can assume that the fact that students who had already opted for the teaching profession in an earlier stage of their educational career are more likely to take up teaching again after studying at university, and that the university grade alone is relevant for the salary level after graduation and not the type of university entrance diploma. The only influence the type of entrance diploma could exert on the salary would be age and experience, for which we control separately in our analysis. A regression of the entry diploma on salaries showed no significant impact of the lower-secondary teacher certificate on the entry salaries of teachers and non-teachers.

Thus we can use equations 3 and 4 to calculate the entry wages for teachers ($\ln W^T$) and non-teachers ($\ln W^o$). For each graduate included in our data set we estimate a teaching and a non-teaching wage as well as the difference between the two, which we

then insert into equation 1. The influence of this variable describes the wage elasticity of the teacher supply, at least as regards the first job after graduation.

THE RESULTS

Table 1 shows the result of a probit regression that was estimated to calculate the inverse Mills ratio (1) for the wage regressions in table 2 and 3. The dependent variable is a dummy for the first occupation chosen after graduating from university (0 for non-teachers, 1 for upper-secondary teachers).¹⁶ Most of the effects shown in table 1 are expected. Teachers are in general older than other graduates when entering the labour market; at the upper-secondary level (contrary to the lower levels of schooling) they are still predominantly male and part-time working. The demand variable (change in the number of pupils) is significant with a positive sign, indicating that the probability of graduates becoming teachers is correlated significantly with the number of pupils at upper-secondary level. Graduates with a PhD are less likely to enter the teaching profession and the dummies for the time-periods show that over the last twenty years, the relative number of teachers among graduates has fallen steadily.¹⁷ Finally, as expected, the fact that a graduate entered university after having gained a teacher diploma for lower-secondary schools increases the probability of becoming a teacher again on upper-secondary level.

¹⁶ All regressions were also run with dummies for each wave of survey. The results are qualitatively the same as the ones shown here. The definition of time periods as presented here was chosen because the four periods represent four different stages of the business cycle over the last twenty years and thereby control also for the potential effects of the general business cycle on supply and demand for teachers. Results for additional variables, like GDP-growth, public spending on education, changes in the organisation of studies or in the admission criteria over time, etc. which were non-significant in all regressions, are not shown and these variables were not used any longer for the final regressions presented in the paper.

¹⁷ We also tested a trend variable using the number of students in each wave of the survey to see, whether the expansion of the tertiary system had an impact on the results. This variable was non-significant in all regressions. Specific time-trends are already captured in the periodical dummies we use in the model but it seems as if the downward trend in the probability of graduates becoming teachers is not just caused by the upward trend in the number of students.

TABLE 1. PROBIT REGRESSION I : DEPENDENT VARIABLE TEACHING VS. NON-TEACHING JOB AFTER GRADUATION

Independent Variables	Coefficient	Std. Err.
Gender (Men = 1)	0.123**	0.039
Age	0.367**	0.003
Nationality (Swiss = 1)	0.280**	0.058
Higher teaching certificate	1.397**	0.041
Part-time job	0.616**	0.030
PhD	-0.103*	0.042
Unemployment rate of graduates	-0.026*	0.013
Change in the number of upper-secondary pupils	0.731**	0.268
University entrance with a teacher diploma	0.296**	0.079
Period 1981-1985	0.518**	0.043
Period 1987-1991	0.214**	0.040
Period 1993-1997	0.165**	0.060
Constant	-4.909**	0.193
Number of observations	36479	
Log-likelihood	-5230.448	
Pseudo R ²	0.3912	

**, ** indicate significance at the 5% and 1% levels respectively. The reference graduate is female, had an A-level university entrance certificate and graduated in the period 1999-2001. 10 dummies for universities, 25 dummies for the cantons of residence and 11 dummies for field of study are used as additional control variables.*

Table 2 shows that real entry salaries for teachers have remained stable over the last twenty years, with the exception of the boom period 1987-1991, when entry salaries were some 4% higher than in the most recent (reference) period 1999-2001, whereas real entry salaries for non-teachers fluctuated in a more pronounced way and in line with the business cycle (table 3). The selection correction term (λ) is not significant in the wage regression for teacher salaries. This result is as expected, as all relevant information for the wage setting in the public sector should be reflected in the observable variables.

TABLE 2. WAGE REGRESSION (OLS) FOR TEACHERS (LOG REAL SALARIES)

Independent Variables	Coefficient	Std. Err.
Gender (Men = 1)	0.037**	0.012
Age	0.016**	0.001
Nationality (Swiss = 1)	0.065**	0.020
Higher teaching certificate	0.125**	0.035
Part-time job	0.046**	0.015
PhD	0.114**	0.015
Unemployment rate of graduates	0.002	0.004
Change in the number of upper-secondary pupils	0.166*	0.083
Period 1981-1985	0.017	0.017
Period 1987-1991	0.040**	0.014
Period 1993-1997	0.005	0.020
Constant	10.569**	0.067
<i>lambda</i>	-0.111	0.078
Number of observations	2546	
F(58, 2487)	17.54	
Adjusted R ²	0.2738	

**, ** indicate significance at the 5% and 1% levels respectively. The reference graduate is female, had an A-level university entrance certificate and graduated in the period 1999-2001. 10 dummies for universities, 25 dummies for the cantons of residence and 11 dummies for field of study are used as additional control variables.*

TABLE 3. WAGE REGRESSION (OLS) FOR NON-TEACHERS (LOG REAL SALARIES)

Independent Variables	Coefficient	Std. Err.
Gender (Men = 1)	0.037**	0.003
Age	0.017**	0.000
Nationality (Swiss = 1)	0.010*	0.004
Higher teaching certificate	0.032*	0.014
Part-time job	0.000	0.003
PhD	0.159**	0.004
Unemployment rate of graduates	0.005** ¹⁸	0.001
Change in the number of upper-secondary pupils	-0.049*	0.025
Period 1981-1985	-0.007	0.004
Period 1987-1991	0.027**	0.003
Period 1993-1997	-0.038**	0.005
Constant	10.657**	0.013
<i>lambda</i>	0.094**	0.031
Number of observations	34419	
F(58, 34360)	191.34	
Adjusted R ²	0.2429	

**, ** indicate significance at the 5% and 1% levels respectively. The reference graduate is female, had an A-level university entrance certificate and graduated in the period 1999-2001. 10 dummies for universities, 25 dummies for the cantons of residence and 11 dummies for field of study are used as additional control variables.*

Contrary to the results in table 2 the selection correction term in table 3 is significant. The selection effect reveals a significant bias that supports the hypothesis of a positive selection, as the observed wages of non-teachers are higher than would have been observed for an average graduate of this sample had he/she chosen non-teaching.

If we now use the two wage regressions to calculate for each graduate a separate wage for teaching and non-teaching, we obtain the predicted wage difference between the two options (see table 4).

¹⁸ The period dummies that have been created in a specific manner in order to reflect the up- and downswings in the business cycle can explain the counterintuitive sign for the variable "unemployment rate". The period dummies already capture the impact of the business cycle on entry wages.

**TABLE 4. PREDICTED ANNUAL EARNINGS FOR TEACHERS AND NON-TEACHERS
IN THEIR FIRST JOB FOLLOWING GRADUATION (CHF IN 2001 VALUES)**

	Teachers	Non-teachers	Difference
Teaching job	84'550	77'381	7'169
Non-teaching job	75'539	73'079	2'460
Difference	9'011	4'302	

We see that teachers in general have a higher entry wage than non-teachers. Thus, those who actually chose teaching had measured abilities that were more valuable in teaching than did those who chose non-teaching. The same is true for non-teaching, although, as seen previously, the unobserved abilities have a negative impact on expected wages in non-teaching for teachers. What is important for our purposes is the observation that even if those who actually chose teaching expect a higher entry wage for both options and that even non-teachers could expect to receive a higher wage if they choose teaching as their initial occupation, the anticipated difference in wages between the two options is substantially higher (9'011 CHF versus 4'302 CHF) for graduates who do in fact become teachers. This indicates that the initial employment choice of teachers is a rather rational decision showing self-selection into employment.

The probit regression results in table 5 finally show that the predicted, individual wage difference between the options teacher vs. non-teacher is significantly correlated with the probability of a graduate choosing teaching as his/her first employment. The elasticity is in the range of 0.41. If the wage differential in favour of teachers is increased by 10%, the proportion of a graduate cohort that chooses to go into teaching is 4.12-percentage points higher.¹⁹ Another interesting two points in table 5 are the signs of the variables "PhD" and "Change in the number of upper-secondary pupils". The results have to be interpreted in the following way. Although the probability of choosing teaching as first job is lower if a graduate has a PhD diploma, given the predicted wage difference between teaching and non-teaching²⁰, more graduates with a PhD opted for teaching than expected. Similarly, given the wage difference, the probability that graduates opted for teaching was lower in periods when the growth in the number of pupils was high and vice versa. In the same line of argument one can interpret the change of sign in the time period 3 (1993-1997) compared to 1999-2001: the probability to choose teaching was higher in period 3 but taking into account the also

¹⁹ For 2001, this would mean that additionally to those who already opted for the teaching profession, 4.1% of all graduates would choose to become teachers if their yearly entry wage were raised by CHF 900 (570 Euro) and wages for other occupations remain unchanged. At first sight, this seems to be quite a large effect for such a modest amount of money. But one has to remember that – based on our empirical observations – we have to part from the idea that graduates see changes in the entry salaries as permanent changes and not just transitory ones. In this case the net-present value of such a change in the salary structure has to be calculated. In other words, 4.1% of all graduates would additionally opt for teaching for the equivalent of approximately 15'800 CHF (10'000 Euro).

²⁰ Contrary to average graduates, those with a PhD have almost no monetary advantage from choosing teaching over non-teaching, if we regard the entry wage level.

significantly higher average wage difference in the same period, the “net”-probability of choosing teaching was lower (although not significantly) compared to the most recent period.

The unemployment rate of graduates does not play an independent role in directly influencing the probability of becoming a teacher. While the wage differential can be seen as some sort of “pull” factor in the supply of new teachers, one could also think of the unemployment rate of graduates as a “push” factor. In times when the labour market for graduates is tight, graduates could opt for employment in the public sector (and teaching) not because it was their first choice but rather because there are more and more stable employment perspectives in the public sector compared to the private sector. As one could argue that the supply of teachers is influenced by “push” and “pull” factors alike, we had to test the influence of the wage differential and the unemployment rate jointly in order to be certain that it is really the wage differential that “pulls” new teachers into the profession.

TABLE 5. PROBIT REGRESSION II : DEPENDENT VARIABLE TEACHING VS. NON-TEACHING JOB AFTER GRADUATION

Independent Variables	Coefficient	Std. Err. ²¹	Marginal effects
Gender (Men = 1)	0.165**	0.042	0.004
Age	0.048**	0.004	0.001
Nationality (Swiss = 1)	-0.423**	0.139	0.019
Higher teaching certificate	0.748**	0.043	0.047
Part-time job	0.161**	0.035	0.005
PhD	0.505**	0.113	0.022
Unemployment rate of graduates	0.011	0.013	0.000
Change in the number of upper-secondary pupils	-2.149**	0.560	-0.062
University entrance with a teacher diploma	0.414**	0.042	0.019
Period 1981-1985	0.313**	0.063	0.011
Period 1987-1991	0.086	0.056	0.003
Period 1993-1997	-0.415**	0.118	-0.010
Expected wage differential ($\ln W^T - \ln W^0$)	14.348**	2.164	0.412
Constant	-4.316**	0.197	
Number of observations	36479		
Observed Probability	0.063		
Log likelihood	-5211.5852		
Adjusted R ²	0.3934		

**, ** indicate significance at the 5% and 1% levels respectively. The reference graduate is female, had an A-level university entrance certificate and graduated in the period 1999-2001. 10 dummies for universities, 25 dummies for the cantons of residence and 11 dummies for field of study are used as additional control variables.*

²¹ Standard errors are adjusted using bootstrapping (50).

Table 5 presents a non-negligible average wage elasticity of the teacher supply in the last twenty years, even when taking into account personal characteristics of the graduates and indicators for the demand for teachers. However, it would be a very strong assumption that the correlation patterns in occupational choices did not change over the last twenty years. We therefore tested whether the wage elasticity changed over the twenty years by calculating all regressions additionally for sub-samples of time by introducing interaction terms for the most important variables (time x variable). Thereby we can still profit from the advantage of the time-series character of the pooled-cross section while allowing the coefficients to change over time at the same time. The results in table 6 suggest that the wage elasticity has remained almost stable over time.

TABLE 6. MARGINAL EFFECTS FOR THE WAGE DIFFERENCE BETWEEN THE OPTIONS TEACHING AND NON-TEACHING FOR FOUR TIME PERIODS

Time period	Coefficient	Difference to reference period
1981-1985	0.431**	-0.021
1987-1991	0.406**	-0.046**
1993-1997	0.400**	-0.052**
1999-2001	0.451**	

**, ** indicate significance at the 5% and 1% levels respectively. The significance levels for the column „coefficient“ test the hypothesis that the coefficient is different from zero and in the second column that the coefficient is different than the coefficient for the reference period (1999-2001).*

Finally, in table 7 it is shown that the individual wage differentials follow the business cycle in a counter cyclical way. The counter cyclical pattern is created by the static wage setting in the public sector and the procyclical wage setting in the private sector.

TABLE 7. INFLUENCE OF THE BUSINESS CYCLE ON INDIVIDUAL WAGE DIFFERENTIALS (OLS)^{22,23}

Independent variables	Coefficient	Std. Err.
GDP growth (2-year average)	-0.0014**	0.0004
Unemployment rate	0.0068**	0.0003
Constant	0.0532**	0.0012
F (2, 36719)	413.21	
Adjusted R ²	0.022	

**, ** indicate significance at the 5% and 1% levels respectively. Note that the independent variables were not used in the wage regressions. The unemployment rate used in table 7 is the general unemployment rate, whereas the unemployment rates used in tables 2 & 3 were the graduate specific unemployment rates. GDP and unemployment were also tested alone. The coefficients are highly significant in all specifications.*

The results through tables 5-7 show clearly that the business cycle has no direct effect on the probability of becoming teacher but a strong indirect effect through the expected wage differential between the two options teaching vs. non-teaching.

DISCUSSION

The labour market for teachers is special in at least two respects. Firstly, in most of the OECD countries the dominance of public schools means that the state is virtually the sole employer and thus a monopsonist. Secondly, the market is characterized by frequent disequilibria that take the form of a shortage or excess of teachers. One possible reason for this might be that the state in its role of employer provokes these disequilibria through the rigidities of its wage-setting process and education budgets. However, we also know that governmental actors lack the knowledge needed for active wage formation. The wage elasticity of the teacher supply is a critical point in this respect because it must be ascertained before we can estimate the effects that changes in the employment rate for teachers will have on the education budget.

In order to learn more about the wage elasticity of the teacher supply in Switzerland, this paper has estimated wages for teachers and non-teachers, with these estimates including a selectivity correction for wage distortions that might possibly be caused by the occupational selection process. The data allow us to estimate wage elasticity only for entry wages and for upper secondary school teachers. These estimates provide us with two expected entry wages for each university graduate, one for the case that the graduate decides to become a teacher, and one for the case that she/he does not. These individual wage estimates enable us to calculate individual wage differentials. These differentials show that the comparative advantage in favour of teaching is substantially higher for teachers than for non-teachers. This can be seen as an indication for self-selection on the base of wage differentials into teaching. Furthermore, if we use the predicted, individual wage differential as an explanatory variable for estimating the likelihood of a graduate going into teaching we find that the variable is highly significant. In the cases examined, the wage differential shows a wage elasticity for the teacher supply of 0.41. This elasticity is substantially lower than what we have found in the literature for other countries. However, these studies are almost always not directly comparable to the analysis presented here and therefore it would be too early to search for the exact explanations for these differences.

Finally, our analyses show that the wage differential itself reacts counter cyclically to the business cycle. This pattern is caused by the differences in the wage setting between the private and the public sector. As a consequence the public sector itself, is creating through stability or inflexibility in the wage setting much of the cyclical pattern of teacher shortages and oversupplies.

REFERENCES

- Ballou, D. and M. Podgursky**, 1995. "Recruiting Smarter Teachers", *Journal of Human Resources*, 30 (2), pp. 326-338.
- Ballou, D. and M. Podgursky**, 1998. "Teacher Recruitment and Retention in Public Schools", *Journal of Policy Analysis and Management*, 17 (3), pp. 393-417.
- Baum, B. and H. Seitz**, 2003. "Demographischer Wandel und Bildungsausgaben: Empirische Evidenz für die westdeutschen Länder", *Vierteljahreshefte zur Wirtschaftsforschung*, 72(2), pp. 205-219.
- Bonesrønning, H., T. Falch and B. Strøm**, 2003. "Teacher Sorting, Teacher Quality and Student Composition", *European Economic Review*, forthcoming.
- Chevalier, A., P. Dolton and St. McIntosh**, 2002. "Recruiting and Retaining Teachers in the UK: An Analysis of Graduate Occupation Choice from the 1960s to the 1990s", London: Centre for Economics of Education.
- Dolton, P.**, 1990, "The Economics of UK Teacher Supply: The Graduate's Decision", *Economic Journal*, 100, Conference papers, pp. 91-104.
- Dolton, P. and W. van der Klaauw**, 1995. "Leaving Teaching in the UK: A Duration Analysis", *Economic Journal*, 105, pp. 431-444.
- Dolton, P. and W. van der Klaauw**, 1996. "Teaching Salaries and Teacher Retention", in Becker, W. E. and W.J. Baumol, *Assessing Educational Practices: the Contribution of Economics*, Cambridge MA: MIT Press, pp. 239-272.
- Dolton, P. and W. van der Klaauw**, 1999. "The Turnover of Teachers: A Competing Risks Explanation", *Review of Economics and Statistics*, 81, pp. 543-552.
- Dolton, P. and G.H. Makepeace**, 1993. "Female Labour Force Participation and the Choice of Occupation. The Supply of Teachers", *European Economic Review*, 37, pp. 1393-1411, North Holland.
- Dolton, P., A. Tremayne and T.P. Chung**, 2003. "The Economic Cycle and Teacher Supply", Paper commissioned by the Education and Training Policy Division, OECD, Paris.
- Falch, T.**, 2003. "Estimating the Elasticity of Labour Supply to an Enterprise using a Quasi-Natural Experiment", Working Paper Series, No. 7/2003, Norwegian University of Science and Technology, Trondheim.
- Gritz, R.M. and N.D. Theobald**, 1996. "The Effects of School District Spending Priorities on Length of Stay in Teaching", *Journal of Human Resources*, 31 (3), pp. 477-512.
- Hanushek, E.A.**, 1997. "Assessing the Effects of School Resources on Student Performance: An Update", *Educational Evaluation and Policy Analysis* 19, 2, pp. 141-164.
- Hanushek, E.A. and R.R. Pace**, 1995. "Who Chooses To Teach (and Why)?", *Economics of Education Review*, 14 (2), pp. 101-117.
- Hanushek, E.A., J. Kain and E.G. Rivkin**, 1999. "Do Higher Salaries Buy Better Teachers?", NBER Working Paper Series, No. 7082, National Bureau of Economic Research, Cambridge MA.
- Hanushek, E.A., J. Kain and E.G. Rivkin**, 2001. "Why Public Schools Loose Teachers?", NBER Working Paper Series, No. 8599, National Bureau of Economic Research, Cambridge MA.

- Loeb, S.**, 2000. "How Teachers' Choices affect what a Dollar can buy: Wages and Quality in K-12 Schooling", Paper prepared for the Education Finance Research Consortium.
- Loeb, S. and M.E. Page**, 2000. "Examining the Link between Teacher Wages and Student Outcomes: The Importance of Alternative Labor Market Opportunities and Non-Pecuniary Variation", *The Review of Economic and Statistics*, 82, 3, pp. 393-408.
- Manski, C.F.**, 1987. "Academic Ability, Earnings, and the Decision to become a Teacher: Evidence from the National Longitudinal Study of the High School Class of 1972", in Wise, D. (ed) *Public Sector Payrolls*, Chicago IL: University of Chicago Press.
- Miles, K.H. and L. Darling-Hammond**, 1997. "Rethinking the Allocation of Teaching Resources: Some Lessons from High Performing Schools", Paper prepared for the University of Wisconsin-Madison, Center for Education Research, Consortium for Policy Research in Education.
- Mont, D. and D.I. Rees**, 1996. "The Influence of Classroom Characteristics on High School Teacher Turnover", *Economic Inquiry*, 34 (Jan), pp. 152-167.
- Murnane, R.M.**, 1991. "Who will Teach? Policies that Matter", Cambridge, Mass.: Harvard University Press.
- Murnane, R.M. and R.J. Olsen**, 1990. "The Effects of Salaries and Opportunity Costs on Length of Stay in Teaching: Evidence from North Carolina", *Journal of Human Resources*, 25, pp. 106-124.
- OECD**, 2002. "The Teaching Workforce: Concerns and Policy Challenges", *Education Policy Analysis 2002*, Paris: OECD, pp. 65-87.
- Santiago, P.**, 2002. "Teacher Demand and Supply: Improving Teaching Quality and addressing Teacher Shortages - A Literature Review and a Conceptual Framework for Future Work", Education Working Papers No. 1, Paris: OECD.
- Santiago, P.**, 2004. "The Labour Market for Teachers", in Johnes, G. and J. Johnes (Eds.), *International Handbook on the Economics of Education*, Cheltenham, UK: Edward Elgar.
- Temin, P.**, 2002. "Teacher Quality and the Future of America", NBER-Working Paper No. 8898, Cambridge MA.
- Waterreus, I.**, 2003. *Lessons in Teacher Pay. Studies on Incentives and the Labor Market for Teachers*, Amsterdam: Thela Thesis.
- Willis, R.J. and S. Rosen, 1979. "Education and Self Selection", *The Journal of Political Economy*, Vol. 87(5), pp. 7-36.
- Wolter, S.C., S. Denzler and B.A. Weber**, 2003. "Betrachtungen zum Lehrermarktes in der Schweiz", *Vierteljahreshefte zur Wirtschaftsforschung*, 72(2), pp. 305-319.
- Wolter, S.C. and B.A. Weber**, 2003. "Welche Löhne und Bildungsrenditen erwarten Studierende an Schweizer Hochschulen?", in Backes-Gellner, U. and C. Schmidtke (Eds.), *Hochschulökonomie – Analysen interner Steuerungsprobleme und gesamtwirtschaftliche Effekte*, Schriften des Vereins für Socialpolitik, Neue Folge Band 296, pp. 145-161.
- Wolter, S.C. and A. Zbinden**, 2002. "Labour Market Expectations of Swiss University Students", *International Journal of Manpower*, 23 (5), pp. 458-470.

APPENDIX

TABLE 8. DESCRIPTIVE STATISTICS OF THE VARIABLES USED

Variables	Mean	Std. Dev.
Upper-secondary teachers (first job)	0.061	0.240
Male	0.673	0.469
Age	29.00	4.28
University of Berne	0.125	0.334
University of Basel	0.083	0.276
University of Lucerne	0.003	0.057
University of Fribourg	0.053	0.225
University of Geneva	0.104	0.305
University of Lausanne	0.086	0.281
Federal Institute of Technology in Lausanne	0.049	0.215
University of Neuchâtel	0.025	0.155
University of St. Gallen	0.052	0.221
Federal Institute of Technology in Zurich	0.182	0.386
Graduate year period 1981-1985	0.170	0.375
Graduate year period 1987-1991	0.266	0.442
Graduate year period 1993-1997	0.310	0.462
Graduate year period 1999-2001	0.255	0.436
French-speaking part of Switzerland	0.270	0.444
Swiss Nationality	0.915	0.278
Graduate unemployment rate	4.963	2.130
Part-time worker	0.281	0.450
Theology	0.022	0.148
Literature and languages	0.071	0.257
History	0.056	0.230
Social sciences and humanities (interdisciplinary)	0.094	0.292
Social sciences	0.005	0.073
Economics	0.161	0.368
Law	0.104	0.306
Exact sciences	0.073	0.260
Natural sciences	0.102	0.303
Natural sciences (interdisciplinary)	0.012	0.110
Engineering	0.151	0.359
Medicine / Pharmacology	0.147	0.354
PhD	0.157	0.364
Higher teaching certificate	0.039	0.193
Change in the number of pupils at secondary II level	0.021	0.055
Certificate as lower secondary teacher	0.010	0.102
Observations (employed graduates)	39479	

