Estimating wage equations for Hungarian higher-education graduates[*]

by Peter Galasi

Introduction

The paper investigates the labour market output of Hungarian higher education in terms of wages based on samples from two cohorts of Hungarian career-beginners. It focuses on five elements of the problem: how 1. university education as compared to college degree, 2. in-school labour market experience, 3. types of education, 4. learning foreign language and information technology (IT) affect school-leavers' wages, and 5. whether cost-priced (state-funded) education plays a role in wage determination.

First, changes on the Hungarian labour market during the '90s, and their consequences for the labour market situation of employees with higher-education diploma are considered. Second, data and variables, and estimation strategy are discussed. Then estimation results are presented, and the final section concludes

Labour market and higher education in the '90s

Hungary has experienced a transition crisis from the middle of '80s. The transformation of the economic system has brought about significant changes in main economic indicators. GDP dropped massively from 1989 to 1993, it started to grow only in 1994 (Fazekas 2001, p.201). Employment considerably declined until 1996, and it has been stagnating since (Fazekas 2001, p. 201). The rate of unemployment reaches a two-digit value in 1993 (from practically zero), then it begins to decrease, and at the end of the decade its value is about 6% (Fazekas 2001, p.201). Having been recovered from the transition shock the Hungarian labour market is now on a new equilibrium path characterised by low level of employment and unemployment, and high level of inactivity.

As regards higher-education input and output both enrolment and graduation have dynamically increased. The number of full-time students soared from 72 000 to 193 000 between 1989 and 2001, a 268 per cent high growth (Statisztikai évkönyv 2001, p.8). The number of graduates also increased during the same period from 16 000 to 30 000, resulting in 168 per cent more graduates in 2001 than in 1989 (Statisztikai évkönyv 2001, p.9). The dynamic increase is due to increases in the number of students of existing higher-education institutions and the appearance of newly founded institutions (run by private foundations and churches). During this period, a new legal form of studying has been formed, namely, the so-

[*] This research was supported by a grant from the CERGE-EI Foundation under a program of the Global Development Network. Additional funds for grantees in the Balkan countries have been provided by the Austrian Government through WIIW, Vienna. All opinions expressed are those of the author(s) and have not been endorsed by CERGE-EI, WIIW, or the GDN.
The author wishes to thank *Gábor Kézdi* for help, advice and comments.

called cost-priced student who covers the full costs of his/her education at a higher-education institution. The number of cost-priced students was 1202 in 1997, the year this legal form was introduced, and it is three times as much (3517) in 2000 (figures come from the Higher Education Admission Office).

As for the labour market outcome of the higher education, the tendencies can be summarised as follows. During the whole period, total labour demand declined or stagnated, whereas demand for young workers with higher education diploma considerably increased. As a consequence, despite the dynamic increases in the higher-education output, the value of higher education diploma in terms of earnings has increased for the young. This can be shown with the help of simple labour market indicators. For example the ratio of monthly wages of young (20-34 year-old) workers with higher-education diploma to young workers with high-school diploma increased from 1.29 to 1.73 between 1986 and 2002, the same wage ratio for the 35-54 year-old to 20-34 year-old workers with higher-education diploma declined from 1.44 to 1.18 during the same period (Employment Office's data).

Summarising the results of recent papers concerning with the Hungarian labour market (Kertesi – Köllő 1995, 1997, 1999, 2002, Kézdi 2002; Kőrösi 1998, 2000, 2002), it can be said that due to the shrinking product demand accompanying the transition, dynamic job-destruction and job-creation have taken place on the Hungarian labour market. In the first years of transition (until 1992-93) the process was dominated by job-destruction resulting in declining employment level. Between 1993-96 job-destruction and –creation had about the same dynamics and as a consequence, stagnating employment level went hand in hand with strong intersectoral and interindustry reallocation of labour. The reallocation resulted in higher productivity and the revaluation of human capital, and had two consequences. First, the returns to education for the most educated young workers increased,[1] and, second, the labour market experience of older workers has been devalued. The relatively high returns to education for the young with higher-education diploma remained unchanged at the end of '90s, although the reallocation of jobs has been slowed down.

Some elements of the wage-determination problem for higher-education graduates – what will be examined?

According to the literature, wage premia associated with higher-education diplomas remained high during the '90s. Papers on the subject, however, did not distinguish between college and university education. Our data allows us to examine this problem, that is, whether university degree produces higher wages as compared to college degree.

Little attention has been paid so far to the dynamically growing cost-priced higher education. In an earlier paper we examined the wages of former cost-priced students, and found that their wages do not differ from earnings paid for persons graduated from state-funded places. This is not necessarily so in other transition countries where cost-priced places might produce lower wages (for example in Romania). Here the problem will be analysed with the help of more complex models and more sophisticated econometric techniques.

[1] Increasing returns to education are observed in other transition countries, as well (see for example Filer – Jurajda – Plánovsky 1999, or the literature referred to in Kertesi and Köllő 2002).

Another potentially important problem concerning the labour market situation of career-beginners with higher education diploma is the role in-school labour market experience might play in their wage formation (Light 2001). Now a not negligible proportion of higher-education students works for pay during their studies and this might affect both the total amount of human capital they accumulate when being in school and also the human capital accumulated by learning. This is an interesting problem from both theoretical and educational-policy points of views since then the accumulation of the two traditional components of human capital occurs at the same time.

Growing higher education output, stagnating overall labour demand and changing labour-demand structure raise other questions related to the education/job match problem, not analysable on other samples.

Such a problem might be the marketability of different types of education, that is the skills learned in school. This can be proxied by the type of education itself the student has chosen and also the number of specialisations (majors and minors) within a given type of education. The structure of types of education offered by higher-education institutions radically changed during the transition period. This partly reflects higher-education-institutions' effort to adjust the structure of their output to labour market demand. This is so in the case of economics&business (some 370 per cent increase between 1989 and 1999, according to data of the Higher-education Admission Office), and law (227 per cent). On the other hand, the number of students has increased considerably in some types of education representing rather declining labour-market demand (the number of students admitted to agricultural specialisations increases by 255 per cent during the period in consideration).

Another problem concerns the number of occupations persons with given types of education have access to. Some types of education offer skills utilisable in many occupations but that initially produce a relatively poor-quality match. Others provide skills to be used in a few occupations with a potentially better-quality initial match. It is an important empirical question which kind of education results in higher wages for career-beginners. This might affect decisions on types of education of the higher-education institutions, as well.

Finally, there are some general skills that might result in higher wages, namely, foreign languages and information technology that might be independent of types of education, but ameliorate the labour market position of career beginners.

Data, variables, empirical specifications

Two data sets are used. The first takes a picture on the September 1999 labour-market situation of young career-beginners graduated from public higher education as full-time students in 1998 (FIDÉV1). The second one describes the 2000 labour market situation of persons graduated from higher education as full-time students in 1999 (FIDÉV2). FIDÉV1 comprises only public, FIDÉV2 includes private and church-run institutions, as well. The questionnaires of the two surveys also differ to some extent. From FIDÉV1 we can get information about foreign-language and information-technology skills of the respondents, whereas from FIDÉV2 we know whether the individuals in the sample had some in-school

labour market experience and whether they were students at cost-priced or state-funded places.

So as to extract most of the information from the data sets, the analysis will be done separately for the two individual samples. The pooled sample (FIDÉV12) may also prove useful since greater sample-size might provide more precise estimations, thus it will also be made use of.

The analysis concerns employees and the self-employed according to the ILO/OECD definition with non-missing wage information. Analytical weights are used (that do not affect sample size) since the composition of respondents does not fully replicate the higher-education output in question (weights are from higher-education statistics of the ministry of education).

The problem is treated in a simple Beckerian-Mincerian human-capital setting (Becker 1975, Mincer 1975), where earnings are related to two components of human capital: education and labour market experience. As dependent variable the natural log of wage rate, constructed with the help of the September net monthly wage and working time, is used (means and standard deviations of variables are reported in Table 1). This is somewhat new in the Hungarian literature on earnings determination in the transition period, for all other papers work with data with no information on working time.

The average wage rates are 467 (FIDÉV1) and 621 HUF (FIDÉV2), respectively. For the pooled sample, where 1999 wages are converted to 2000 prices, this amounts to 566 HUF. Due to lack of comparable data it is hard to say whether these wage rates are high or low. In terms of net monthly wages, however, our career-beginners earn 11.8% (FIDÉV1) and 16.5% (FIDÉV2) more than the average Hungarian employee does in the same year (see Table 7.1 in Fazekas 2001).

Education is measured by a dummy: whether the individual has a college or BA (=0) or a university or MA (=1) degree. University diploma-holders constitute about 40% of the samples.

Labour market experience is in-school (Light 2001), it is also proxied by a dummy variable: whether or not the respondent worked regularly for pay during their studies (0 = no, 1 = yes). The proportion of persons having in-school labour market experience is 30% in the sample (FIDÉV2).

We insert a gender dummy in the in order to capture women's relatively disadvantageous labour market position (women = 1). The proportion of women in FIDÉV1 is about 52%. The customary way of treating gender wage-gap is to estimate earnings equations for men and women separately. Here we do not do this, because the persons in our samples are at the beginning of their labour-market life-cycle and all have higher-education diplomas. Differences attributable to either family division of labour or labour market discrimination are likely to be formed during later phases of the life cycle due to marriage and/or child rearing. The standard result is, however, a negative parameter estimate for the coefficient, although it might be that estimated gender differences will be zero, as the literature on the subject, at least for Central-European transition countries, detects a very important decline in the gender pay-gap ((Brainerd 2000, Hunt 2002).

In addition, we use two dummies for foreign language skills (whether the respondent speaks English or German, FIDÉV1), and a dummy that is intended to proxy the IT skills of the respondent (whether s/he uses regularly the Web when working, FIDÉV1).[2] If these skills become more valuable on the labour market of a transition economy in the '90, as the stronger integration of Hungary as a small and open economy into the European economy and the direction of the so-called skill-biased technological changes suggest, we expect positive signs for these variables.

The diversity of initial skills might be important for higher-education graduates, since it can affect both their access to jobs and the returns to human capital on a labour market with heterogeneous jobs and skill requirements. Two variables, that might something to do with skill diversity acquired in a higher education institution, are added to the wage equation. The first one is a dummy measuring that the graduate has one or two fields of study (0 = one, 1= two); 16.5% (FIDÉV1) and 21.1% (FIDÉV2) of persons in the two samples have two fields of studies. Fields of studies are defined within a giving type of education: for example a person may choose Hungarian and History as fields of studies, and thus his/her type of education will be Humanities. If having two fields of study instead of one ameliorate the potential labour market situation of the graduate, then the parameter estimate for this variable will be positive.

The second one is an occupational concentration index[3] that shows how individuals with a given type of education are distributed among occupations. Some types of education provide skills that might be useful for a relatively large number of occupations - they are labelled „broad" fields of education by van Smoorenburg and van der Velden -, some prepare students for a small number of occupations („narrow" fields of study). The concentration index is used to proxy this problem. Its value is zero if individuals with a given type of education are employed in only one occupation, it is unity if individuals with a given type of education are distributed evenly among occupations. A type of education with zero value is, in this sense, very „narrow", whereas a type of education with a unit value is very „broad". „Narrower" fields of study can assure education/job match of better quality but with relatively high searching costs, that is, it might be costly to find a good match due to the „narrowness" of the type of education. „Broader" types of education might result in a match of worse quality but with relatively low costs of searching. The question is whether „narrower" or „broader" types of education provide advantages in terms of wages. They might work in both ways depending on the actual structure of labour demand and the resulting searching costs of finding a job with given skill requirements. If the parameter estimate of the variable is positive, that means that a person with a „narrower" type of education is worse off since s/he could not find a good

[2] Here other specifications are also possible since we have two kinds of additional information as regards IT use: s/he uses PC and local networks. However, all the specifications have produced qualitatively similar results.

[3] The index for type of education *i* with occupations *o* is as follows : $K_i^o = (1 - \sum_o p_{io}^2) \frac{N_o}{N_o - 1}$, where p_{io} denotes the proportion of individuals with type of education *i* working in occupation *o*, N_o is the number of occupations, and $0 \le K_i^o \le 1$. If it is zero, then individuals with a given type of education are concentrated in one occupation. If it is one, individuals with a given type of education are distributed evenly among occupations (van Smoorenburg-van der Velden, 2000). When constructing the concentration index, we had 54 types of education and 117 occupations.

education/job match. If the reverse holds true then an individual with a „broader" type of education will be worse off in terms of wage premia for the same reason.

In Hungary an important point of the debate on higher-education policy is the quality of cost-priced education. It is possible that cost-priced education produces poor quality since admission criteria for cost-priced places are less strict in terms of admission scores, and the ratio of admitted to applied students (Galasi and Varga 2002). In order to see whether this results in higher or lower wages, the equations include a cost-priced dummy (FIDÉV2). If students admitted to cost-priced and state-funded places differ in their probability of admission, then an individual might choose a cost-priced place even if the expected wage is lower than that obtainable with a state-funded diploma.[4] This implies that a cost-priced student's wage might be either lower or higher than a state-funded one's.

The equations include a series of type-of-education dummies (with primary-school teachers as the reference). Although knowledge and skills embodied in the type of initial education is not necessarily related to wages for older workers, one might suspect that type of education would influence the wage of the career-beginners. This might work via the actual state and structure of labour-market equilibrium. On the labour market some skills related to jobs might actually be in short supply, whereas others are not. Though the correlation between job-skill requirements and types of education, as well as correlation between types of education and wage can be weak as regards realised (observed) job/education matches, it can be assumed that when demand is high for some skills, then persons with types of education possibly having these kinds of skills might benefit from this situation by earning more. In a transition economy three types of education might be possible candidates for providing high wages due to high demand: economics&business, law and informatics. However, this might not be the case since the number of students admitted to these types of education also increased dynamically during the '90s. Another example is agricultural education. The number of students admitted dynamically increased, whereas the number of agricultural workers

[4] Assume that the potential higher-education student maximises the present value of his/her life-time income, and - for simplicity - assume that s/he will be admitted to a higher education institution at the given probability of admission and the decision solely concerns the choice of a cost-priced or state-funded place. Then s/he will choose a cost-priced place if the present value of the lifetime wage gain due to the cost-priced diploma exceeds the additional costs of obtaining a diploma at a cost-priced place. She will choose a cost-priced place (institution) if the following (in)equality holds:

$$\sum_{t=k}^{T} \frac{(1-p)W_{CP} - pW_{SF}}{(1+i)^t} \geq \sum_{t=1}^{k-1} \frac{C_{CP} - C_{SF}}{(1+i)^t},$$

where C_{CP} and C_{SF} are the costs of a cost-priced and state-funded place for the potential student, respectively, W_{CP} and W_{SF} are the expected (annual) wage obtainable by graduating form a cost-priced or state-funded places, p denotes the probability of admission to a state-funded place, t is life-cycle time, the individual spends k-1 time periods on studies and k to T time periods on the labour market (with a final period of time T), and i is the individual's discount rate. By assumption $C_{CP} > C_{SF}$, thus the potential student would choose a cost-priced place if $(1-p)W_{CP} > pW_{SF}$; therefore the decision will depend on the wages and the admission probabilities associated with the two kinds of places. p is a function of the criteria of admission (entry exams, admission restrictions in terms of the number of students to be admitted, entry scores, etc). If the criteria of admission are much stricter for state funded than cost-priced places ($1 - p > p$) then the student might end up with a choice $W_{SF} > W_{CP}$. If the criteria of admission do not differ much or do not differ at all then choosing a cost-priced place will result in $W_{CP} > W_{SF}$.

(self-employed included) declined dramatically in the last decade, and this might imply depressed wages for career-beginners with agricultural education.

So as to control for wage differences in regional and occupational labour markets, several variables are used. These are as follows: micro-regional rates of unemployment[5], per-capita income tax of the workplace's settlement[6], log median, gross, monthly wage of the workplace's settlement[7], log average occupational wage for the occupation the career-beginner is employed in[8], average probability of remaining on the labour market for the occupation the career-beginner is employed in[9].

From theoretical considerations the natural log of monthly working time is included, as well.

Some variables are available only for one of the samples. FIDÉV1 contains information on sex, foreign-language and Web use, from FIDÉV2 we know the in-school experience and the cost-priced variables.

The wage equation for the pooled sample includes a dummy indicating that the person is from the FIDÉV1 or the FIDÉV2 samples. That would capture the effect changes in labour market situation of graduates between 1999 and 2000 might have on wages.

Estimation strategy

Estimating wage equations raises several questions related to the estimators to be used, since the problem is full of potential biases. One of them is the selectivity bias caused by self-selection into employment, and leading to biased coefficients if Heckman's reservation-wage/wage-offer argument holds (Heckman 1979). Here we cannot correct for selectivity into employment for we could not find a variable that is correlated with participation and uncorrelated with wage. Hopefully, this variant of self-selection would not cause severally biased coefficients, however, because the proportion of the unemployed and inactive persons (full-time students excluded) are relatively low: 6.4% and 5.6% for FIDÉV1, 6.1 and 2.9% for FIDÉV2, respectively.

Papers focusing on returns to education discuss extensively the endogeneity of the education variable (for example Card 1998, 2001). In a simple human capital model, unobserved characteristics of the individuals might affect discount rates, costs of education and productivity (learning ability, family background, earnings potential, etc.), and these omitted variables might lead to either over- or underestimation of the „true" schooling effect, if the wage equation is estimated by ols. The literature on the subject focused primarily on ability bias in the '70s and '80s (Willis-Rosen 1979, Maddala 1983), and with having used treatment-effect and/or ability-selection models it predicted that the coefficient of education would result in upward-biased parameter estimates if estimated by ols, for individuals with better abilities would attain higher levels of education. Recent papers, however, show (Card

[5] Registered unemployment rates from National Employment Office's data base.
[6] Central Statistical Office's settlement-level data base (TSTAR)
[7] Wage Survey of the National Employment Office, full-time workers
[8] Wage Survey of the National Employment Office, full-time workers
[9] Calculated on the basis of interquarterly flows, Central Statistical Office's Labour Force Survey

1998, 2001, Bound and Solon 1999) that the ols estimate could be downward-biased if for example individuals with higher earnings potential have higher discount rates and as a consequence choose lower levels of education. A similar argument would apply, if individuals with better family background have lower discount rates due to favourable accessibility to funding, or smaller losses in terms of forgone earnings or consumption, and for this reason they choose higher levels of education. If this family-background element play an important role in the schooling decision, then the less-able from families with a better family background will obtain a higher level of education than the more able with a less good family background, and as a result ols would produce downward-biased coefficients for the education variable.

IV techniques have recently been successfully applied to correcting for the endogeneity of education (Bedi-Gaston 1999, Brunello-Miniaci 1999, Levin–Plug 1999, Card 2001). This technique requires to find a valid instrument that is correlated with the endogenous variable and uncorrelated with wage, and the model can be estimated by 2sls. A potentially valid instrument for the education variable is the date (year) of admission to the higher education institution. Individuals in our samples were admitted in different years and this variable must be correlated with the schooling variable, since, first, persons graduated from colleges have 2-4 years of education, whereas for those attended universities the length of study is 5 to 7 years, and, second, all of them graduated in the same year (1999 or 2000). In addition, it is very unlikely that the date of admission would be correlated with wages. This variable is available for both samples thus it can be used for estimations on the first (FIDÉV1), the second (FIDÉV2) and the pooled (FIDÉV12) samples.

One can suspect that with using the instrument above, the endogeneity of education variable cannot be fully eliminated, therefore it is worth including additional variables. A possible technique for doing this might be the extension of the proxy variable solution, suggested originally by Griliches (1977), for ols estimations. A multiple-indicator solution might be applied (Wooldridge 2002), meaning that there are two indicator variables correlated with both the unobserved variables and wages. If one of the indicators is inserted into the model as explanatory variable and the other one serves as an instrument for the first indicator variable this might contribute to removing endogeneity from the coefficient of education when the equation is estimated by 2sls. We have two potential indicator variables that can meet these conditions: the mark of General Certificate of Education (GCE or maturity exam) and the scores of the higher-education admission exam. Better examination marks and/or scores can be correlated with unobserved ability and/or family backgrounds assuring good conditions for studies. These variables are available for the FIDÉV1 sample.

Another potential bias due to ols estimation, coming from the literature on labour supply, is the simultaneity of wage rate and working time (Killingsworth 1983, Mroz 1987). If workers choose wage rate-working time packages, the wage equation will be part of a two-equation problem (wage equation and hours-of-work equation). The independent variable of both equations is included in the other equation as an explanatory variable, therefore the hours-of-work variable will be endogenous in the wage equation, thus its parameter estimate will be biased when the model is estimated by ols. Here no working time equation will be estimated

but the simultaneity problem should be handled as regards the wage equation. As the hours-of-work variable is endogenous, we need a valid instrument that is correlated with working time but uncorrelated with wages. We use a dummy variable indicating that the respondent works as a teacher (educator) or not. This variable capture an important element characterising differences in labour-supply preferences of career beginners. A quite considerable proportion of our school-leavers possesses diplomas with a qualification to teach. Almost a half of these individuals, however, enter jobs not requiring teaching skills/qualification. A possible reason for this is that teachers' salaries (monthly net earnings) are low, but their working time is much shorter than with other jobs requiring the same level of education. For example the average monthly working time of teachers is 90 hours, and it is 147 hours for the others not working in teaching jobs in the pooled sample. If monthly wages are converted to wage rates then intregroup differences in wages disappear (the average wage rate of teachers amounts to 407.7 HUF, whereas that of non-teachers is 407.3 HUF). In additon, teachers have longer paid holidays. One can thus argue that teachers' preferences differ from non-teachers', the former group is willing to work less at a given wage rate. Then the potential instrument will be correlated with the working-time variable and uncorrelated with the wage-rate variable. This instrumental variable is available for both FIDÉV1, and FIDÉV2 thus for the pooled sample, as well.

Two other explanatory variables are potentially endogenous: in-school labour market experience and cost-priced education. As for the former, it is possible that in-school experience would be associated with higher earnings potential or better job abilities. It also might be that it would be correlated with unobserved family-background variables influencing discount rates. Unfortunately we could find no potentially valid instrument for this variable, so the problem remains unsolved in this paper. The latter raises similar questions. Cost-priced students might have high earnings potentials and/or better family backgrounds since studying at cost-priced places imply higher costs of education. A valid instrument for this variable might be the proportion of last-year-high-school students admitted to higher-education institutions from the high schools individuals in our samples attended. More exactly, it is the average proportion of persons admitted during the period of 1994 to 1999. This variable might be interpreted as a proxy for high-school quality and/or high-school-students' quality. Since admission criteria for cost-priced higher-education places are less strict than those for state-funded ones, we expect that high-school admission proportions would be negatively correlated with the cost-priced dummy, meaning that lower-quality high-schools induce students to choose cost-priced places to a greater extent. At the same time it is not likely that the proxy indicating differences in high-school quality would be correlated with wages. The cost-priced-student variable is available only for FIDÉV2.

These reduced-form models will be estimated by 2sls with including indicator and instrumental variables. So as to accept estimation results we have to test for the validity of instruments and the endogeneity of the suspected explanatory variables.

We use several model specifications.

A base model is estimated, first, that include variables available for both samples (FIDÉV1 and FIDÉV2). This allows us to make estimations for the pooled sample (FIDÉV12),

as well. The base model will be estimated by ols and 2sls; we consider ols as a benchmarking model providing us with information on the endogeneity bias. The base model also include the working time variable implying that when estimating it by 2sls two instrumental variables have to be used (date of admission to higher education, working as a teacher).

Two extended models are estimated then. They include the additional variables that are only present in one of the samples meaning that no extended model is estimated for the pooled sample. Both of them will be estimated by ols and 2sls. From FIDÉV1 we know the sex, foreign language and the IT variables. The extended model estimated by 2sls on the FIDÉV1 sample includes an indicator as explanatory variable (mark of GCE), and three instruments (date of admission to higher education, working as a teacher, and higher-education admission scores). For FIDÉV2 two additional explanatory variables are available: the in-school experience and the cost-priced dummies. Moreover, three instrumental variables are inserted into the 2sls estimation (date of admission to higher education, working as a teacher, and the proportion of high-school students admitted to higher education of the high school concerned).

We focus on the education variable, that is the wage premia attributable to a university diploma as compared to a college degree. All in all, ten parameters will be estimated for capturing the effect education may have on wages.

No attention will be paid to the working time variable. The interpretation of its coefficient would be problematic, and it is used only for removing simultaneity bias from the 2sls estimations.[10] As regards the rest of the explanatory variables we will be concerned only with the coefficients of the 2sls extended models, although 2sls base models will also be considered for checking the robustness of results.

We need testing for the validity of instruments and the endogeneity of the potentially endogenous variables. An instrument can be considered valid if regressing the potential endogenous variable on all the exogenous variables and the instrument, and using ols, the partial effect of the instrument on the potential endogenous variable proves significant (produces a significant *t* value). As regards the endogeneity of variables a regression-based Hausman test is used (Wooldridge 2002), that can handle several instruments and heteroscedastic residuals. First, each of the potentially endogenous variables are regressed on the instruments and the exogenous variables, second, the ols residuals of these equations are included in the reduced-form equation and are estimated by ols. If the parameter estimates of residuals are jointly significant, the exogeneity of the potentially exogenous variables is rejected. Test results are included in tables reporting 2sls estimations (see Tables A1-A5 in the Appendix), and they confirm both the validity of instruments and the endogeneity of potentially endogenous variables.

Results

[10] The parameter estimates for the working time variable are negative and significant for all specifications.

Table 2 displays the estimated coefficients for the education variable. Wage premia due to university education as compared to college education are reported in percentage. All the parameters are significant and positive. As regards the base model ols, the wage gains amount to 16.8 (FIDÉV1), 12.5 (FIDÉV2), and 14.2 (FIDÉV12) percent, respectively. 2sls estimations for the base model produce 20.7, 28.1, and 21.7 per cent higher wages for university diploma-holders. The extended models result in 14.5 (FIDÉV1) and 12.1 (FIDÉV2) percent when estimated by ols, and higher values are obtained by 2sls: 24.9 and 31.0 percent, respectively.

This implies that the wage premia due to additional schooling are considerably underestimated by ols. It is not a unique result, for many 2sls estimations produce higher returns than ols estimations do (Card 1998, Brunello and Miniaci 1999, Trostel, Walker and Woolley 2002). It is not a standard result, however, since estimations using estimators other than 2sls do not necessarily lead to underestimation by ols (for example Callan and Harmon 1999). The results can be interpreted within the standard human-capital frameworks as follows. One possible explanation is that more productive individuals expect high wages even with college diploma, then additional schooling does not seem advantageous for them, and that induces these individuals to set a high discount rate (subjective time-preference rate) when evaluating life-time income streams, and as consequence they systematically choose lower levels of schooling – college in our case.

The parameter estimates for the other variables are shown in Table 3. Note that the parameter values for variables included in both of the samples are not directly comparable. The robustness of the results can be checked, however, by having a look at base-model 2sls results displayed in Table A1 and A2 of the Appendix.

The gender variable has produced a non-significant coefficient, thus no gender wage-gap can be detected as regards career-beginners with higher-education diploma. Speaking English or German increases wages by 6 and 4 percent, respectively, although the latter is significant only at the $p = 0.1$ level. Using IT leads to wage premia of a similar magnitude (6.5 percent). In-school experience does not affect wages, and, similarly, a young worker earns neither less nor more – ceteris paribus - if s/he graduates from a cost-priced place.

As regards the variables estimated for both of the samples, the results are mixed and somehow unstable.

Having two fields of study instead of one produces a 10-percent-high wage premia for the FIDÉV1 sample, and it results in nothing for the other one. The same holds for the 2sls base model, so it is unlikely that differences in estimates are due to differences in model specifications.

The estimated parameters of the occupational concentration index are either negative, but significant only at the $p=0.1$ level (FIDÉV1), or significant and positive (FIDÉV2). The negative parameter value suggests that a career-beginner with a „broader" type of education will earn less because s/he is less capable to find an education-job match of good quality, although s/he has access to a relatively great number of jobs. The coefficient for FIDÉV2 suggests the opposite: a „broader" type of education is tantamount to having wage premia for it assures a relatively good education/job match with relatively low job-searching costs due to

accessibility to many jobs. These results are not very sensitive to model specifications, either, for we get essentially the same results from the base model estimated by 2sls (see Table A1 and A2 panel B in the Appendix).

The estimated coefficients for types of education also differ for the two samples. The parameters for FIDEV1 are mostly in line with patterns expected from a transition labour market with skill-biased technological changes. Majoring in informatics produces an 50-percent-high wage premium as compared to the category of reference (primary-school teacher). The 41- and 14-percent-high wage-gain for economics&business and foreign language, respectively, could be a logical consequence of an export-oriented, small, and open transition economy. Technical education also implies some advantage in wages, although the parameter is only significant at the p = 0.1 level. The strong and negative coefficient for medical education also makes sense if we take into account that it implies public-sector employment with relatively low wages and that most of our graduates are not licensed, as yet (it takes 4 to 6 years after graduation to become a fully qualified doctor). As regards the FIDÉV2 sample, we have only one coefficient with the same sign as for the FIDÉV1 sample: that of medical education. Wage gains associated with informatics, business&economics, foreign language and technical education have been disappeared. For many types of education, with zero coefficient values for FIDÉV1, we get significant and negative parameters (agricultural education, humanities, physical education, law, social and natural sciences), and only the sign for the agricultural education is consistent with increasing higher-education output and a simultaneous decline in agricultural production observed during the '90s. In addition, the 2sls extended models result in parameter estimates similar to the ones obtained by the 2sls base models, so these differences are unlikely to be attributed to model specifications.

The reasons of this instability are unclear and require further investigation. The analysis of wage determination on more recent samples of higher-education graduates may provide the answers but no such surveys are available, as yet. It might be that our second cohort of higher education graduates faces the consequences of a more elastic supply of educated labour implying a decline in wage premia that the young with skills in high demand experienced earlier. As Kézdi (2002) states, in the second half of the '90s, increasing demand for educated labour was coupled with inelastic supply. During this decade higher-education enrolment rates and the number of persons admitted to higher education have considerably increased but educated labour has continuously realised high wage premia. Returns to skills should decline if labour supply becomes more elastic, and it is possible that we accidentally observed a cohort (FIDÉV2) experiencing this. This story would be consistent with some of our results, in particular with the evaporated wage premia for some types of education (informatics, business&economics, foreign language).

Summary

The paper have investigated the labour market output of Hungarian higher education in terms of wages based on samples from two cohorts of Hungarian career-beginners.

We have considered wage premia associated with university diploma compared to college degree. When correcting for endogeneity and simultaneity of some variables we arrive at about 24.9 (FIDÉV1) and 31.0 (FIDÉV2) per-cent-high wage-gain.

As regards gender pay-gap, there is no sign that women would earn less than men do.

When having a look at IT technology and foreign language knowledge, skills mostly independent of types of education, we see that they produce a non-negligible wage advantage.

The idea that work for pay when in school (in-school labour market experience) affects post-school wage does not seem to be justified.

Similarly, the hypothesis that cost-priced education implies lower wages, so cost-priced students earn less than those finished their study at state-funded places is rejected.

Having two field of studies instead of one results in higher wages for the FIDÉV1 sample, whereas no such an effect is detected for the FIDÉV2 sample.

The graduates differ in their accessibility to jobs, due to the skills embodied in he type of education they have. It is unclear whether this factor has an impact on wages and in which direction. The estimated parameter for the FIDÉV2 sample, however, suggests that a "broader" type of education produces wage premia for it leads to better education/job match due to lower job-search costs resulted from accessibility to many jobs.

As regards the effects types of education might have on wages the results are mixed, and they are consistent with patterns related to a transition economy for the FIDÉV1 sample. There informatics, economics&business, and foreign language seem to result in considerable wage premia. Results from second sample are different, hard to be interpreted in transition and skill-biased technological changes frameworks. This requires further examination of the problem on more recent samples.

References

Becker, G.S. (1975) *Human Capital*, University of Chicago Press, Chicago

Bedi, A. S and N. Gaston (1999) Using variation in schooling availability to estimate educational returns for Honduras, *Economics of Education Review*, v18, p107

Bound, J. and G. Solon (1999) Double trouble: on the value of twins-based estimation of the return to schooling, *Economics of Education Review*, v18, p169-182

Brainerd, E. (2000) Women in Transition: Changes in Gender Wage Differentials in Eastern Europe and the Former Soviet Union, *Industrial and Labor Relations Review*, v.54, p138-162

Brunello, G. and R. Miniaci (1999) The economic returns to schooling for Italian men. An evaluation based on instrumental variables, *Labour Economics*, v6, p509

Callan, T. and C. Harmon (1999) The economic return to schooling in Ireland, *Labour Economics*, v6 p543–550

Card, D. (1998) The Causal Effect of Education on Earnings, Center for Labor Economics, University of California, Berkeley, Working Paper No 2

Card, D. (2001) Estimating the Return to Schooling: Progress on Some Persistent Econometric Problems, *Econometrica*, v.69, p1127-1160

Fazekas, K. (ed.) (2001) *Munkaerőpiac*i *tükör*, MTA Közgazdaságtudományi Kutatóközpont - Országos Foglalkoztatási Közalapítvány, Budapest

Filer, R.K., S. Jurajda and J. Plánovskỳ (1999) Education and wages in the Czech and Slovak Republics during transition, *Labour Economics*, v6 pp .581–593

Galasi, P. and J. Varga (2002) Does Private and Cost-priced Education Produce Poor Quality?, *Budapest Working Papers on the Labour Market 2002/1,* Institute of Economics, Hungarian Academy of Sciences and Department of Human Resources, Budapest University of Economics, Budapest

Griliches, Z. (1977) Estimating the Return to Schooling: Some Econometric Problems, *Econometrica*, Vol.45, pp.1-22.

Heckman, J. (1979): Sample Selection Bias as a Specification Error, *Econometrica*, Vol.47, pp.153-161.

Hunt, J. (2002) The Transition in East Germany: When Is a Ten-Point Fall in the Gender Wage Gap Bad News?, *Journal of Labor Economics*, v.20, no. 1, pp.148-169

Kertesi, G. and J. Köllő (1995): Kereseti egyenlőtlenségek Magyarországon, MTA Közgazdaságtudományi Intézet, Budapest, December

Kertesi, G. and J. Köllő (1997): Reálbérek és kereseti egyenlőtlenségek, 1986-1996, *Közgazdasági Szemle*, 7-8.

Kertesi, G. and J. Köllő (1999): Economic Transformation and the Return to Human Capital. *Budapest Working Papers on the Labour Market 1999/6,* Institute of Economics, Hungarian Academy of Sciences and Department of Human Resources, Budapest University of Economics, Budapest

Kertesi, G. and J. Köllő (2002): Economic Transformation and the Revaluation of Human Capital – Hungary 1986-1999, in: A. de Grip, Van Loo,J. és Mayhew K. (eds) *The Economics of Skills Obsolescence*, Research in Labor Economics v. 21, JAI, Oxford, p235-273

Kézdi, G. (2002) Two Phases of Labor Market Transition in Hungary: Inter-Sectoral Reallocation and Skill-Biased Technological Change, *Budapest Working Papers on the Labour Market 2002/3,* Institute of Economics, Hungarian Academy of Sciences and Department of Human Resources, Budapest University of Economics, Budapest

Killingsworth, M.R. (1983) *Labor Supply*, Cambridge University Press, Cambridge

Kőrösi, G. (1998) Labour Demand During Transition in Hungary, *Budapest Working Papers on the Labour Market 1998/5,* Institute of Economics, Hungarian Academy of Sciences and Department of Human Resources, Budapest University of Economics, Budapest

Kőrösi, G. (2000) A vállalatok munkaerő-kereslete, Budapesti Munkagazdaságtani Füzetek *BWP. 2000/3*

Kőrösi, G. (2002) Labour Adjustment and Efficiency in Hungary, *Budapest Working Papers on the Labour Market 2002/4,* Institute of Economics, Hungarian Academy of Sciences and Department of Human Resources, Budapest University of Economics, Budapest

Levin, J. and E. J. S Plug (1999) Instrumenting education and the returns to schooling in the Netherlands, *Labour Economics* v6, p521–534

Light, A. (2001) In-School Work Experience and the Returns to Schooling, *Journal of Labor Economics*, v19 (1) p65

Maddala, G. S. (1983) *Limited-dependent and Qualitative Variables in Econometrics*, Cambridge University Press, Cambridge

Mincer, J. (1974): *School, Experience and Earnings*, NBER, New York

Mroz, T.A. (1987) The Sensitivity of an Empirical Model of Married Women's Hours of Work to Economic and Statistical Assumptions, *Econometrica*, v55, p765-799

Trostel, P., I. Walker and P. Woolley (2002) Estimates of the economic return to schooling for 28 countries, *Labour Economics*, v9,p1-16

van Smoorenburg, M. S M. and R. K. W. van der Velden (2000) The training of school leavers. Complementarity or substitution? *Economics of Education Review*, v19, p207-217

Willis, R. and S. Rosen (1979) Education and Self-Selection, *Journal of Political Economy,* Supplement, v87 S7

Wooldridge, J. M. (2002) *Econometric Analysis of Cross Section and Panel Data*, The MIT Press, Cambridge, Mass.

Tables

Table 1 Means, standard deviations, distributions of variables

	FIDÉV1		FIDÉV2		FIDÉV12[3]	
	Mean	Std.dev.	Mean	Std.dev	Mean	std.dev.
Wage rate[1]	5.974	0.616	6.079	0.712	6.027	0.669
Working time[1]	4.930	0.542	4.871	0.609	4.900	0.578
University	0.422		0.405		0.413	
Woman	0.517					
Two fields of study	0.165		0.211		0.189	
Speaking English	0.789					
Speaking German	0.539					
Use of the Web	0.624					
In-school experience			0.330			
Cost-priced student			0.154			
Job concentration	0.858	0.081	0.851	0.172	0.855	0.135
Type of education						
Agricultural	0.118		0.094		0.106	
Humanities	0.077		0.115		0.096	
Foreign Language	0.078		0.066		0.072	
Small Languages	0.003		0.004		0.003	
Physical Education	0.013		0.007		0.010	
Teacher in primary school	0.074		0.102		0.088	
Informatics	0.042		0.063		0.053	
Technical	0.217		0.180		0.198	
Arts	0.017		0.011		0.014	
Medical	0.081		0.056		0.068	
Law	0.026		0.048		0.037	
Business&economics	0.182		0.180		0.181	
Social Sciences	0.010		0.019		0.015	
Natural Sciences	0.064		0.055		0.059	
Wave[2]					0.512	

[1] Wage rate and working time are natural log
[2] Wave: proportion of persons in the FIDÉV2 sample
[3] Wage rate for the FIDÉV1 sample is converted to 2000 prices

Table 2 Wage premia due to university education (%)

Base model			
	FIDÉV1	FIDÉV2	FIDÉV12
ols	16.8	12.5	14.2
2sls	20.7	28.1	21.7
Extended model			
ols	14.5	12.1	
2sls	24.9	31.0	

Parameter estimates for the education variable, see Tables A1-A5

Table 3 Estimated coefficients, extended model, 2sls

	FIDÉV1		FIDÉV2	
	Coeff.	t-value	Coeff.	t-value
Woman	-0.015	0.56		
Speaking English	0.059	2.32		
Speaking German	0.040	1.76		
Use of the Web	0.064	2.25		
In-school experience			0.068	1.26
Cost-priced student			0.436	0.53
Two fields of study	0.097	2.96	-0.021	-0.64
Occupational concentration	-0.519	-1.83	0.643	2.10
Type of education				
Agricultural	0.012	0.15	-0.438	-2.61
Humanities	0.027	0.50	-0.319	-2.45
Foreign Language	0.143	2.69	-0.219	-1.65
Small Languages	-0.165	-0.87	-0.195	-0.68
Teacher in primary school	0.000	0.00	0.000	0.00
Physical Education	-0.016	-0.18	-0.397	-2.52
Informatics	0.404	5.17	-0.215	-0.80
Technical	0.112	1.76	-0.262	-1.74
Arts	-0.199	-1.54	-0.236	-1.28
Medical	-0.282	-3.67	-0.396	-5.28
Law	-0.005	-0.07	-0.377	-2.95
Business&economics	0.341	4.35	-0.144	-1.00
Social Sciences	-0.088	-0.91	-0.406	-2.25
Natural Sciences	-0.049	-1.00	-0.287	-2.18

See Table A4 and A5

Appendix

Table A1 Wage equations, base model, FIDÉV1

A ols

	Coef.	Robust Std. Err	t	P>|t|
Working time 1	-0.841	0.022	-38.73	0.000
University	0.156	0.020	7.83	0.000
Two fields of study	0.039	0.025	1.56	0.118
Type of education				
Agricultural	0.203	0.048	4.23	0.000
Humanities	0.041	0.042	0.99	0.322
Foreign Language	0.092	0.040	2.31	0.021
Small Languages	-0.291	0.173	-1.68	0.094
Physical Education	0.000	0.000	0.00	0.000
Teacher in primary school	0.046	0.073	0.64	0.524
Informatics	0.525	0.059	8.96	0.000
Technical	0.314	0.041	7.74	0.000
Arts	-0.302	0.074	-4.09	0.000
Medical	-0.121	0.044	-2.76	0.006
Law	0.073	0.049	1.48	0.139
Business&economics	0.444	0.039	11.42	0.000
Social Sciences	-0.033	0.075	-0.45	0.655
Natural Sciences	-0.047	0.038	-1.22	0.223
Occupational concentration	-0.568	0.202	-2.81	0.005
Regional and occupational variables				
Median earnings, workplace's settlement 1	0.219	0.069	3.19	0.001
Per capita income tax, workplace's settlement 1	0.258	0.065	3.96	0.000
Regional rate of unemployment	-0.177	0.329	-0.54	0.591
Occupational rate of stayers	0.597	0.251	2.38	0.017
Mean occupational earnings 1	0.191	0.029	6.54	0.000
Constant	1.938	0.857	2.26	0.024
N				2413
F				100.65
Prob > F				0
R-squared				0.6135

B. 2sls

	Coef.	Robust Std. Err	t	P>|t|
Working time 1	-0.267	0.116	-2.30	0.021
University	0.188	0.040	4.76	0.000
Two fields of study	0.101	0.035	2.92	0.004
Type of education				
Agricultural	-0.028	0.077	-0.36	0.720
Humanities	0.020	0.060	0.33	0.742
Foreign Language	0.149	0.058	2.56	0.011
Small Languages	-0.067	0.183	-0.37	0.714
Teacher in primary school	0.000	0.000	0.00	0.000
Physical Education	0.031	0.097	0.32	0.749
Informatics	0.390	0.081	4.78	0.000
Technical	0.099	0.071	1.40	0.162
Arts	-0.233	0.108	-2.16	0.031
Medical	-0.381	0.079	-4.81	0.000
Law	-0.061	0.074	-0.82	0.412
Business&economics	0.263	0.065	4.02	0.000
Social Sciences	-0.095	0.102	-0.93	0.351
Natural Sciences	-0.060	0.056	-1.09	0.277
Occupational concentration	-0.448	0.261	-1.72	0.085
Regional and occupational variables				
Median earnings, workplace's settlement 1	0.308	0.088	3.49	0.000
Per capita income tax, workplace's settlement 1	0.195	0.085	2.29	0.022
Regional rate of unemployment	0.104	0.408	0.26	0.798
Occupational rate of stayers	0.396	0.261	1.52	0.129
Mean occupational earnings 1	0.144	0.036	3.94	0.000
Constant	-0.322	1.249	-0.26	0.797
N				2413
F				25.92
Prob > F				0
R-squared				0.394

Dependent variable: natural log of wage rate
1 natural log
Endogenous variables: working time, university; Instruments:working as a teacher, date (year) of admission into the higher-education institution
Validity of instruments: working as a teacher t-value:-8.12, admission date t-value = -21.94
Endogeneity of working time and university: F-value 22.94 p=0.0000

Table A2 Wage equations, base model, FIDÉV2

A. ols

		Robust		
	Coef.	Std. Err	t	P>|t|
Working time 1	-0.897	0.017	-54.18	0.000
University	0.118	0.020	5.87	0.000
Two fields of study	-0.024	0.021	-1.14	0.253
Type of education				
Agricultural	0.059	0.075	0.79	0.431
Humanities	-0.036	0.066	-0.55	0.580
Foreign Language	0.013	0.073	0.17	0.862
Small Languages	-0.156	0.088	-1.76	0.078
Teacher in primary school	0.000	0.000	0.00	0.000
Physical Education	-0.235	0.106	-2.21	0.027
Informatics	0.320	0.067	4.80	0.000
Technical	0.207	0.069	3.02	0.003
Arts	-0.118	0.143	-0.82	0.410
Medical	-0.104	0.041	-2.55	0.011
Law	-0.086	0.051	-1.69	0.091
Business&economics	0.330	0.069	4.78	0.000
Social Sciences	-0.011	0.073	-0.16	0.876
Natural Sciences	-0.041	0.062	-0.66	0.512
Occupational concentration	0.154	0.148	1.04	0.296
Regional and occupational variables				
Median earnings, workplace's settlement 1	0.292	0.061	4.76	0.000
Per capita income tax, workplace's settlement 1	0.299	0.062	4.85	0.000
Regional rate of unemployment	-0.555	0.276	-2.01	0.044
Occupational rate of stayers	0.427	0.190	2.24	0.025
Mean occupational earnings 1	0.314	0.028	11.41	0.000
Constant	-0.571	0.709	-0.81	0.421
N				3231
F				191.93
Prob > F				0
R-squared				0.6717

B. 2sls

	Coef.	Robust Std. Err	t	P>|t|
Working time 1	-0.237	0.104	-2.29	0.022
University	0.247	0.052	4.74	0.000
Two fields of study	-0.043	0.030	-1.44	0.149
Type of education				
Agricultural	-0.483	0.156	-3.11	0.002
Humanities	-0.320	0.130	-2.47	0.013
Foreign Language	-0.195	0.135	-1.45	0.148
Small Languages	-0.237	0.278	-0.85	0.394
Teacher in primary school	0.000	0.000	0.000	0.000
Physical Education	-0.408	0.145	-2.80	0.005
Informatics	-0.058	0.121	-0.48	0.632
Technical	-0.296	0.141	-2.10	0.036
Arts	-0.276	0.159	-1.74	0.082
Medical	-0.419	0.074	-5.69	0.000
Law	-0.453	0.106	-4.26	0.000
Business&economics	-0.157	0.140	-1.13	0.260
Social Sciences	-0.492	0.140	-3.52	0.000
Natural Sciences	-0.310	0.123	-2.51	0.012
Occupational concentration	0.703	0.278	2.53	0.011
Regional and occupational variables				
Median earnings, workplace's settlement 1	0.228	0.092	2.49	0.013
Per capita income tax, workplace's settlement 1	0.336	0.088	3.83	0.000
Regional rate of unemployment	-0.236	0.420	-0.56	0.574
Occupational rate of stayers	0.356	0.300	1.19	0.236
Mean occupational earnings 1	0.266	0.037	7.26	0.000
Constant	-3.166	1.165	-2.72	0.007
N				3219
F				30.67
Prob > F				0
R-squared				0.379

Dependent variable: natural log of wage rate
1 natural log
Endogenous variables: working time, university; Instruments:working as a teacher, date (year) of admission into the higher-education institution
Validity of instruments: working as a teacher t-value:-8.51, admission date t-value = -25.84
Endogeneity of working time and university: F-value 46.31 p=0.0000

Table A3 Wage equations, base model, FIDÉV12

A. ols

	Coef.	Robust Std. Err	t	P>|t|
Working time 1	-0.874	0.013	-69.44	0.000
University	0.133	0.013	10.33	0.000
Two fields of study	0.003	0.016	0.22	0.825
Type of education				
Agricultural	0.069	0.031	2.24	0.025
Humanities	-0.026	0.029	-0.91	0.364
Foreign Language	0.039	0.031	1.25	0.212
Small Languages	-0.151	0.087	-1.74	0.082
Teacher in primary school	0.000	0.000	0.000	0.000
Physical Education	-0.030	0.060	-0.51	0.611
Informatics	0.357	0.035	10.05	0.000
Technical	0.218	0.028	7.70	0.000
Arts	-0.122	0.064	-1.91	0.057
Medical	-0.084	0.027	-3.08	0.002
Law	-0.044	0.031	-1.40	0.160
Business&economics	0.344	0.029	11.95	0.000
Social Sciences	-0.033	0.042	-0.77	0.442
Natural Sciences	-0.037	0.030	-1.22	0.223
Occupational concentration	0.129	0.066	1.96	0.050
Wave	0.056	0.011	5.13	0.000
Regional and occupational variables				
Median earnings, workplace's settlement 1	0.229	0.044	5.25	0.000
Per capita income tax, workplace's settlement 1	0.286	0.042	6.81	0.000
Regional rate of unemployment	-0.439	0.200	-2.19	0.028
Occupational rate of stayers	0.475	0.138	3.44	0.001
Mean occupational earnings 1	0.265	0.019	14.21	0.000
Constant	0.555	0.503	1.10	0.269
N				6350
F				287.67
Prob > F				0
R-squared				0.638

B. 2sls

	Coef.	Robust Std. Err	t	P>|t|
Working time 1	-0.254	0.074	-3.44	0.001
University	0.197	0.027	7.23	0.000
Two fields of study	0.013	0.021	0.64	0.524
Type of education				
Agricultural	-0.188	0.051	-3.68	0.000
Humanities	-0.060	0.043	-1.39	0.164
Foreign Language	0.093	0.046	2.04	0.041
Small Languages	-0.058	0.175	-0.33	0.738
Teacher in primary school	0.000	0.000	0.000	0.000
Physical Education	-0.059	0.070	-0.84	0.400
Informatics	0.198	0.051	3.89	0.000
Technical	-0.019	0.047	-0.39	0.693
Arts	-0.034	0.071	-0.48	0.631
Medical	-0.400	0.052	-7.70	0.000
Law	-0.233	0.052	-4.45	0.000
Business&economics	0.130	0.046	2.81	0.005
Social Sciences	-0.222	0.061	-3.62	0.000
Natural Sciences	-0.094	0.042	-2.21	0.027
Occupational concentration	0.137	0.088	1.55	0.121
Wave	0.080	0.014	5.53	0.000
Regional and occupational variables				
Median earnings, workplace's settlement 1	0.202	0.061	3.32	0.001
Per capita income tax, workplace's settlement 1	0.279	0.058	4.82	0.000
Regional rate of unemployment	-0.273	0.276	-0.99	0.322
Occupational rate of stayers	0.312	0.173	1.81	0.071
Mean occupational earnings 1	0.214	0.024	8.84	0
Constant	-1.299	0.747	-1.74	0.082
N				6338
F				53.680
Prob > F				0
R-squared				0.382

Dependent variable: natural log of wage rate
1 natural log
Endogenous variables: working time, university; Instruments:working as a teacher, date (year) of admission into the higher-education institution
Validity of instruments: working as a teacher t-value:-12.23, admission date t-value = -38.44
Endogeneity of working time and university: F-value 74.07 p=0.0000

Table A4 Wage equations, extended model, FIDÉV1

A. ols

		Robust		
	Coef.	Std. Err	t	P>|t|
Working time 1	-0.857	0.021	-40.04	0.000
University	0.135	0.020	6.89	0.000
Woman	-0.067	0.020	-3.41	0.001
Two fields of study	0.040	0.025	1.63	0.103
Speaking English	0.070	0.020	3.43	0.001
Speaking German	0.027	0.018	1.55	0.121
Use of Web	0.125	0.020	6.24	0.000
Type of education				
Agricultural	0.148	0.047	3.12	0.002
Humanities	0.020	0.041	0.49	0.624
Foreign Language	0.062	0.039	1.60	0.110
Small Languages	-0.342	0.208	-1.64	0.101
Teacher in primary school	0.000	0.000	0.00	0.000
Physical Education	0.026	0.069	0.38	0.706
Informatics	0.424	0.059	7.16	0.000
Technical	0.238	0.041	5.76	0.000
Arts	-0.291	0.072	-4.06	0.000
Medical	-0.150	0.043	-3.50	0.000
Law	0.040	0.050	0.81	0.419
Business&economics	0.370	0.039	9.54	0.000
Social Sciences	-0.038	0.076	-0.50	0.620
Natural Sciences	-0.049	0.040	-1.22	0.223
Occupational concentration	-0.556	0.197	-2.83	0.005
Regional and occupational variables				
Median earnings, workplace's settlement 1	0.226	0.067	3.39	0.001
Per capita income tax, workplace's settlement 1	0.215	0.064	3.37	0.001
Regional rate of unemployment	-0.026	0.316	-0.08	0.936
Occupational rate of stayers	0.621	0.262	2.37	0.018
Mean occupational earnings 1	0.151	0.029	5.18	0
Constant	2.831	0.852	3.32	0.001
N				2413
F				92.94
Prob > F				0
R-squared				0.6262

B. 2sls

	Coef.	Robust Std. Err	t	P>|t|
Working time 1	-0.407	0.127	-3.19	0.001
University	0.223	0.052	4.30	0.000
Mark of GCE exam	-0.101	0.061	-1.67	0.095
Woman	-0.015	0.026	-0.58	0.561
Two fields of study	0.097	0.033	2.96	0.003
Speaking English	0.059	0.026	2.32	0.020
Speaking German	0.040	0.023	1.76	0.079
Use of Web	0.064	0.028	2.25	0.024
Type of education				
Agricultural	0.012	0.077	0.15	0.880
Humanities	0.027	0.053	0.50	0.616
Foreign Language	0.143	0.053	2.69	0.007
Small Languages	-0.165	0.190	-0.87	0.384
Teacher in primary school	0.000	0.000	0.00	0.000
Physical Education	-0.016	0.088	-0.18	0.856
Informatics	0.404	0.078	5.17	0.000
Technical	0.112	0.064	1.76	0.079
Arts	-0.199	0.130	-1.54	0.125
Medical	-0.282	0.077	-3.67	0.000
Law	-0.005	0.072	-0.07	0.942
Business&economics	0.341	0.078	4.35	0.000
Social Sciences	-0.088	0.096	-0.91	0.362
Natural Sciences	-0.049	0.049	-1.00	0.317
Occupational concentration	-0.519	0.283	-1.83	0.067
Regional and occupational variables				
Median earnings, workplace's settlement 1	0.327	0.085	3.86	0.000
Per capita income tax, workplace's settlement 1	0.178	0.079	2.26	0.024
Regional rate of unemployment	0.164	0.389	0.42	0.673
Occupational rate of stayers	0.522	0.246	2.12	0.034
Mean occupational earnings 1	0.131	0.035	3.79	0.000
Constant	0.772	1.262	0.61	0.541
N				2388
F				24.55
Prob > F				0
R-squared				0.4783

Dependent variable: natural log of wage rate
1 natural log
Endogenous variables: working time, university; Instruments:working as a teacher, date (year) of admission into the higher-education institution, indicator variables: mark of GCE exam, admission scores
Validity of instruments: working as a teacher t-value:-7.07, admission date t-value = -21.75, admission scores t-value = 4.26
Endogeneity of working time, university, CGE exam: F-value 10.36 p=0.0000

Table A5 Wage equations, extended model, FIDÉV2

A. ols

	Coef.	Robust Std. Err	t	P>|t|
Working time 1	-0.895	0.016	-54.33	0.000
University	0.114	0.020	5.63	0.000
Cost-priced student	0.026	0.024	1.09	0.276
In-school experience	0.088	0.018	4.78	0.000
Two fields of study	-0.024	0.021	-1.15	0.250
Type of education				
Agricultural	0.090	0.075	1.19	0.234
Humanities	-0.020	0.066	-0.30	0.766
Foreign Language	0.025	0.073	0.35	0.730
Small Languages	-0.152	0.091	-1.68	0.093
Teacher in primary school	0.000	0.000	0.00	0.000
Physical Education	-0.217	0.104	-2.09	0.037
Informatics	0.306	0.068	4.50	0.000
Technical	0.232	0.069	3.37	0.001
Arts	-0.102	0.144	-0.71	0.480
Medical	-0.109	0.041	-2.67	0.008
Law	-0.058	0.051	-1.14	0.253
Business&economics	0.351	0.070	5.05	0.000
Social Sciences	0.001	0.073	0.02	0.986
Natural Sciences	-0.020	0.062	-0.33	0.743
Occupational concentration	0.106	0.148	0.71	0.475
Regional and occupational variables				
Median earnings, workplace's settlement 1	0.288	0.061	4.76	0.000
Per capita income tax, workplace's settlement 1	0.287	0.061	4.69	0.000
Regional rate of unemployment	-0.540	0.272	-1.98	0.047
Occupational rate of stayers	0.402	0.187	2.15	0.032
Mean occupational earnings 1	0.312	0.028	11.35	0.000
Constant	-0.351	0.710	-0.49	0.621
N				3224
F				177.76
Prob > F				0
R-squared				0.6753

B. 2sls

	Coef.	Robust Std. Err	t	P>|t|
Working time 1	-0.276	0.101	-2.74	0.006
University	0.270	0.077	3.50	0.000
Cost-priced student	0.436	0.816	0.53	0.593
In-school experience	0.068	0.054	1.26	0.207
Two fields of study	-0.021	0.033	-0.64	0.521
Type of education				
Agricultural	-0.438	0.168	-2.61	0.009
Humanities	-0.319	0.130	-2.45	0.014
Foreign Language	-0.219	0.133	-1.65	0.099
Small Languages	-0.195	0.284	-0.68	0.494
Teacher in primary school	0.000	0.000	0.00	0.000
Physical Education	-0.397	0.157	-2.52	0.012
Informatics	-0.215	0.270	-0.80	0.426
Technical	-0.262	0.151	-1.74	0.082
Arts	-0.236	0.185	-1.28	0.201
Medical	-0.396	0.075	-5.28	0.000
Law	-0.377	0.128	-2.95	0.003
Business&economics	-0.144	0.144	-1.00	0.318
Social Sciences	-0.406	0.180	-2.25	0.024
Natural Sciences	-0.287	0.131	-2.18	0.029
Occupational concentration	0.643	0.307	2.10	0.036
Regional and occupational variables				
Median earnings, workplace's settlement 1	0.203	0.092	2.22	0.027
Per capita income tax, workplace's settlement 1	0.383	0.110	3.49	0.000
Regional rate of unemployment	-0.206	0.424	-0.49	0.627
Occupational rate of stayers	0.368	0.326	1.13	0.259
Mean occupational earnings 1	0.282	0.056	4.99	0.000
Constant	-3.564	1.945	-1.83	0.067
N				2999
F				26.32
Prob > F				0
R-squared				0.3815

Dependent variable: natural log of wage rate
1 natural log
Endogenous variables: working time, university, cost-priced student; Instruments:working as a teacher, date (year) of admission into the higher-education institution, high-school admission rates
Validity of instruments: working as a teacher t-value:-8.50, admission date t-value = -24.45, high-school admission rate t-value = -2.76
Endogeneity of working time, university, cost-priced education: F-value 27.65 p=0.0000