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Comparative analysis of the returns to education in Germany and Hungary (2000)

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COMPARATIVE ANALYSIS OF THE RETURNS TO EDUCATION IN GERMANY AND HUNGARY (2000)

BY SZILVIA HÁMORI

Abstract

In this study standard Mincer earnings equations are estimated using both ordinary least squares (OLS) and quantile regression in order to give a comprehensive picture of the returns to education in Germany and Hungary for the year 2000. To make the cross-country comparison of the returns to education informative, six differentiated categories for formal education, rather than years of schooling, are generated and used in the empirical analysis. Moreover, the returns to three and eight field of study groups for Germany and Hungary respectively are estimated in order to shed more light on the valuation of specific university degree. Most importantly, the empirical results provide evidence for the fact that the OLS estimate is not an accurate estimate of the return to education for the population (more specifically for the selected samples). That is, the estimates of the quantile regressions point to the fact that differences in returns to education within educational groups contribute significantly to aggregate earnings inequality, especially in Hungary.

Keywords: Quantile regression, education systems, return to education, between-educational-levels earnings inequality, within-educational-levels earnings inequality

JEL Classification: C13, I21, J24, J31

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HÁMORI SZILVIA

ÖSSZEHASONLÍTÓ ELEMZÉS AZ EMBERI TŐKE HOZAMÁRÓL NÉMETORSZÁGBAN ÉS MAGYARORSZÁGON (2000)

Összefoglaló

A tanulmány az iskolázottság értékelését elemzi Németországban és Magyarországon 2000-ben. A becslések mindkét országban hat iskolazottsági fokozaton alapulnak, amelyek összehasonlíthatók. Továbbá a tanulmány felméri az egyetemi diplomák piaci értekét a két országban. A standárd Mincer egyenleteket OLS és kvantilis regresszióval becsültem meg. Az eremények azt mutatják, hogy a kvantilis regresszó becslései sokkal pontosabb képet adnak az emberi tőke hozamáról, mivel ezek (az OLS regresszióval ellentétben) az iskolzottsági fokozatiokon belüli egyenlőtlenséget is felmérik, ami főleg Magyarországon fontos tényezője az aggregált béregyenlőtlenségnek.

Kulcsszavak: kvantilis regresszió, oktatási rendszerek, emberi tőke hozama, béregyenlőtlenség az iskázottsági fokozatokon belül és között

1. INTRODUCTION

Cross-country comparisons of the returns to education are often conducted within the European Union. Although such studies shed light on the interplay between education and earnings inequality across countries, there is a danger that, unless the empirical analysis is based on differentiated schooling categories, the results may not be very informative. For instance, if only the years of schooling is used as a proxy for the formal component of human capital, cross-country comparisons can be misleading if one of the countries under analysis has multiple education streams at some level of education and subsequently a year of schooling in itself does not necessarily convey the true value of education neither in the respective country nor in a cross-country comparison.

Therefore, one of the objectives of this paper is to develop a system for comparison of the German and Hungarian education systems, which can be used to compare the returns to the education across the two countries in a meaningful way.[1] Given Hungary's recent EU accession this study has its relevance in analysing how the returns to education in a "new" EU member state compare to that of an "older" member state. Germany as an "older" EU member state is chosen because (a) Germany is a country with a stable wage structure in a cross-country comparison[2] and (b) the two countries have similar education systems, which allows for a differentiated cross-country comparison of the returns to schooling.[3]

It is important to note, that the purpose of this paper is purely descriptive. That is to say, the aim is not to deal with the problems of measuring the causal impact of education on earnings, namely measurement error, omitted ability bias and self-selection bias. Instead, the purpose is to provide a comprehensive picture of the returns to education in the two countries, that is, to analyse both "between- and within-educational-levels earnings differentials", given the existing evidence that aggregate earnings inequality arises from differences between as well as within educational groups, due to the heterogeneity of the labour force.[4]

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[1] Note that "German" refers to the "West German" education system throughout the paper.

[2] For descriptive evidence on wage inequality in Germany, among others, see Fitzenberger (1999), Fitzenberger et al. (2001) in Fitzenberger at al. (Eds.), Abraham and Houseman (1995) in Freeman and Katz (Eds.) Krueger and Pischke (1995) in Freeman and Katz (Eds.) (with an emphasis on a East and West German comparison) and Pereira and Martins (2000) (with an emphasis on international comparison).

[3] Phillips (1995), pp 243 – 247 offers an extensive discussion of the common traditions of the education systems in Germany and Hungary.

[4] See for example Fitzenberger et al. (2001) in Fitzenberger et al., pp. 41 – 86.

Although there is an ample of studies on the returns to human capital in Hungary for the transition period and for the years prior to transition[5], finding evidence that the widening earnings differentials across education groups is a significant contributing factor to the increase in earnings inequality for the decade of 1989 – 1999, this paper extends on the existing literature on the Hungarian labour market, by estimating "within-educational-levels earnings differentials". Furthermore, in order to provide a more comprehensive picture to the returns to university education, the returns to the eight fields of study at university are estimated in Hungary.[6] In addition, despite the vast literature on the topic of returns to education/earnings inequality in Germany, this paper extends the descriptive evidence on the German labour market in the sense that it draws conclusions based on (a) more differentiated schooling categories than most existing estimates are based on and (b) quantile regression simultaneously. Moreover, the returns to the three broad fields of study at university are estimated for Germany.

Subsequently, in the empirical analysis standard Mincer earnings equations are estimated using both ordinary least squares estimation (OLS) and quantile regression.[7] The advantage of quantile regressions over OLS estimation is that quantile regressions allow for the full characterisation of the conditional earnings distribution, thereby providing a more comprehensive picture of the returns to education. In other words, whereas OLS estimation only reveals the differences in mean earnings associated with different education levels (i.e. "between-educational-levels earnings differentials"), quantile regression allows for the analysis of the differences in returns to education within educational groups ("within-educational-levels earnings differentials").

The data for the empirical analysis is drawn form the "Hungarian National Labour Center's Wage Survey"[8] and from the "German Socio-economic Panel (GSOEP)" for Hungary and Germany respectively. The analysis is restricted to the year 2000 in order to take advantage of the extensive educational information in the "Hungarian National Labour Center's Wage Survey" and of the newly surveyed educational information in the GSOEP which became available in 1997 and 2000 respectively. This recent educa-

[5] For an extensive discussion of the Hungarian labour market using the "Hngarian National Labour Center's Wage Survey", among others, see Àbrahám and Kézdi (2000), Halpern and Kőrösi (1997), Kertesi and Köllő (2001), Kertesi and Köllő (2005), Kézdi (2002) and Köllő (2002) in Fazekas and Koltay (Eds.), pp. 70 – 77.

[6] For estimated wage equations for the group of higher education graduates see, among others, Galasi (2003).

[7] Note that weights are used in estimation for all specifications.

[8] I would like to thank János Köllő for providing the "Hungarian National Labour Center's Wage Survey" used in this study and for his assistance with the dataset.

tional information for the two countries lends itself very well to a differentiated comparative analysis.

The empirical findings provide evidence for the fact that the mean return to education (as well as to other characteristics) is not an accurate estimate of the return to education for the population (more specifically, for the selected samples). That is, (a) the estimated return to all six educational levels increases across the quantiles for both genders in Hungary and to high school and tertiary education for males in Germany and (b) the within-educational-levels dispersion is increasing with the increasing levels of education in Hungary, and is especially high at the tertiary level. It is important to note that the within-educational-levels earnings dispersion is larger in Hungary than in Germany at all levels of education. Another finding worth noting is that the return to tertiary education is substantially larger in Hungary than in Germany, i.e. at the top decile the estimated additional return to university education is 164 and 78 percent in the two countries respectively. The facts that (a) in both countries tertiary education is free and (b) university education takes similar number of years would have lead one to believe that the monetary returns to tertiary education in the two countries are (more) similar. The difference can be attributed to the fact that in Hungary the demand for highly qualified labour still is larger than the supply. Nevertheless, it is important to point to an expected similarity across the two countries in terms of university education at all estimated quantiles and at the mean, namely, the high valuation of quantitative skills (i.e. high relative returns to "Natural sciences" in Germany and to "Science, Mathematics and Computing" and "Engineering" in Hungary.)

The remainder of this paper is organised as follows: Section 2 introduces quantile regressions and summarises the advantages of quantile regressions over OLS when estimating the returns to education. In Section 3, the German and Hungarian education systems are described, and the system for comparing the two education systems is developed. Section 4 presents the data used in the empirical analysis for the two countries and some descriptive statistics. Section 5 presents the regression results and Section 6 concludes.

2. EMPIRICAL FRAMEWORK

Numerous studies on the returns to human capital are embedded in the framework of the Mincer earnings equation (1974):

$$\ln w_i = \alpha + \beta s_i + \gamma_1 ex_i + \gamma_2 ex_i^2 + x_i'\delta + \mu_i, \qquad i = 1,\ldots,n \tag{1}$$

where the dependent variable, the logarithm of some measure of earnings $(\ln w_i)$ for individual i, is explained by some measure of schooling (s_i), actual or potential labour market experience (ex_i), a vector of other explanatory variables (x_i), such as gender and occupation, and a random disturbance term (μ_i), which contains the unobserved determinants of earnings.

The OLS estimate of β in the benchmark Mincer earnings equation (1) is an estimate of the mean return to schooling i.e. the mean earnings premium associated with and additional year of schooling/with an additional degree level. However, given the heterogeneity of the workforce, the mean return to education may not be a good estimate of the return to education of the population/selected sample.

The advantage of quantile regressions, introduced by Koenker and Basset (1978), over OLS estimation is that quantile regression allows for the full characterisation of the conditional earnings distribution, thereby providing a more comprehensive picture of the returns to human capital. In other words, whereas OLS estimation only reveals the differences in (mean) earnings associated with different education levels (i.e. "between-educational-levels earnings differentials"), quantile regression allows for the analysis of the differences in returns to education within educational groups (i.e. "within-educational-levels earnings differentials").

The quantile regression model is formulated as:

$$y_i = x_i'\beta_\theta + \mu_{\theta_i}, \text{ with } Quant_\theta(y_i \mid x_i) = x_i'\beta_\theta, \qquad (2)$$

where y_i is the regression's dependent variable, x_i is a $K \times 1$ vector of regressors, μ_{θ_i} is a disturbance term and β_θ is the vector of parameters to be estimated. The subscript i indexes the individuals in the sample, $i = 1,...,n$. $Quant_\theta(y_i \mid x_i)$ denotes the θ^{th} conditional quantile of y_i, conditional of the regressor vector x_i. As one increases θ continuously from 0 to 1, one traces the entire conditional distribution of y, conditional on x. The distribution of the disturbance term is left unspecified, and it is only assumed that $Quant_\theta(\mu_{\theta_i} \mid x_i) = 0$.

The θ^{th} regression quantile, $0 < \theta < 1$, is defined as a solution to the problem of minimizing a weighted sum of absolute residuals. The θ^{th} regression quantile can be computed by:

$$\min_{\beta \in R^k} \left\{ \sum_{i: y_i \geq x_i' \beta} \theta \, | \, y_i - x_i' \beta_\theta \, | + \sum_{i: y_i < x_i' \beta} (1-\theta) \, | \, y_i - x_i' \beta_\theta \, | \right\}. \tag{3}$$

This can be rewritten as:

$$\min_{\beta \in R^k} \sum_i \rho_\theta \left(y_i - x_i' \beta_\theta \right), \tag{4}$$

where $\rho_\theta(\varepsilon)$ is the check function defined as $\rho(\varepsilon) = \theta\varepsilon$ if $\varepsilon \geq 0$ or $\rho_\theta(\varepsilon) = (\theta - 1)\varepsilon$ if $\varepsilon < 0$. In the framework of the Mincer earnings equation (1), the resulting regression fit $x_i' \beta_\theta$ describes the θ^{th} quantile of the earnings of individual i given the characteristics (e.g. education level, potential labour market experience, gender etc.) of individual i.

As noted earlier, this paper is purely descriptive in nature. I estimate Mincer earnings equations by OLS and quantile regression at five quantiles of the log earnings distribution, namely, 10th quantile, 25th quantile, median, 75th quantile and 90th quantile. The dependent variable is the log of monthly gross earnings. The set of independent variable includes: education, potential labour market and its square, sector of employment, gender and interaction terms between education and gender, potential labour market experience and gender and sector of employment and gender. For all specifications weights are used in estimation. Standard errors are obtained by 1000 and 200 bootstrap replications for the quantile regressions for Germany and Hungary respectively.

3. DESCRIPTION OF THE GERMAN AND HUNGARIAN EDUCATION SYSTEMS

3. 1. THE GERMAN EDUCATION SYSTEM

This section gives a brief description of the (West) German education system, based on the International Standard Classification of Education (ISCED-97). In Germany, compulsory education starts at the age of six in the primary school, *Grundschule*, (ISCED-97 level 1). After the completion of the four-year-long *Grundschule*, children are screened according to academic ability, and can choose among the three tracks of the lower secon-

dary education (ISCED-97 level 2), namely the lower level secondary school, *Hauptschule*, the intermediate secondary school, *Realschule,* or the lower level of the general secondary school, *Gymnasium – Unterstufe*.

The academically least demanding type of school at the lower secondary level is the *Hauptschule*. The *Hauptschule* is five years in duration and grants its graduates a general school leaving certificate, *Hauptschulabschluss*, which marks the end of compulsory (general) schooling requirement. The children are offered general education with a vocational orientation, as graduation from the *Hauptschule* opens the door vocational training, but in itself not to further academic career. The academically most demanding institution at the lower secondary level is the *Gymnasium – Unterstufe*, which lasts six years and prepares its pupils for the upper level of the general secondary school, *Gymnasium – Oberstufe*. Graduates from the *Gymnasium – Unterstufe* are also free to continue their education at any other institution at the upper secondary level (i.e. vocational training). The six-year-long *Realschule* is positioned between the *Hauptschule* and the *Gymnasium*. Graduation from the *Realschule* provides the intermediate school leaving certificate, *Mittlerer Schulabschluss* (also called the *Realschulabschluss*)*,* which grants its holders access to both vocational training and to further academic studies.[9]

The upper secondary level (ISCED-97 level 3) can be divided along three lines, (1) whether pupils obtain a vocational degree which in itself does not enable them to pursue their studies at the tertiary level, (2) whether they obtain a degree which enables them to continue their studies at the practically oriented tertiary institutions only or (3) whether graduation allows them to pursue further studies at any tertiary institution. The two institutions belonging to the first subcategory at the upper secondary level are the apprentice school, *Duales System* (also called the *Lehre*)*,* and the full-time vocational school, *Berufsfachschule,* which are both vocational in orientation. The *Duales System* lasts two to three years and offers an apprenticeship at an enterprise combined with general education at the part-time vocational school, *Berufsschule*. Its graduates, at the age of 18, obtain a voca-

[9] Note that the comprehensive school, *Gesamtschule*, combines all the three tracks described above in two possible ways. The first alternative is the cooperative comprehensive school which has the three different branches on its premises in order to facilitate transfer from one type of school to another. The other alternative is the integrated comprehensive school which combines the three different school types in one. That is, all pupils are taught together until the beginning of grade seven, when certain subjects are taught at different levels and the qualifications are awarded accordingly. Therefore, graduates of the comprehensive school may either leave with the *Hauptschulabschluss,* the *Mittlerer Schulabschluss,* or the *Allgemeine Hochschulreife*.

tional qualification, the *Berufsqualifizierende Abschluss,* which marks the completion of compulsory education and provides direct entry to the labour market or to further vocational education. The *Duales System* is the most common route after the completion of the *Hauptschule*, although graduates of the *Realschule* and *Gymnasium* may also choose this track. The second type of institution, the *Berufsfachschule*, is a two- to three-year-long full-time vocational school, which also provides direct entry into the labour market and to further vocational education. The institutions belonging to the second subcategory at the upper secondary level are those offering a qualification for studies at college, the *Fachhochschulreife*. More specifically, the two-year-long *Fachoberschule*, the two- or three-year-long *Berufsfachschule,* which only offers the *Fachhochschulreife* under certain conditions*,* and the two-year long *Berufsoberschule* belong to this subcategory. The entrance requirement for these institutions is the *Mittlerer Schulabschulss*. The route to university is through the third subcategory of upper secondary education, namely the upper level of the general secondary school, *Gymnasium – Oberstufe.* The *Gymnasium – Oberstufe* is four years in duration, academically oriented, and grants its pupils the high school degree, *Allgemeine Hochschulreife* (also called the *Abitur*), which is the prerequisite for university. The *Allgemeine Hochschulreife* can also be acquired at the vocational secondary school, *Fachgymnasium.*[10]

Accordingly, there is room for further education for the graduates of the three subcategories of upper secondary education described above, namely for those with the *Berufsqualifizierende Abschluss*, those with the *Fachhochschulreife* and those with the *Allgemeine Hochschulreife*. The holders of the *Berufsqualifizierende Abschluss* may only pursue further vocational education offered at the so-called technical school, *Fachschule* (ISCED-97 level 4). The *Fachschule* is a post-secondary non-tertiary institution of one to three years in duration, which, under certain conditions, grants the *Fachhochschulreife* in addition to a further vocational qualification (i.e. enables its graduates to become master craftsman in their field). Those with a *Fachhochschulreife* aspire to colleges, *Fachhochschule* (ISCED-97 level 5), which are more practically oriented tertiary institutions and are shorter in duration than universities (i.e. three to four years). Finally, those individuals holding the A*llgemeine Hohschulreife* (or in some cases *Fachgebundene Hochschulreife* which can be obtained after the completion of the first three years of the *Gymnasium – Oberstufe*) fulfil the prerequisite for acceptance at university, *Universität* and *Technische Hochschule* (ISCED-97 level 5), which last at least eight semesters, depending on the field of

[10] Note that the *Hauptschulabschluss*, the *Mittlerer Schulabschluss,* and the *Allgemeine Hochschulreife* can also be acquired via adult education the *Abendgymnasium* or *Kolleg*.

study. Under certain conditions students can pursue further research at the second stage of tertiary education (ISCED-97 level 6).

3. 2. THE HUNGARIAN EDUCATION SYSTEM

From the onset of transition there were significant changes in the Hungarian education system. For instance, the 1993 Public Education Act and the 1996 Amendment to the Public Education Act extending the end of compulsory education from the age of 14 to the age of 16 and to the age of 18 respectively (starting with those who enter primary school in the 1998/99 school year). Moreover, the content and structure of education, the system of secondary school leaving examinations and vocational examinations as well as the admission criteria to successive educational institutions have been continuously altered during the past decade. As even the youngest individuals in the 2000 sample completed their formal education before these reforms came into effect, the purpose of this section is not to describe in detail the continuous changes in the Hungarian education system and the education system as of 2005. Instead, the aim is to provide to a brief overview of the institutions as attended by the individuals under analysis, based on the ISCED-97 framework.

Compulsory education in Hungary starts at the age of five in the kindergarten, *óvoda*, (ISCED-97 level 0). At the age of six[11] children are enrolled in primary school, *általános iskola*, which lasts eight years and consists of two levels, a lower level lasting 4 years, *alosó tagozat,* (ISCED-97 level 1) and an upper level lasting another 4 years, *felső tagozat* (ISCED-97 level 2)[12].

After the completion of primary and lower secondary education, children are screened according to ability in order to start one of the five types of upper secondary schools (ISCED-97 level 3). There are two main categories of institutions at the upper secondary level, those which do not offer a high school degree, *érettségi*, which entitles pupils to continue their education at the tertiary level, and those which do. The former institutions, which are of two types, have a vocational emphasis and their successful completion allows for direct entry to the labour market. The first type, the vocational school, *szakiskola*, offers two years of general and vocational education and grants its students a lower level vocational qualification. The apprentice school, *szakmunkásképző*, is the second, more advanced, type of

[11] The legal regulations allow children to start school at the age of five or seven.
[12] The 1990 Amendment to the 1985 Education Act authorised six and eight year general secondary schools. Accordingly, children who are to pursue their education in such institutions leave the primary school after six and four years respectively.

vocational institution which does not offer a high school degree. The three-year-long education in the apprentice schools takes place both at a firm and in school. Successful graduates of the *szakmunkásképző* obtain a skilled worker's qualification which allows them to work in various sectors including construction, agriculture and trade.[13] Institutions offering a high school degree, and thereby granting access to further education at the tertiary level, have three subdivisions. Vocational secondary schools, *szakközépiskola*, last four or five years and offer a vocational qualification as well as a high school degree. Technical schools, *technikum*, are a special form of secondary vocational schools which last five years and provide students with a technician's qualification in addition to a high school degree. General secondary schools, *gimnázium*, are four, six or eight years in duration (after the completion of eight, six or four years of primary school respectively) and offer only a high school degree.[14]

Tertiary education (ISCED-97 level 5), like upper secondary education, is divided into two subdivisions depending on whether a more vocational or a more academic curriculum is offered. On the one hand, colleges, *főiskola*, offer education at a more practical level and last three to four years. Universities, *egyetem*, on the other hand, offer a more academic curriculum and last at least five years, depending on the field of study. After successful graduation from university, students can pursue further research leading to an advanced research qualification (ISCED-97 level 6).

3. 3. SYSTEM FOR COMPARISON OF THE GERMAN AND HUNGARIAN EDUCATION SYSTEMS

The system for comparison of the German and Hungarian education systems has been constructed along the lines of the ISCED-97 framework. The resulting six categories are based on the available educational information in the GSOEP and the "Hungarian National Labour Center's Wage Survey" for Germany and Hungary respectively. Note that the motivation for the use of dummies for degree attainment as the measure of the formal component of human capital, rather than the years of schooling, is twofold. First,

[13] Note that The Act of Public and Vocational Education of 1993 transformed the content and structure of vocational education radically as vocational education had been the weak point in the Hungarian education system prior to transition. In addition, due to the extension of the end of compulsory education to the age of 18 starting 1998 vocational institutions last 4 years, providing two years of general education until the age of 16 and two further years of vocational training.

14 Note that, as in Germany, the various degrees at the upper secondary level can also be acquired via adult education.

it serves to eliminate the potential downward bias of the schooling coefficient caused by the computational error when the years of schooling is imputed form from the average number of years required to complete a specific degree (due to individual variation in the number of years to complete a degree).[15] The schooling variable may nevertheless suffer from measurement error due to recall/reporting error. Second, as both the German and Hungarian education systems have multiple education streams starting from the secondary level, "type of schooling" is more suitable for a cross-country comparison of the returns to schooling than "year of schooling".

Information on educational attainment in the GSOEP is organised in three main (generated) categories, namely, secondary school degree, vocational degree and tertiary degree.[16] The subdivisions within these three categories (see Table 1 in Appendix 1 one for detail) are differentiated enough to (a) construct variables for the highest degree attained for the selected sample, and (b) to develop a system for comparison across the two countries. For Hungary, nine categories for the highest degree completed (see Table 2 in Appendix 1 for detail) are available in the dataset. For both countries, the six categories for educational attainment used in this study are more aggregated than those reported in the datasets due to sample size considerations. For instance, optimally one would want to differentiate between the all types of secondary degrees for Germany (i.e. *Haputschulabschluss* vs. *Realschulabschluss*, *Fachhochschulreife* (with vs. without vocational qualification) vs. *Abitur* (with vs. without vocational qualification) but the small number of cases motivate the aggregation of certain degrees. Consequently, the resulting six categories are (a) broad enough to assure the comparability of the degree levels between the two countries and (b) assure a sufficient number of observations for both countries for empirical analysis and are as follows:

(1) No formal vocational degree and no high school degree: The general idea behind this educational group is to merge individuals from the datasets who (a) do not satisfy the compulsory (general) schooling requirement or (b) who only satisfy the compulsory (general) schooling requirement. These two groups have been merged as the number of observations in the former group is not sufficient for independent analysis. At most satisfying the compulsory (general) schooling requirement is, in fact, the equivalent of having no formal vocational degree and no high school degree in both countries.

[15] "Actual years of schooling" is not available in the "Hungarian National Labour Center's Wage Survey".

[16] The education level of foreigners and those who obtained their degree in East Germany prior to 1991 is integrated into these three main categories as well as reported separately.

In Germany, the compulsory (general) schooling requirement is nine years, that is, it ends with the completion of lower secondary education. Therefore, Group (1) consists of those individuals who (a) have less than a lower secondary school degree (*Ohne Abschluss verlassen*) or (b) possess at most a lower secondary school degree, namely, *Hauptschulabschluss* or *Realschulabschluss* or *anderer Schulabschluss* (other secondary school degree).

In Hungary, when the individuals in the 2000 sample attended school the compulsory schooling requirement was marked by the successful completion of the eight years of primary school. Subsequently, for these individuals their primary school degree is accepted as the minimum schooling requirement in the labour market.[17] Hence, Group (1) consists of those individuals who (a) did not complete primary school (less than *általános iskola*) or (b) at most possess a primary school degree (*általános iskola*).

(2) Lower level vocational degree and no high school degree: The general idea behind this educational group is to cover individuals who have completed a lower level of vocational training, which grants them direct access to the labour market but does not in itself enable them to continue their studies at the tertiary level.

For Germany, Group (2) is the largest group as it merges individuals with different schooling and vocational qualifications. As far as the schooling qualification is concerned, all those individuals who have a *Hauptschulabschluss* or *Realschulabschluss* or *anderer Schulabschluss* belong to Group (2). Although the *Hauptschulabschluss*, *Realschulabschluss* and *anderer Schulabschluss*, differ in terms of "quality", they are aggregated for two reasons. Namely, it would be difficult to differentiate between these subgroups in a way which (a) assures enough observations per category and (b) has a Hungarian equivalent (as in Hungary there is no such differentiation at the lower secondary level of education). As far as the vocational qualification is concerned, Group (2) merges all those individuals who possess a vocational qualification at the upper secondary level, that is, who have completed either the *Lehre* or *Berufsfachschule* or *Schule des Gesundheitswesens* (Health care school) or *Beamtensausbildung* (Civil service training) or *sonstige Ausbildung* (Other training). It is important to note however that in terms of vocational qualification Group (2) is not as heterogeneous as it may first seem. That is, approximately 76 percent of all individuals belonging to Group (2) completed the *Lehre* in the 2000 sample.

For Hungary, Group (2) merges (a) the graduates of the *szakiskola* and (b) the graduates of the *szakmunkásképző*. All these individuals posses a voca-

[17] Any primary school degree obtained before 2000 is accepted in Hungary as the minimum schooling requirement in the labour market, albeit the extension of the end of compulsory schooling.

tional qualification which grants them direct entry to the labour market but not to any tertiary institution. As for Germany, the aggregation of the two vocational qualifications cannot be considered a severe problem as in the 2000 sample approximately 91 percent of all individuals belonging to Group (2) obtained their degree from the *szakmunkásképző.* Moreover, the fact that most of the individuals in Group (2) undertook vocational training in the framework of the Lehre and in the *szakmunkásképző* in Germany and Hungary respectively has the advantage that, among all vocational institutions, the *Lehre* and *szakmunkásképző* are the most similar ones, and so Group (2) is well suited for the cross-country comparison.

(3) Higher level vocational degree and no high school degree/higher level vocational degree: The general idea behind Group (3) is to select those individuals who possess a qualification which is of a higher level than the (a) the vocational and (b) the general qualifications held by the individuals belonging to Group (2).

For Germany, this amounts to subdividing the large group of individuals holding some kind of a "vocational degree and no high school degree" (i.e. they make up over half of the 2000 sample) according to the level of vocational degree held. The *Fachschule* graduates are selected into Group (3) as the *Fachschule* is the only post-secondary and non-tertiary vocational institution (ISCED-97 level 4) and thus goes beyond the institutions of vocational education in Group (2) at both the practical and academic level. First, at the practical level the *Fachschule* provides advanced vocational training for those pupils with initial vocational qualifications in trades, agriculture, hotel and catering etc.. Second, at the academic level, the *Fachschule,* under certain conditions, grants the *Fachhochschulreife,* unlike the institutions of vocational education in Group (2).

For Hungary, the selection criterion for Group (3) is somewhat different than that for Germany. That is, the motivation is to subdivide the group of high school graduates[18], the largest group in the 2000 sample, according to (a) academic and (b) vocational qualification. Subsequently, due to the differences in practical/academic curriculum (as well as differences in labour market opportunities), the graduates of the *technikum* are separated from the group of high school graduates i.e. belong to Group (3). Although the *technikum* is classified at the upper secondary level (ISCED-97 level 3), it is an institution which can be compared to the *Fachschule* in many respects.[19] First, graduation from the *technikum* grants a technician's certifi-

[18] Hence the name "Higher level vocational degree" rather than "Higher level vocational degree and no high school degree" for Group (3) for Hungary.

[19] In Hungary, ISCED-97 level 4 institutions for post-secondary vocational training have only been introduced in 1998. (i.e. the 2000 sample does not contain graduates from such vocational institutions). The number of accredited institutions for higher training and the attendance rate in such institutions is still insignificant.

cate; a vocational qualification which is more valuable on the labour market than that obtained at the other secondary vocational institutions. Second, at the academic level the *technikum* is superior to the *szakiskola* and *szakmunmásképző* (the institutions belonging to Group (2)) as successful graduation from the *technikum* (like graduation from the *Fachschule*) grants access to higher educational institutions. Third, it is an upper secondary institution which, in opposition to the four other tracks of upper secondary institutions in Hungary, is of 5 years in duration.[20]

(4) High school degree and no tertiary degree: The general idea behind this educational category is to combine all those who could potentially pursue their studies at the tertiary level, but do not possess a degree at the tertiary level.

For Germany, Group (4) is the most heterogeneous one. First, it merges those who (a) have a *Fachhochschulreife*, hence can only enter the *Fachhoschschule* (approximately 42 percent of all individuals in 2000), and (b) those who have an *Abitur,* which allows them to enter any tertiary institution (approximately 58 percent of all individuals in 2000). Second, this group merges those with and without formal vocational training. The aggregation is due to the insufficient number of high school graduates (without tertiary degree) for a more differentiated analysis. The heterogeneity is mitigated by the fact that the majority of the individuals belonging to Group (4) do posses a vocational degree, i.e. approximately 86 percent of the individuals in Group (4) posses some kind of a vocational degree in the 2000 sample.

For Hungary, the graduates of (a) the *szakközépiskola* and (b) of the *gimnázium* have been merged. The aggregation is motivated by the fact that (unlike for the graduates of the *technikum*, who have been separated from Group (4)) the estimated returns to completing the *szakközépiskola* and the *gimnázium* are not significantly different. That is, the estimated return differs by approximately 1 – 2 percentage points between the two groups at all of the estimated quantiles, and when estimated by WLS, which implies that the aggregation of the two groups does not pose a qualitative problem for Hungary for the selected year. Furthermore, the aggregation is in line with the aggregation of the various degrees in Group (4) for Germany, hence Group (4) is suitable for cross-country comparison. It is important to note that there is a fundamental difference across the two countries as far as the subgroup "high school degree and vocational qualification" of Group (4) is concerned. On the one hand, in Germany these individuals have completed a one- to three-year-long vocational training (*Lehre* or *Berufsfachschule* or *Schule des Gesundheitswesens* or *Fachschule* or *Beamtenausbildung* or

[20] With the exception of the bilingual general secondary schools and some vocational secondary schools which also last 5 years.

sonstige Ausbildung) on top of the high school degree. Thus, *Fachhochschulreife* or *Abitur* holders with a vocational qualification are "educated" for over 12 and 13 years respectively. In Hungary, on the other hand, those with a "high school degree and vocational qualification", namely, the graduates of the *szakközépiskola*, do not have further "on-the-job vocational training", and thus only undertake a maximum of 13 years of schooling. Despite this difference in the content and duration of vocational education, this subgroup remains comparable across the two countries in the sense that the individuals possess both a academic and an vocational qualification i.e. have similar labour market opportunities in both countries.

(5) College degree: The idea behind this educational group is to cover all those individuals who have a tertiary qualification which is (a) more applied in curriculum and (b) is shorter in duration than university education. In Germany, the *Fachhochschule* belongs to Group (5). In Hungary, the *főskola* belongs to Group (5).

(6) University degree: This educational category merges all university graduates. That is, there is no distinction across the first (ISCED-97 level 5) and second stages of university education (ISCED-97 level 6), due to the fact that there is no differentiated reporting at the university level in neither datasets. In Germany, the *Universität* and *Technische Hochschule* belong to Group (6). In Hungary, the *egyetem* belongs to Group (6).

Note that whereas the six educational categories for Germany represent a ranking in terms of the level of education, this is not (always) true for Hungary where Group (3) is (potentially) of a higher level than Group (4). Note also that Groups (1) (2) (5) and (6) are well suited for comparison across the two countries, whereas Groups (3) and (4) are (somewhat) less suited for a cross-country comparison, due to the cross-country differences in the nature and duration of vocational training. Hence, the comparison of the estimated returns to the latter two groups across the two countries must be interpreted in light of these differences.

4. DATA AND DESCRIPTIVE STATISTICS

4. 1. DATA FOR GERMANY

The data for Germany is drawn from the "German Socio-Economic Panel" (GSOEP), a micro-dataset, which was started in 1984 and since then data collection is carried out on an annual basis. In 1984 around 12, 000 individuals, aged over 16, who were either "West German Residents" (Sample A) or "Foreigners in West Germany" (Sample B) were interviewed. The GSOEP was extended to cover "German Residents in the GDR" (Sample C), and "Immigrants" (Sample D) in 1990 and in 1994 respectively. In 1998 a "Refreshment" sample (Sample E) and in 2000 an "Innovation" sample (Sample F) were added. In order to control for the different sampling probabilities of the various samples, weighting factors are provided at the individual level for cross-sectional analysis, which are used in estimation.[21] Data is collected on a large number of socio-economic variables, covering eight main areas, including variables representing income, demography, educational attainment, level and sector of employment.

In order to assure a sufficient number of observations Samples A through F are used in the empirical analysis. Subsequently, the analysis must start in 2000, which marks the first year when all of the six samples were available. Starting the analysis in 2000 has a further advantage: in 2000, instead of updating previous educational information, an explicit educational survey of all respondents was carried out, regardless of whether something has changed in the past years. Subsequently, this newly surveyed educational information is used in the empirical analysis. Only those individuals with a West German educational background are selected for the empirical analysis. This selection assures that the returns to the degrees of the Hungarian and West German education system are compared – which is the aim of the paper. An alternative to using all six samples would be to use Sample A only, since the (majority of the) individuals in Sample A have completed their education in West Germany. This alternative however has the disadvantage that, after the working sample has been selected, the number of observations in Sample A is only 1, 520 (as opposed to 3, 440 when all available samples are used). Furthermore, excluding the individuals who have (a) completed schooling in West Germany but (b) come from a household where the household head is not West German would mean losing relevant

[21] For an extensive description of the different samples and on their sampling probabilities see Haicksen-DeNew and Frick (Eds.) (2002), pp. 34 – 38.

information in terms of estimating the returns to degrees of the West German education system.

The samples are restricted to cover full-time employees (i.e. wage and salary earners, excluding the self-employed) of both genders who were (a) full-time employed for 12 months and (b) had a non-zero monthly wage for each month of the given year. In all specifications and for both countries, the logarithm of monthly gross earnings is used as the dependent variable, defined as monthly gross wages plus one twelfth of the sum of all bonuses paid over the year.[22] The logarithm of monthly gross earnings is used as the income measure, rather than the logarithm of hourly gross wages, because the only income variable available for Hungary is monthly gross earnings[23]. The sample is restricted to consist of prime age individuals, aged 25 – 55 years, in order to (a) avoid the overrepresentation of the low qualified and (b) to avoid the problems due to self-selection into early retirement. Note however that the self-selection into higher education coupled with self-selection into employment does pose a problem in this paper. Therefore, the empirical results must be interpreted conditional on the selected samples (rather than for the population as a whole).

In addition to the three standard explanatory variables (1) a set of schooling dummies, (2) potential labour market experience and (3) its square, (4) a dummy variable indicating gender and (5) a dummy variable indicating the sector of employment, that is, "public vs. private" is included (as the level of earnings and educational attainment differ across the genders and the sectors of employment in both countries). An alternative specification is fitted which is augmented with interaction terms between the explanatory variables (namely, schooling, potential labour market experience and its square and sector) and gender. For all specifications, individual weights are used in estimation. Table 1 in Appendix 1 provides a description of the variables used in the analysis. Note that years potential labour market experience, measured as age minus years of schooling minus school starting age, may suffer from measurement error (especially for females who interrupt their career for child-rearing reasons) as years of schooling is imputed from the average number of years taken to complete a degree.[24] Thus, the coefficient estimate needs to be interpreted with caution.

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[22] Bonuses reported explicitly in the GSOEP include "13th month salary", "14th month salary", "additional Christmas bonus", "vacation bonus", "profit-sharing bonuses" and "other bonuses".

[23] In the Hungarian dataset monthly gross wages and the amount/type of bonus paid is not reported separately. Furthermore, (actual) hours worked are not reported either.

[24] Note that although one of the advantages of the GSOEP is that actual labour market experience as well as actual years of schooling can be calculated using the *Biography Spell Data,* potential labour market experience and schooling dummies are used in this study as proxies for the informal and formal components of human capital in order to

Finally, the returns to three broad fields of university education are estimated. For this analysis the (occupational) group of "Professionals" is used because the field of study can only be inferred for this occupational group using occupational information (the *International Standard Classification of Occupations* (ISCO-88)) provided in the GSOEP. The three categories are more general than the ISCED "Broad fields of university education" due to the small number of university graduates in the sample, and are as follows: (1) Education (2) Social sciences, Humanities and Arts (3) Natural sciences. Appendix 5 describes how the three categories for university education have been generated and some summary statistics on the variables used in estimation.

4. 2. DATA FOR HUNGARY

The data for Hungary is drawn from the "Hungarian National Labour Center's Wage Survey", which is available for the time period of 1986 – 2004. The Wage Survey was first carried out in May 1986. Until 1992 data was collected every three years and from 1992 onwards on a yearly basis. The Wage Survey covers both the private and public sectors, whereby all companies employing at least 20 employees, and all institutions in the public sector, independent of size, provide information on an approximately 10 percent random sample of their full-time employees.[25] The fact that there is no self-reporting has the advantage of delivering more reliable earnings information, i.e. there is evidence that self-reported earnings data is about 20 percent lower that company reported figures.[26] However, one of the drawbacks of the lack of self-reporting specific to this analysis is that actual years of schooling and actual years of labour market experience are not available. The Wage Survey has the advantage of having a large number of observations, ranging from 130, 000 to 180, 000, depending on the wave. Data is collected (in the month of May) on monthly gross earnings, defined as monthly gross wage plus one twelfth of the sum of all other payments and irregular incomes connected to the full-time job paid over the previous year, gender, age, educational attainment, occupation, firm size, location and ownership structure, sector of employment and industry classification. Weights are included in the dataset in order to restore the representativness of the sample.

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assure comparability to the Hungarian specifications (i.e. actual years of schooling and of experience are not available in the Hungarian dataset).

[25] From 1995 and 2001 onwards a 20 percent random sample of companies employing at least 10 and at least 5 employees respectively are included in the Wage Survey, which provide information on all of their full-time employees. From 2002 onwards part-timers are also included in the Survey.

[26] For evidence see Fazekas and Koltay (Eds.) (2002), p. 51.

The empirical analysis is restricted to the year 2000 as the extensive educational information became available in that year. As for Germany, the analysis is restricted to full-time employees, of both genders, who are aged 25 – 55 years, given the evidence that the participation rate is the highest among the prime age workers.[27] As for Germany, the dependent variable of the earnings equation is monthly gross earnings, which is explained by variables representing (1) schooling (2) potential labour market experience and (3) its square, (4) gender and (5) sector (public vs. private). The second specification is augmented by interaction terms between gender and the other explanatory variables of the earnings equation. Table 2 in Appendix 1 provides a description of the variables used in the analysis.

The large number of observations in 2000 has the advantage that the returns to the specific fields of study at university can be estimated in order to give a more comprehensive picture of the returns to university education. This amounts to replacing the schooling dummies with eight fields of study dummies (i.e. the dependent variable and the other explanatory variables remain identical). As for Germany, for this specification the (occupational) group of "Professionals" is used from all occupational groups because (a) the field of study can only be inferred for this occupational group[28] (using the *Foglaglkozások Egységes Osztályozási Rendszere* (FEOR-93) classification which is based on the *International Standard Classification of Occupations* (ISCO-88)) and (b) the group of "Professionals" contains over half of the university graduates in the 2000 sample. The eight categories, based on the ISCED "Broad fields of university education", are as follows: (1) Training for secondary school teachers (2) Training for primary school and other teachers (3) Social sciences, Humanities and Arts (4) Economics, Business and Law (5) Science, Mathematics and Computing (6) Engineering (7) Medicine and Veterinary Medicine and (8) Other professionals. Appendix 5 provides detail on how the eight categories for university education have been generated as well as some summary statistics on the variables used in estimation.

4. 3. CROSS-COUNTRY COMPARISON

As expected (see Tables 1 and 2 in Appendix 1), the (sample) mean of monthly gross earnings is substantially higher in Germany as it is in Hungary in 2000. The German and Hungarian samples are similar in terms of (a) age composition (the mean being at around 40), (b) years of potential

[27] For evidence see Fazekas and Koltay (Eds.) (2002), p. 20.
[28] Note that the parameter estimates may suffer from measurement error given that the field of study is not self-reported but inferred from the individual's occupation.

labour market experience and (c) distribution across sector of employment. However, the gender composition of the sample of full-employees differs across the countries. Whereas the Hungarian sample of full-time employees (who satisfy the selection criterion) consists of slightly more females than males, there are only approximately 31 percent female employees (who satisfy the selection criteria) in the German sample. This difference in gender composition across the two countries can partially be attributed to the differences in the proportion of part-timers within the group of employed women. That is, whereas in Hungary the fraction of part-timers within the group of employed women is not significant, in Germany female part-time employment has grown in the past two decades[29] and is high even in an international comparison. According to OECD figures, the female employment rate (women aged 15 – 64 years) was approximately 50 percent and the share of part-timers within the group of employed women was slightly under 5 percent in Hungary in 2000. The respective figures for Germany were approximately 50 percent and 34 percent. Note also that the share of part-timers in Germany is not only high in comparison to Hungary but also in an international comparison, i.e. the share of part-time employment as a proportion of female employment in the OECD was around 21 percent in 2000.[30]

Since the returns to human capital is the center of interest of this analysis, the distribution of educational attainment in the two countries is worth some attention. First, it must be noted that the distribution of educational attainment is representative for both countries. Namely, in Germany the most common school degree is the *Hauptschulabschluss* (39 percent), followed by the *Realschulabschluss* (28 percent), the *Abitur* (23 percent) and finally the *Fachhochschulreife* (9 percent). Around 49 percent of the individuals completed the *Lehre* and around 22 percent of the individuals possess a tertiary degree. In Hungary approximately 28 percent of the individuals have completed the apprentice school, about 31 percent posses a high school degree as the highest qualification and approximately 19 percent of the individuals have completed tertiary education. In both countries the number of individuals without any kind of schooling degree is insignificant, around 1 percent.

Second, it must be noted the differences in allocation across the six education groups in the two countries reflect the differences in educations system and labour market conditions. First of all, in Hungary, although decreasing, there is still a large number of individuals with only a primary school degree in the labour market[31]. Subsequently, it is not surprising that approxi-

[29] For evidence see Fitzenberger and Wunderlich (2002).
[30] See OECD Employment Outlook (2004) p. 296 and p. 310.
[31] Note that transition brought with itself a decrease in demand for unskilled labour and hence major changes in the composition of the workforce by qualification, namely a

mately 20 percent of the individuals belong to Group (1), which is twice as much as in Germany. In Germany, about half of the individuals belong to Group (2), whereas in Hungary only around 30 percent of the individuals posses a lower level vocational degree – which reflects the importance of the vocational education in the German education system as opposed to the Hungarian education system[32]. On the other hand, at the secondary level in Hungary there are significantly more individuals who posses a high school degree (and no tertiary degree), i.e. approximately 31 percent in Hungary as opposed to 12 percent in Germany. In Hungary he rate of students enrolling in university education (a) has increased but (b) is still below the OECD[33] which is reflected by the composition of Groups (5) and (6). That is, whereas in Germany approximately 9 percent and 13 percent of the individuals belong to Groups (5) and (6) respectively, in Hungary the respective figures are approximately 13 percent and 6 percent.

5. RESULTS

5. 1. RESULTS FOR GERMANY

Tables 3 and 4 in Appendix 2 present the parameter estimates for Germany for the quantile regressions for five quantiles without and with interaction terms respectively. The WLS estimates are also provided in order to allow for the comparison with the mean effects.

The first specification to be analysed is the one without gender interaction terms (See Table 3 in Appendix 2). First of all, in terms of between-educational-levels earnings differentials, as expected, there is an earnings premium associated with the additional degree levels at all estimated quantiles (and at the mean). Second of all, the importance of differentiating between lower and higher level vocational training is supported by the fact that at all quantiles and at the mean the return to higher level vocational training (Group (3)) is higher that that to lower level vocational training (Group (2)). However, it is interesting that a higher level vocational training is valued more at the lower quantiles than at the higher quantiles, i.e. the additional return to possessing a higher level vocational degree rather than a lower level vocational degree is 24, 19 and 16 percent at the 10th

reduction and an increase in the fraction of primary school graduates and college/university graduates respectively. For evidence see Labour Force Survey 1992 – 2001: Time Series (2002), p. 39.

[32] For an extensive discussion of the weaknesses and strength of vocational training in Germany see for example Kloss (1995) in Phillips, pp. 161 – 171.

[33] For evidence see Lannert (2001), pp. 21 – 23.

quantile, at the median and at the 90th quantile respectively. The third interesting feature is that the estimated gap between a higher vocational degree and a high school degree is increasing across the earnings distribution (note also that at the 10th quantile a higher level vocational degree is valued (slightly) more than a high school degree). The latter two findings suggest that at the lower quantiles vocational skills are valued more than academic skills, and the opposite is true at the upper quantiles. Moreover, in addition to high school education, the return to tertiary education, both college and university, is increasing across the distribution. In terms of tertiary education, a university degree (Group (6)) entails a higher monetary payoff than a college degree at all estimated quantiles and at the mean, which in turn reinforces the importance of subdividing tertiary education along these lines. Finally, as expected, the within dispersion increases with the increasing levels of education, with the exception of higher level vocational training.

The effect of the other explanatory variables, namely potential labour market experience, gender and sector, is not uniform across the quantiles. First, (a) as expected, the return to the first year of potential labour market experience increases across the quantiles, (b) the marginal return to potential labour market experience diminishes more rapidly at the top of the distribution and (c) the turning point is located at a (slightly) earlier point at the top of the distribution (i.e. the turning point is located at 30, 29 and 28 years of potential labour market experience at the bottom decile, at the median and at the top decile respectively) (See Figure 1 in Appendix 4). Second, the gender wage gap narrows over the earnings distribution, i.e. whereas at the 10th quantile the gender wage gap is 28 percent it is 20 percent at the median and only 15 percent at the 90th quantile. (Note that the WLS estimate of the average gender wage gap is 23 percent.) Finally, the public sector wage premium decreases across the quantiles. That is, the gap in favour of the public sector is only positive at the 10th quantile (5 percent) and is becomes negative at the 25th quantile i.e. the private sector earnings premium is 6 percent at the median and 18 percent at the top decile. (Note also that the WLS estimate of the (5 percent) gap in favour of the private sector is not informative).

Table 4 in Appendix 2 reports the regression results with the gender interaction terms. A few points are worth noting about this specification. First, the WLS estimates reveal that the (mean) returns to education for males are lower at all education levels other than to college education than for females (which is in line with the findings of Krueger and Pischke (1995)). The results of the quantile regressions provide a more informative picture of the differences in returns to education across the genders and amount to the following conclusions: (a) whereas for males the return to high school, college and university education increases across the quantiles (and no such

pattern can be observed for vocational education), no such pattern is observed for females at any educational level and (b) not surprisingly for males the within dispersion increases with the level of education (i.e. the within dispersion is largest at the university level), whereas this is not observed for females. In addition, it is important to note that (a) for both males and females the return to possessing a higher level vocational degree is higher at all quantiles than that to possessing a lower level vocational degree and (b) this incremental return is higher than for females than for males at all quantiles (other than at the top decile where the gap is of the same size). Finally, the return of possessing a university degree is higher than that to possessing a college degree at all quantiles for both males (other than at the bottom decile) and females. The latter results give (continuous) support to the importance of subdividing the large group of individuals with a "vocational qualification and no high school degree" and the group of tertiary graduates when the center of analysis is the returns to education.

The coefficient estimate of the public sector interacted with gender is significant at all quantiles and the private-public sector gap differs across the two genders in an expected manner. Namely, whereas for males there is a positive gap in favour of the private sector at all quantiles other than at the 10^{th} quantile and the gap is increasing across the quantiles, for females the gap in favour of the private sector is only positive at the top of the earnings distribution (75^{th} and 90^{th} quantiles). (Note that quantile regression results contrast sharply with the WLS estimate of the 2 percent gap in favour of the private sector for females.)

Finally, Table 5 in Appendix 2 presents the regression results using the subgroup of university graduates who belong to the occupational group of "Professionals". The composition of the three fields of study across genders is representative (for detail see Table 12 in Appendix 5). That is, approximately 48 percent of female professionals have studied "Education", nearly 41 percent have studied "Social sciences, Humanities and Arts" and merely 11 percent undertook studies in "Natural sciences". For males, the picture is quite different, that is, approximately 20, 32 and 48 percent of the selected males studied "Education", "Social sciences, Humanities and Arts" and "Natural sciences" respectively. Due to the compositional differences across the genders, ideally one would want to augment the specification for the university graduates with gender interaction terms, but this is not possible due to the small number of university graduates (i.e. 263), especially females who have studied "Natural sciences". Note also that the three aggregated groups are heterogeneous (see Table 10 in Appendix 5) not only in terms of educational background but also in terms of earnings prospects (in particular "Social sciences, Humanities and Arts" (Group 2) which in fact experiences the largest within dispersion). Subsequently, the coeffi-

cient estimates only provide an indication of the returns to university education. In summary, as expected, (a) despite the small sample size and the necessary aggregation of degrees, the set of field of study dummies are jointly significant at all estimated quantiles (other than at the bottom quantile and at the mean), (b) the return to "Natural sciences" is the highest at all estimated quantiles (other than at the top decile) and (c) the return to all three fields increases across the estimated quantiles. It is also worth noting that the public-private sector earnings gap is (a) positive in favour of the private sector at all estimated quantiles and (b) is increasing across the estimated quantiles.

5. 2. RESULTS FOR HUNGARY

Tables 6 and 7 in Appendix 3 present the parameter estimates for the WLS estimation and the quantile regressions for five quantiles without and with interaction terms respectively. As in the previous subsection, the analysis of the empirical results will center on the parameter estimates of the quantile regressions.

The parameter estimates in Table 6 in Appendix 3 reveal some interesting features about the between- and within-educational-levels earnings differentials. First, it must be noted that, as expected, university education is valued the most in the labour market, followed by college education, technical school education, high school education and lower level vocational training at the mean and at all estimated quantiles.[34] Note also that the increasing educational levels, as expected, entail a larger within dispersion (except for a high school degree, which has a larger within dispersion than a college degree, which is in part attributed to the fact that the group of high school graduates includes the individuals with and without vocational qualification). What is striking is the large within dispersion at the university level. Namely, whereas at the bottom decile the premium to a university degree (relative to "no vocational and no high school degree") is about 89 percent, it increases across the quantiles and at the top decile the return to university reaches 164 percent, which (a) supports further the standard finding that aggregate earnings inequality arises from differences between as well as within educational groups, and (b) is the first motivation for analysing the group of university graduates in more detail.

As far as the coefficient estimates of the other explanatory variables are concerned a few points are worth mentioning. First, as opposed to the for-

[34] Note that in Hungary the return to a *szakiskola* degree is lower than that to a *szakmunkásképző* degree, so the aggregate return to Group (2) is a overestimate of the former and a underestimate of the latter type of vocational qualification.

mal component of human capital, potential labour market experience is not valued more at higher quantiles (see Figure 2 in Appendix 4). Furthermore, the gender wage gap increases across the quantiles, from 3 percent at the 10^{th} quantile to 21 percent at the 90^{th} quantile. Moreover, the private-public sector gap is not uniform across the earnings distribution. That is, at the bottom decile the positive gap is in favour of the public sector (24 percent) and from the 25^{th} quantile it is reversed i.e. the positive gap is in favour of the private sector is 27 percent at the median and reaches 49 percent at the top decile.

The specification with the gender interaction terms (see Table 7 in Appendix 3) imply that (a) for both genders university education is valued the most, followed by college, technical school, high school and lower level vocational education across all quantiles, (b) the estimated returns to the educational categories increase across the quantiles for both genders, (c) the within-educational-levels earnings differentials are smaller for females than for males at all educational categories and (d) as expected, the within-educational-levels earnings differentials are the largest for university education for both genders, which in turn dictates a closer look at the university graduates. Accordingly, the estimated returns to the eight fields of study for the group of "Professionals" are tabulated in Tables 8 and 9 in Appendix 3.[35] Before commenting on the results, it is important to look at the gender composition of the different fields (see Table 13 in Appendix 5). As expected, there are over twice as many females than males in the teaching profession (approximately 39 percent vs. 17 percent) and approximately trice as many males than females who have studied "Science,

[35] Specifications were estimated using all university graduates, whereby all of those for whom the field of study could not be imputed were assigned to the category "Other". This amounts to having about half of the university graduates in the category "Other", over 60 percent of whom belong to the occupation category "Legislators, senior officials and managers (for whom earnings are evidently higher than for other university graduates, and are mostly males working in the private sector). The latter specification, as opposed to the specification where the analysis is based on the "Professionals", has the advantage that (a) the sample size is larger and (b) the ratio of males to females and that of private and public sector of employment is not distorted as all university graduates are used. However, there are numerous disadvantages of this latter specification, namely (a) the field of study cannot be inferred for occupations other than the professionals so (b) the group "Other" is large and heterogeneous in terms of field of study and (c) there is correlation between the group "Other" and the other field of study categories. In terms of estimation, the latter specification leads to (a) the estimated gender wage gap to be larger at all quantiles (b) the estimated private-public sector gap to be larger at all quantiles other than the median (c) only some minor quantitative differences in terms of the estimated returns to the different field of study categories (as opposed to qualitative differences). Overall, the specification with the "Professionals" only is the preferred specification and the estimated returns to the different fields of study are considered to be reliable .

Mathematics and Computing" and "Engineering" (approximately 12 percent vs. 4 percent and 25 percent vs. 8 percent for the respective fields of study). For the other fields of study the number of males and females is approximately equal. Note that "Medicine and Veterinary Medicine" is selected as the reference category among the eight field of study groups due to (a) the large number of cases (i.e. the fraction of individuals belonging to "Medicine and Veterinary Medicine" is approximately 18 percent of the overall sample of professionals) and (b) the approximately equal fraction of males and females in this category (i.e. approximately 18 and 19 percent of all male and female professionals have studied "Medicine and Veterinary Medicine").

Because the results of the regression with the gender interaction terms (see Table 9 in Appendix 3) are more informative, they will be the center of analysis in this subsection. However, it must be noted that the between-educational levels earnings differentials are apparent from the specification without interaction terms (see Table 8 in Appendix 3). Not surprisingly, on average and at each estimated quantile, relative to "Medicine and Veterinary Medicine" the group of "Economics, Business and Law" professionals enjoy the highest returns (other than at the top decile), followed by "0ther professionals" (who are mostly composed of administrative professionals (see Table 11 in Appendix 5), "Science, Mathematics and Computing" and "Engineering" (other than at the bottom two deciles), respectively. Those who have studied "Training for secondary school teachers", "Training for primary school and other teachers" and "Social sciences, Humanities and Arts" reap negative returns relative to the omitted category (in increasing order). Therefore, one may conclude that (in addition to the group of university graduates who enjoy executive positions i.e. the group "Legislators, senior officials and managers" and are not a part of this analysis), the high average returns to university education, are driven by the high returns to the university fields of "Economics, Business and Law" and fields requiring quanatiative skills such as "Science, Mathematics and Computing" and "Engineering". Furthermore, from this specification and from the gender composition of the group of Professionals, it is apparent that the gender wage gap in favour of men (See Table 6 in Appendix 3) is partially explained by the fact that most (approximately 63 percent) of the female professionals work in occupations which require the completion of lower-paying fields of study, i.e. "Training for secondary school teachers", "Training for primary school and other teachers", "Social Sciences, Humanities and Arts" and "Medicine and Veterinary Medicine".

Turning to the specification with gender interaction terms (see Table 9 in Appendix 3), the WLS estimates reveal that (a) the pattern of estimated (mean) returns to the fields of study is (qualitatively) identical for the two genders (i.e. same as described in the paragraph above) and (b) (mean) re-

turn to the teaching profession and "Social Sciences, Humanities and Arts" is higher for females than for males and (c) the (mean) return to "Economics, Business and Law", "Science, Mathematics and Computing", "Engineering" and "Other professionals" is higher for males than for females, implying that (d) the between-fields-of-study earnings dispersion (measured as the difference in return between the highest- and lowest-paying field) is, on average, smaller for females than for males.

The quantile regressions augment the WLS estimates in the following respects: (a) the between-fields-of-study earnings dispersion (measured as the difference in return between the highest- and lowest-paying field) is smaller for females than for males at all quantiles other than at the 25th quantile, (b) it increases across the quantiles for both genders and (c) whereas for males the high-paying fields i.e. "Other professionals", "Science, Mathematics and Computing" and "Economics, Business and Law" experience the highest within dispersion, for females the low-paying fields i.e. "Training for secondary school teachers", "Training for primary school and other teachers" and "Medicine and Veterinary Medicine" experience the highest within dispersion. For instance, the WLS estimate of the return to "Economics, Business and Law" relative to "Medicine and Veterinary Medicine" is similar across the two genders, namely 57 and 52 percent for males and females respectively. However, whereas the WLS estimate of 52 return to studying "Economics, Business and Law" is a (relatively) good indicator for the return for females, it is by no means a good indicator for males, i.e. for males the return is 18, 54 and 110 percent at the bottom decile, at the median and at the top decile respectively. Subsequently, the estimated results of the quantile regressions imply that the large gender earnings gap at the top of the distribution for university graduates (see Table 6 in Appendix 3) can be (in part) attributed to the lower (level and dispersion of) the monetary returns to the high-paying fields of study for females. Once again, the empirical results for the group of university graduates stress the importance of looking at the entire conditional distribution of (log) earnings rather than just the mean when analysing the returns education.

5. 3. CROSS-COUNTRY COMPARISON

Despite the country specific differences across the estimated quantiles and across the genders pointed out in the last two subsections, the parameter estimates at the median of the specification with the two genders pooled provides a valid starting point for the description of the between-educational-levels earnings differentials in the two countries. The coefficient estimates (see Table 3 in Appendix 2 and Table 6 in Appendix 3 for Germany and

Hungary respectively) imply that at the median (relative to having "No high school degree and no vocational degree") (a) lower level vocational education enjoys a slightly higher additional return in Germany than in Hungary, namely 17 and 13 percent respectively (b) the additional return to "Higher level vocational degree" is around 20 percentage points higher in Hungary than in Germany (c) the return to "High school degree and no tertiary degree" is slightly higher in Hungary than in Germany, namely the additional return is approximately 40 and 45 percent in Germany and Hungary respectively, (d) the additional return to college education is around 22 percentage points higher in Hungary than in Germany and (e) the additional return to university education is around 45 percent higher in Hungary than in Germany. The fact that the individuals who have completed "Higher level vocational degree" enjoy a higher return in Hungary than in Germany is not surprising as the composition of academic skills (not only vocational skills) varies across the countries (see Section 3 for detail). However, the high return to tertiary education in Hungary relative to Germany is somewhat surprising considering that in both countries (a) tertiary education is free and (b) takes a similar number of years to complete. These high returns in Hungary can be attributed to the fact that the demand for highly qualified labour is still higher than its supply. Nevertheless, it is important to add that the coefficient estimates of the quantile regressions for the specification using the group of university graduates (see Table 5 in Appendix 2 and Table 8 in Appendix 3 for Germany and Hungary respectively) reveal an expected similarity across the two countries in terms of university education, namely, the high valuation of quantitative skills (i.e. high relative returns to "Natural sciences" in Germany and to "Science, Mathematics and Computing" and "Engineering" in Hungary.)

Furthermore, a few points are worth noting in terms of the within-educational-levels earnings differentials (see Table 4 in Appendix 2 and Table 7 in Appendix 3 for Germany and Hungary respectively): (a) in Hungary the returns to all educational categories are increasing across the quantiles for both genders (as opposed to Germany where an increase across quantiles is only observed for males with a high school or tertiary degrees), (b) as expected, the within-educational-levels earnings dispersion is substantially lower for a vocational degree than for a university degree for both genders in Hungary and for males in Germany and (c) the within-educational-level earnings dispersion is larger in Hungary than in Germany at all educational levels. The latter points emphasize that the fact that differences within education groups are an significant contributing factor to aggregate earnings inequality.

Although the center of the empirical analysis is the comprehensive comparison of the returns to education in the two countries, a few points about the remaining explanatory variables are worth noting. In terms of the in-

formal component of human capital (see Table 4 in Appendix 2 and Table 7 in Appendix 3 for Germany and Hungary respectively), unlike in Germany, in Hungary (a) the return to the first year of potential labour market experience does not increase across the quantiles, for neither genders and (b) (not surprisingly) the return to the first year of potential labour market experience is higher in Germany at all estimated quantiles (especially at the top quantiles) for both genders, (except for the 10^{th} and 25^{th} quantiles for females). Second, (see Table 3 in Appendix 2 and Table 6 in Appendix 3 for Germany and Hungary respectively) the average estimated gender earnings gap is (a) approximately 23 and 15 percent in Germany and Hungary respectively and (b) narrows and widens across the quantiles in Germany and Hungary respectively, i.e. at the bottom and top deciles the estimated gender gap is approximately 28 and 15 percent in Germany and 4 and 21 percent in Hungary, which implies that the WLS estimate is not an accurate comparative measure. Moreover, the public-private gap in the favour of the private sector is larger at every estimated quantile in Hungary than in Germany, reaching 18 and 48 percent at the top decile in Germany and Hungary respectively when two genders are pooled.

Finally, from the specifications with gender interaction terms (see Table 4 in Appendix 2 and Table 7 in Appendix 3 for Germany and Hungary respectively), the following similarities across the two counties are worth noting: (a) females experience lower returns to tertiary education than males at the top of the earnings distribution, (b) the within-educational-levels earnings differentials are smaller at the tertiary level for females than for males and (d) the public-private earnings gap is smaller for females than for males at all quantiles.

6. CONCLUSION

In this paper standard Mincer earnings equations are estimated using both WLS and quantile regression in order to give a comprehensive picture of the returns to education in Germany and Hungary for the year 2000. To make the cross-country comparison of the returns to education informative, six differentiated categories for formal education, rather than years of education, are generated and used in the empirical analysis.

In summary, the regression results document several differences between the returns to formal education in Germany and Hungary. Namely, (a) whereas the (relative) returns to lower vocational training and high school education are similar in the two countries across the estimated quantiles (b) the (relative) return to tertiary education is substantially higher in Hungary

than in Germany, especially at the top quantiles. These differences in return remain characteristic when the two genders are analysed separately. Furthermore, the returns to all educational categories are increasing in Hungary across the estimated quantiles, for both genders, as opposed to Germany where an increase across quantiles is only observed for males with high school and tertiary degrees. It is important to note that the quantile regression estimates for Germany contradict to some extent those of Pereira and Martins (2000) who find evidence (using the GSOEP, 1984 – 1995, and years of schooling as a proxy for the formal component of human capital) for a negative relationship between the returns to education and the earnings distribution. The (significantly) higher returns to university education in Hungary (a) are somewhat surprising given that tertiary education is free and takes a similar number of years in both countries and (b) can be attributed to the fact that, although the composition of the workforce has changed by qualification over the past decade, the demand for qualified labour is still larger than its supply. Note also that such high relative returns to tertiary degrees, despite the increase in the number of individuals holding tertiary degrees, has also been observed for Portugal (see Machado and Mata (2000)) and is in line with the literature for Hungary (see for example Köllő (2002)) and for other Central and Eastern European countries (see for example Orazem and Vodopvec (1997)). It is also important to note that (a) the within dispersion is substantially larger at the university level than at the lower vocational level for both genders in Hungary and for males in Germany and (b) the within-educational-levels earnings dispersion is larger in Hungary than in Germany at all educational levels and is especially high at the tertiary level, suggesting that within-educational-levels earnings differentials are an important contributing factor of aggregate earnings inequality in Hungary. Concerning tertiary education two similarities across the two countries are worth pointing out: (a) females experience lower returns to tertiary education than males at the top of the earnings distribution and (b) the within-educational-levels earnings differentials are smaller at the tertiary level for females than for males.

It is important to point to an expected similarity across the two countries in terms of university education at all estimated quantiles and at the mean, namely, the high valuation of quantitative skills (i.e. high relative returns to "Natural sciences" in Germany and to "Science, Mathematics and Computing" and "Engineering" in Hungary.) For Hungary, the more disaggregated field of study categories and the additional specification with interaction terms shed even more light on the valuation of university education. Namely, for both genders, the subjects of "Economics, Business and Law", "Science, Mathematics and Computing" and Engineering", are valued highly in the labour market as opposed to "Training for teachers", "Social

sciences Humanities and Arts" and "Medicine". Moreover, the lower return university education for females is, on the one hand, attributed to the fact that the fraction of female professionals in occupations requiring low-paying fields of study, such as Teaching and Medicine, is relatively high and, on the other hand, that female professionals reap lower returns to the high-paying fields than their male counterparts, especially at the top quantiles. Hence, compositional factors also attribute to the observed positive earnings-gap in favour of men at the top of the earnings distribution.

A few interesting features in terms of the other variables of interest are worth commenting on. First, the return to the first year of potential labour market experience in Germany (a) is higher than in Hungary for both genders (other than at the 10^{th} and 25^{th} quantiles for females), especially at the top of the distribution and (b) as opposed to Hungary, it increases across the estimated quantiles for both genders. Note that the low valuation of the informal component of human capital in Hungary (as opposed to the high valuation of the formal component of human capital) is in line with the literature on Hungary and on other transition economies (see for example Köllő (2002) and Orazem and Vodopvec (1997)). Second, the estimated gender earnings gap narrows and widens across the quantiles in Germany and Hungary respectively. Third, the public-private earnings gap is (a) larger at every estimated quantile in Hungary than in Germany and (b) is smaller for females than for males at all estimated quantiles in both countries. Note that a large sector of employment gap is also characteristic for the decade of transition in Hungry (see for example Köllő (2002)).

Overall, the estimates of the quantile regressions provide evidence for the fact that in Hungary, like in other EU countries (see Pereira and Martins (2000)), within-educational-levels earnings differentials contribute significantly to aggregate earnings inequality, and subsequently emphasize the relevance of using quantile regression when the center of analysis is the returns to human capital.

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APPENDIX 1

Table 1. Weighted descriptive statistics for Germany, 2000

Variable	
Mean monthly gross earnings	3, 086. 88
Secondary school degree completed as reported in the GSOEP (%)	
Hauptschulabschluss (General school leaving certificate)	38. 61
Realschulabschluss (Intermediate school leaving certificate)	28. 15
Fachhochschulreife (Qualification for studies at college)	8. 67
Abitur (High school degree)	23. 17
Anderer Schulabschluss (Other secondary school degree)	0. 28
Ohne Abschluss verlassen (No secondary school degree)	1. 13
Vocational degree completed as reported in the GSOEP (%)	
Lehre (Apprentice school)	48. 35
Berufsfachschule (Full-time vocational school)	9. 16
Schule des Gesundheitswesens (Health care school)	1. 89
Fachschule (Technical school)	7. 82
Beamtenausbildung (Civil service training)	5. 89
Sonstige Ausbildung (Other training)	1. 59
Tertiary degree completed as reported in the GSOEP (%)	
Fachhochschule (College)	8. 71
Universität/Technische Hochschule (University/Technical university)	12. 86
Six categories for the highest level of education completed (%)	
(1) No formal vocational degree and no high school degree	9. 09
(2) Lower level vocational degree and no high school degree	52. 26
(3) Higher level vocational degree and no high school degree	5. 37
(4) High school degree and no tertiary degree	11. 71
(5) College degree	8. 71
(6) University degree	12. 86
Informal component of human capital	
Mean years of potential labour market experience	19. 94
Gender (%)	
Male	68. 98
Female	31. 02
Sector (%)	
Private sector	71. 93
Public sector	28. 07
Mean Age	39. 62
Observations	3, 440

Note: Earnings are denoted in Euro.

Table 2. Weighted descriptive statistics for Hungary, 2000

Variable	
Mean monthly gross earnings	352. 18
Highest level of education completed as reported in the "Hungarian National Labour Center's Wage Survey" (%)	
Less than általános iskola (Less than primary school)	0.75
Àltalános iskola (Primary school)	19. 27
Szakiskola (Vocational school)	2. 34
Szakmunkásképző (Apprentice school)	27. 96
Szakközépiskola (Vocational secondary school)	17. 22
Gimnázium (General secondary school)	10. 02
Technikum (Technical school)	3. 45
Főiskola (College)	12. 84
Egyetem (University)	6. 14
Six categories for the highest level of education completed (%)	
(1) No formal vocational degree and no high school degree	20. 02
(2) Lower level vocational degree and no high school degree	30. 30
(3) Higher level vocational degree	3. 45
(4) High school degree and no tertiary degree	27. 24
(5) College degree	12. 84
(6) University degree	6. 14
Informal component of human capital	
Mean years of potential labour market experience	22. 94
Gender (%)	
Male	49. 00
Female	51. 00
Sector (%)	
Private sector	71. 02
Public sector	28. 98
Age group (%)	
Mean Age	40. 66
Observations	150, 775

Note: Earnings are denoted in Euro.

APPENDIX 2

Table 3. Regression results for Germany, 2000

	Germany 2000					
	WLS	.10	.25	.50	.75	.90
Constant	8. 063	7. 817	7. 919	8. 017	8. 193	8. 245
	(0. 039)	(0. 082)	(0. 054)	(0. 045)	(0. 073)	(0. 073)
Education group						
(2)	0. 165	0. 115	0. 161	0. 169	0. 124	0. 140
	(0. 023)	(0. 041)	(0. 029)	(0. 035)	(0. 052)	(0. 050)
(3)	0. 353	0. 355	0. 316	0. 357	0. 260	0. 295
	(0. 034)	(0. 046)	(0. 040)	(0. 044)	(0. 065)	(0. 073)
(4)	0. 411	0. 344	0. 348	0. 397	0. 408	0. 468
	(0. 029)	(0. 062)	(0. 047)	(0. 042)	(0. 067)	(0.067)
(5)	0. 660	0. 549	0. 571	0. 608	0. 635	0. 679
	(0. 031)	(0. 058)	(0. 044)	(0. 043)	(0. 066)	(0. 105)
(6)	0. 670	0. 622	0. 674	0. 712	0. 700	0. 777
	(0. 028)	(0. 117)	(0. 046)	(0. 039)	(0. 061)	(0. 070)
Informal component of human capital						
Experience	0. 029	0. 021	0. 027	0. 034	0. 037	0. 048
	(0. 003)	(0. 008)	(0. 005)	(0. 004)	(0. 006)	(0. 006)
Experience^2(/100)	-0. 049	-0. 034	-0. 047	-0. 059	-0. 063	-0. 085
	(0. 000)	(0. 000)	(0. 000)	(0. 000)	(0. 000)	(0. 000)
Gender						
Female	-0. 231	-0. 278	-0. 229	-0. 202	-0. 174	-0. 145
	(0. 014)	(0. 036)	(0. 024)	(0. 018)	(0. 025)	(0. 029)
Sector						
Public sector	-0. 054	0. 052	-0. 007	-0. 059	-0. 127	-0. 179
	(0. 014)	(0. 033)	(0. 018)	(0. 017)	(0. 022)	(0. 030)
Observations	3, 440	3, 440	3, 440	3, 440	3, 440	3, 440

Table 4. Regression results for Germany, 2000

	Germany 2000					
	WLS	.10	.25	.50	.75	.90
Constant	7. 993	7. 800	7. 890	7. 976	8. 094	8. 210
	(0. 048)	(0. 109)	(0. 060)	(0. 056)	(0. 079)	(0. 098)
Education group						
(2)	0. 138	0. 124	0. 124	0. 128	0. 122	0. 168
	(0. 028)	(0. 045)	(0. 033)	(0. 039)	(0. 050)	(0. 040)
(3)	0. 300	0. 355	0. 269	0. 278	0. 246	0. 317
	(0. 039)	(0. 052)	(0. 043)	(0. 049)	(0. 058)	(0. 066)
(4)	0. 365	0. 262	0. 308	0. 356	0. 366	0. 502
	(0. 036)	(0. 072)	(0. 054)	(0. 046)	(0. 055)	(0. 058)
(5)	0. 669	0. 563	0. 564	0. 584	0. 667	0. 790
	(0. 036)	(0. 064)	(0. 047)	(0. 052)	(0. 081)	(0. 139)
(6)	0. 636	0. 503	0. 638	0. 679	0. 734	0. 845
	(0. 034)	(0. 261)	(0. 049)	(0. 046)	(0. 061)	(0. 063)
Informal component of human capital						
Experience	0. 039	0. 023	0. 032	0. 042	0. 047	0. 048
	(0. 004)	(0. 010)	(0. 005)	(0. 005)	(0. 007)	(0. 009)
Experience^2(/100)	-0. 069	-0. 036	-0. 056	-0. 078	-0. 082	-0. 084
	(0. 000)	(0. 000)	(0. 000)	(0. 000)	(0. 000)	(0. 000)
Gender						
Female	-0. 078	-0. 197	-0. 039	-0. 133	0. 027	0. 055
	(0. 079)	(0. 222)	(0. 119)	(0. 106)	(0. 172)	(0. 168)
Sector						
Public sector	-0. 072	0. 036	-0. 004	-0. 084	-0. 142	-0. 181
	(0. 017)	(0. 036)	(0. 021)	(0. 020)	(0. 025)	(0. 043)
Interaction terms						
(2) * female	0. 070	-0. 121	0. 048	0. 137	0. 018	-0. 088
	(0. 048)	(0. 165)	(0. 075)	(0. 081)	(0. 158)	(0. 124)
(3) * female	0. 203	-0. 114	0. 241	0. 209	0. 049	-0. 093
	(0. 087)	(0. 208)	(0. 190)	(0. 106)	(0. 195)	(0. 330
(4) * female	0. 116	0. 139	0. 071	0. 128	0. 024	-0. 059
	(0. 060)	(0. 182)	(0. 105)	(0. 103)	(0. 192)	(0. 156)
(5) * female	-0. 070	-0. 100	0. 011	0. 021	-0. 157	-0. 346
	(0. 069)	(0. 185)	(0. 107)	(0. 095)	(0. 181)	(0. 191)
(6) * female	0. 078	0. 054	0. 021	0. 040	-0. 152	-0. 303
	(0. 061)	(0. 313)	(0. 112)	(0. 097)	(0. 166)	(0. 153)
Experience * female	-0. 023	-0. 002	-0. 023	-0. 021	-0. 019	-0. 009
	(0. 007)	(0. 017)	(0. 011)	(0. 009)	(0. 012)	(0. 013)
Experience^2 * female (/100)	0. 049	-0. 004	0. 044	0. 044	0. 033	0. 017
	(0. 000)	(0. 000)	(0. 000)	(0. 000)	(0. 000)	(0. 000)
Sector * female	0. 050	0. 079	0. 033	0. 088	0. 081	0. 021
	(0. 030)	(0. 071)	(0. 054)	(0. 037)	(0. 047)	(0. 061)
Observations	3, 440	3, 440	3, 440	3, 440	3, 440	3, 440

Notes on Tables 3 – 4: 1) The reference group among the education categories is Group (1) "No formal vocational training and no high school degree". 2) Experience is measured as years of potential labour market experience, i.e. "age – years of schooling – 6". 5) Standard errors are in parenthesis. 6) Standard errors are computed by 1000 bootstrap replications for the quantile regressions.

Table 5. Regression results for Germany, 2000

	Germany 2000					
	WLS	.10	.25	.50	.75	.90
Constant	8. 555	7. 861	8. 512	8. 590	8. 764	8. 685
	(0. 179)	(0. 309)	(0. 255)	(0. 201)	(0. 171)	(0. 133)
Field of Study						
Social sciences, Humanities	0. 031	-0. 152	-0. 174	0. 020	0. 067	0. 311
and Arts	(0. 091)	(0. 158)	(0. 127)	(0. 116)	(0. 096)	(0. 133)
Natural sciences	0. 008	0. 005	0. 004	0. 089	0. 138	0. 308
	(0. 107)	(0. 975)	(0. 178)	(0. 116)	(0. 103)	(0. 097)
Informal component of human capital						
Experience	0. 046	0. 087	0. 051	0. 053	0. 052	0. 064
	(0. 018)	(0. 035)	(0. 028)	(0. 019)	(0. 018)	(0. 015)
Experience^2(/100)	-0. 082	-0. 165	-0. 095	-0. 106	-0. 108	-0. 147
	(0. 001)	(0. 001)	(0. 001)	(0. 001)	(0. 000)	(0. 000)
Gender						
Female	-0. 118	-0. 150	-0. 240	-0. 164	-0. 165	-0. 094
	(0. 075)	(0. 140)	(0. 106)	(0. 081)	(0. 063)	(0. 063)
Sector						
Public sector	-0. 215	-0. 160	-0. 252	-0. 160	-0. 265	-0. 200
	(0. 081)	(0. 165)	(0. 099)	(0. 093)	(0. 099)	(0. 099)
Observations	263	263	263	263	263	263

Notes on Table 5: 1) The reference group among the "Field of Study" categories is "Education". 2) Experience is measured as years of potential labour market experience, i.e. "age – years of schooling – 6". 3) Standard errors are in parenthesis. 5) Standard errors are computed by 1000 bootstrap replications for the quantile regressions.

APPENDIX 3

Table 6. Regression results for Hungary, 2000

	Hungary 2000					
	WLS	.10	.25	.50	.75	.90
Constant	10. 674	9. 873	10. 145	10. 633	11. 067	11. 395
	(0. 008)	(0. 012)	(0. 011)	(0. 013)	(0. 013)	(0. 020)
Education group						
(2)	0. 124	0. 107	0. 122	0. 133	0. 150	0. 176
	(0. 004)	(0. 006)	(0. 007)	(0. 007)	(0. 007)	(0. 009)
(3)	0. 565	0. 400	0. 570	0. 562	0. 633	0. 721
	(0. 008)	(0. 033)	(0. 015)	(0. 012)	(0. 012)	(0. 016)
(4)	0. 430	0. 241	0. 391	0. 451	0. 502	0. 595
	(0. 004)	(0. 007)	(0. 006)	(0. 007)	(0. 005)	(0. 009)
(5)	0. 864	0. 706	0. 816	0. 832	0. 894	1. 028
	(0. 005)	(0. 007)	(0. 005)	(0. 006)	(0. 006)	(0. 011)
(6)	1. 227	0. 885	1. 057	1. 163	1. 377	1. 640
	(0. 007)	(0. 013)	(0. 007)	(0. 010)	(0.011)	(0. 014)
Informal component of human capital						
Experience	0. 014	0. 018	0. 024	0. 019	0. 009	0. 005
	(0. 001)	(0. 001)	(0. 001)	(0. 001)	(0. 001)	(0. 002)
Experience^2(/100)	-0. 012	-0. 021	-0. 027	-0. 022	-0. 003	0. 005
	(0. 000)	(0. 000)	(0. 000)	(0. 000)	(0. 000)	(0. 000)
Gender						
Female	-0. 150	-0. 036	-0. 120	-0. 166	-0. 184	-0. 209
	(0. 003)	(0. 005)	(0. 006)	(0. 006)	(0. 005)	(0. 007)
Sector						
Public sector	-0. 213	0. 238	-0. 033	-0. 267	-0. 395	-0. 480
	(0. 003)	(0. 005)	(0. 006)	(0. 004)	(0. 005)	(0. 007)
Observations	150, 775	150, 775	150, 775	150, 775	150, 775	150, 775

Table 7. Regression results for Hungary, 2000

	Hungary 2000					
	WLS	.10	.25	.50	.75	.90
Constant	10. 690	10. 015	10. 214	10. 696	11. 078	11. 338
	(0. 012)	(0. 019)	(0. 032)	(0. 030)	(0. 028)	(0. 027)
Education group						
(2)	0. 141	0. 056	0. 121	0. 137	0. 157	0. 193
	(0. 006)	(0. 008)	(0. 013)	(0. 011)	(0. 010)	(0. 011)
(3)	0. 551	0. 332	0. 553	0. 539	0. 619	0. 698
	(0. 010)	(0. 039)	(0. 019)	(0. 016)	(0. 015)	(0. 019)
(4)	0. 397	0. 132	0. 353	0. 401	0. 466	0. 567
	(0. 007)	(0. 013)	(0. 018)	(0. 013)	(0. 011)	(0. 016)
(5)	0. 926	0. 593	0. 812	0. 894	1. 050	1. 216
	(0. 009)	(0. 016)	(0. 015)	(0. 011)	(0. 017)	(0. 018)
(6)	1. 251	0. 762	1. 041	1. 201	1. 447	1. 711
	(0. 009)	(0. 017)	(0. 015)	(0. 016)	(0. 018)	(0. 022)
Informal component of human capital						
Experience	0. 014	0. 009	0. 020	0. 017	0. 011	0. 011
	(0. 001)	(0. 002)	(0. 003)	(0. 003)	(0. 003)	(0. 002)
Experience^2(/100)	-0. 015	-0. 004	-0. 021	-0. 022	-0. 011	-0. 013
	(0. 000)	(0. 000)	(0. 000)	(0. 000)	(0. 000)	(0. 000)
Gender						
Female	-0. 196	-0. 230	-0. 230	-0. 295	-0. 255	-0. 146
	(0. 017)	(0. 023)	(0. 036)	(0. 034)	(0. 032)	(0. 035)
Sector						
Public sector	-0. 230	0. 297	-0. 057	-0. 322	-0. 426	-0. 474
	(0. 040)	(0. 008)	(0. 009)	(0. 008)	(0. 008)	(0. 012)
Interaction terms						
(2) * female	-0. 040	0. 067	0. 002	-0. 006	-0. 008	-0. 024
	(0. 008)	(0. 010)	(0. 016)	(0. 013)	(0. 013)	(0. 014)
(3) * female	0. 060	0. 140	0. 033	0. 071	0. 053	0. 104
	(0. 017)	(0. 049)	(0. 032)	(0. 027)	(0. 028)	(0. 034)
(4) * female	0. 054	0. 168	0. 053	0. 077	0. 050	0. 038
	(0. 008)	(0. 015)	(0. 019)	(0. 015)	(0. 012)	(0. 019)
(5) * female	-0. 087	0. 178	0. 012	-0. 069	-0. 205	-0. 283
	(0. 011)	(0. 017)	(0. 016)	(0. 013)	(0. 018)	(0. 022)
(6) * female	-0. 046	0. 187	0. 034	-0. 056	-0. 149	-0. 174
	(0. 013)	(0. 020)	(0. 018)	(0. 018)	(0. 024)	(0. 038)
Experience * female	0. 001	0. 016	0. 006	0. 004	0. 002	-0. 008
	(0. 001)	(0. 002)	(0. 003)	(0. 003)	(0. 003)	(0. 003)
Experience^2 * female (/100)	0. 005	-0. 028	-0. 008	0. 002	0. 006	0. 026
	(0. 000)	(0. 000)	(0. 000)	(0. 000)	(0. 000)	(0. 000)
Sector * female	0. 028	-0. 077	0. 035	0. 083	0. 045	-0. 008
	(0. 007)	(0. 010)	(0. 012)	(0. 010)	(0. 011)	(0. 016)
Observations	150, 775	150, 775	150, 775	150, 775	150, 775	150, 775

Notes on Tables 6 – 7: 1) The reference group among the education categories is Group (1) "No formal vocational training and no high school degree". 2) Experience is measured as years of potential labour market experience, i.e. "age – years of schooling – 6". 3) Standard errors are in parenthesis. 5) Standard errors are computed by 200 bootstrap replications for the quantile regressions.

Table 8. Regression results for Hungary, 2000

	Hungary 2000					
	WLS	.10	.25	.50	.75	.90
Constant	11. 488	10. 479	11. 138	11. 547	11. 838	12. 225
	(0. 039)	(0. 080)	(0. 053)	(0. 045)	(0. 060)	(0. 061)
Field of Study						
Training for secondary	-0. 068	0. 091	0. 046	-0. 022	-0. 143	-0. 295
school teachers	(0. 023)	(0. 016)	(0. 014)	(0. 015)	(0. 019)	(0. 030)
Training for primary school	-0. 148	-0. 028	-0. 056	-0. 106	-0. 222	-0. 343
and other teachers	(0. 031)	(0. 023)	(0. 020)	(0. 017)	(0. 021)	(0. 037)
Social sciences, Humanities	-0. 220	-0. 133	-0. 153	-0. 217	-0. 262	-0. 268
and Arts	(0. 040)	(0. 069)	(0. 032)	(0. 029)	(0. 034)	(0. 076)
Economics, Business and	0. 538	0. 359	0. 447	0. 530	0. 624	0. 628
Law	(0. 030)	(0. 078)	(0. 050)	(0. 050)	(0. 057)	(0. 053)
Science, Mathematics and	0. 309	0. 024	0. 082	0. 271	0. 485	0. 460
Computing	(0. 035)	(0. 079)	(0. 070)	(0. 062)	(0. 072)	(0. 089)
Engineering	0. 162	0. 109	0. 105	0. 085	0. 198	0. 129
	(0. 031)	(0. 056)	(0. 043)	(0. 040)	(0. 060)	(0. 059)
Other professionals	0. 404	0. 167	0. 206	0. 320	0. 416	0. 651
	(0. 028)	(0. 029)	(0. 030)	(0. 030)	(0. 052)	(0. 093)
Informal component of human capital						
Experience	0. 027	0. 022	0. 023	0. 029	0. 031	0. 036
	(0. 004)	(0. 005)	(0. 004)	(0. 003)	(0. 003)	(0. 005)
Experience^2(/100)	-0. 050	-0. 019	-0. 025	-0. 044	-0. 049	-0. 070
	(0. 000)	(0. 000)	(0. 000)	(0. 000)	(0. 000)	(0. 000)
Gender						
Female	-0. 082	-0. 004	-0. 035	-0. 055	-0. 077	-0. 124
	(0. 015)	(0. 017)	(0. 014)	(0. 012)	(0. 014)	(0. 023)
Sector						
Public sector	-0. 164	0. 383	-0. 103	-0. 361	-0. 422	-0. 509
	(0. 023)	(0. 059)	(0. 043)	(0. 036)	(0. 052)	(0. 049)
Observations	6, 243	6, 243	6, 243	6, 243	6, 243	6, 243

Table 9. Regression results for Hungary, 2000

	Hungary 2000					
	WLS	.10	.25	.50	.75	.90
Constant	11. 451	10. 740	11. 252	11. 567	11. 718	11. 788
	(0. 054)	(0. 118)	(0. 084)	(0. 084)	(0. 089)	(0. 216)
Field of Study						
Training for secondary school teachers	-0. 084	0. 054	0. 008	-0. 046	-0. 137	-0. 277
	(0. 037)	(0. 024)	(0. 019)	(0. 024)	(0. 029)	(0. 043)
Training for primary school and other teachers	-0. 186	-0. 108	-0. 120	-0. 157	-0. 222	-0. 311
	(0. 055)	(0. 051)	(0. 029)	(0. 033)	(0. 043)	(0. 078)
Social sciences, Humanities and Arts	-0. 251	-0. 410	-0. 239	-0. 269	-0. 270	-0. 072
	(0. 060)	(0. 129)	(0. 084)	(0. 051)	(0. 065)	(0. 203)
Economics, Business and Law	0. 578	0. 180	0. 341	0. 541	0. 731	1. 104
	(0. 044)	(0. 187)	(0. 094)	(0. 083)	(0. 084)	(0. 243)
Science, Mathematics and Computing	0. 435	-0. 042	0. 068	0. 342	0. 683	0. 994
	(0. 046)	(0. 115)	(0. 130)	(0. 100)	(0. 090)	(0. 232)
Engineering	0. 266	0. 054	0. 085	0. 115	0. 359	0. 549
	(0. 042)	(0. 077)	(0. 067)	(0. 066)	(0. 078)	(0. 204)
Other professionals	0. 521	0. 121	0. 196	0. 356	0. 623	1. 382
	(0. 039)	(0. 047)	(0. 044)	(0. 050)	(0. 117)	(0. 250)
Informal component of human capital						
Experience	0. 023	0. 001	0. 015	0. 028	0. 034	0. 042
	(0. 005)	(0. 008)	(0. 007)	(0. 006)	(0. 006)	(0. 008)
Experience^2(/100)	-0. 046	0. 031	-0. 002	-0. 046	-0. 063	-0. 089
	(0. 000)	(0. 000)	(0. 000)	(0. 000)	(0. 000)	(0. 000)
Gender						
Female	-0. 041	-0. 325	-0. 283	-0. 088	0. 062	0. 438
	(0. 077)	(0. 156)	(0. 112)	(0. 102)	(0. 113)	(0. 230)
Sector						
Public sector	-0. 084	0. 335	-0. 103	-0. 337	-0. 320	-0. 154
	(0. 033)	(0. 090)	(0. 064)	(0. 057)	(0. 074)	(0. 205)
Interaction terms						
Training for secondary school teachers * female	0. 016	0. 068	0. 067	0. 040	-0. 017	-0. 065
	(0. 048)	(0. 030)	(0. 026)	(0. 032)	(0. 039)	(0. 061)
Training for primary school and other teachers * female	0. 042	0. 113	0. 111	0. 078	-0. 014	-0. 064
	(0. 067)	(0. 055)	(0. 037)	(0. 041)	(0. 050)	(0. 094)
Social science, Humanities and Arts * female	0. 058	0. 418	0. 141	0. 092	0.023	-0. 226
	(0. 080)	(0. 146)	(0. 088)	(0. 066)	(0. 076)	(0. 221)
Economics, Business and Law * female	-0. 061	0. 224	0. 223	-0. 005	-0. 131	-0. 566
	(0. 061)	(0. 208)	(0. 112)	(0. 107)	(0. 113)	(0. 354)
Science, Mathematics and Computing * female	-0. 346	0. 067	-0. 032	-0. 235	-0. 499	-0. 905
	(0. 077)	(0. 184)	(0. 155)	(0. 139)	(0. 125)	(0. 249)
Engineering * female	-0. 242	0. 035	-0. 009	-0. 069	-0. 373	-0. 653
	(0. 065)	(0. 111)	(0. 094)	(0. 089)	(0. 106)	(0. 240)
Other professionals* female	-0. 227	0. 046	0. 034	-0. 033	-0. 298	-1. 013
	(0. 055)	(0. 060)	(0. 062)	(0. 062)	(0. 129)	(0. 260)

Table 9 continues on next page

Table 9 continued

Experience * female	0. 011	0. 031	0. 017	0. 001	-0. 004	-0. 010
	(0. 007)	(0. 010)	(0. 008)	(0. 007)	(0. 007)	(0. 010)
Experience^2 * female	-0. 013	-0. 072	-0. 034	0. 006	0. 022	0. 036
(/100)	(0. 000)	(0. 000)	(0. 000)	(0. 000)	(0. 000)	(0. 000)
Sector * female	-0. 154	-0. 004	0. 019	-0. 029	-0. 108	-0. 427
	(0. 046)	(0. 128)	(0. 088)	(0. 074)	(0. 098)	(0. 215)
Observations	6, 243	6, 243	6, 243	6, 243	6, 243	6, 243

Notes on Table 8 – 9: 1) The reference group among the "Field of Study" categories is "Medicine and Veterinary Medicine". 2) Experience is measured as years of potential labour market experience, i.e. "age – years of schooling – 6". 3) Standard errors are in parenthesis. 5) Standard errors are computed by 1000 bootstrap replications for the quantile regressions.

APPENDIX 4

Figure 1. Experience profiles for Germany, 2000

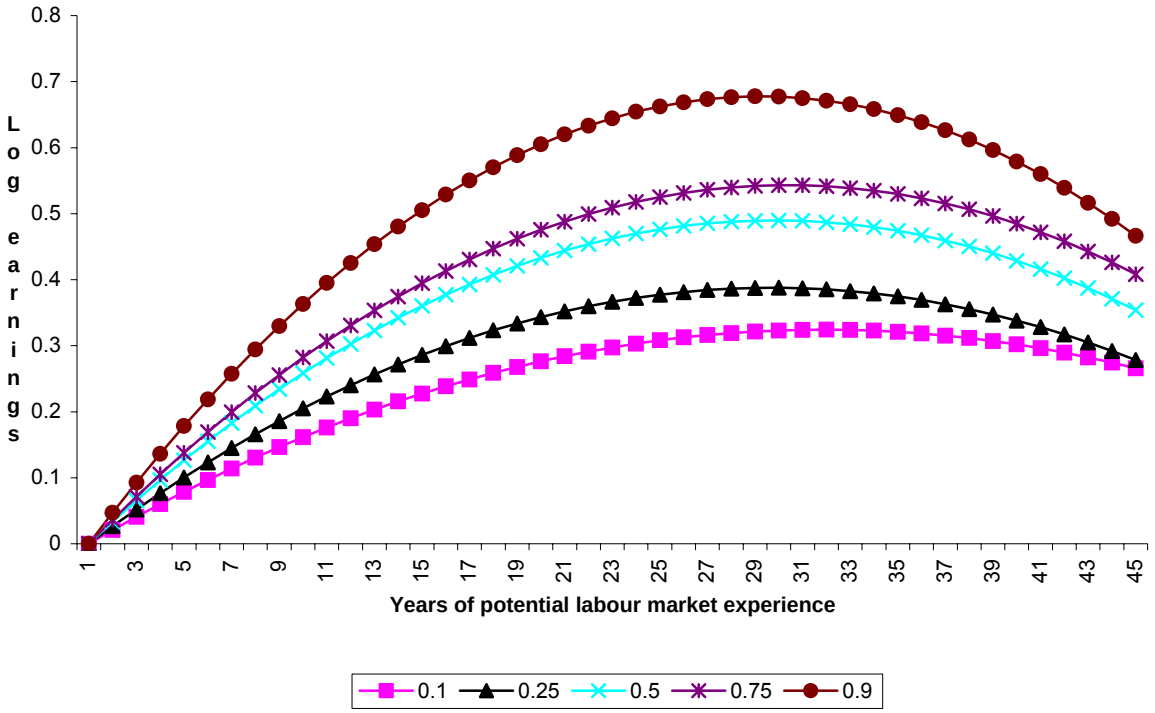
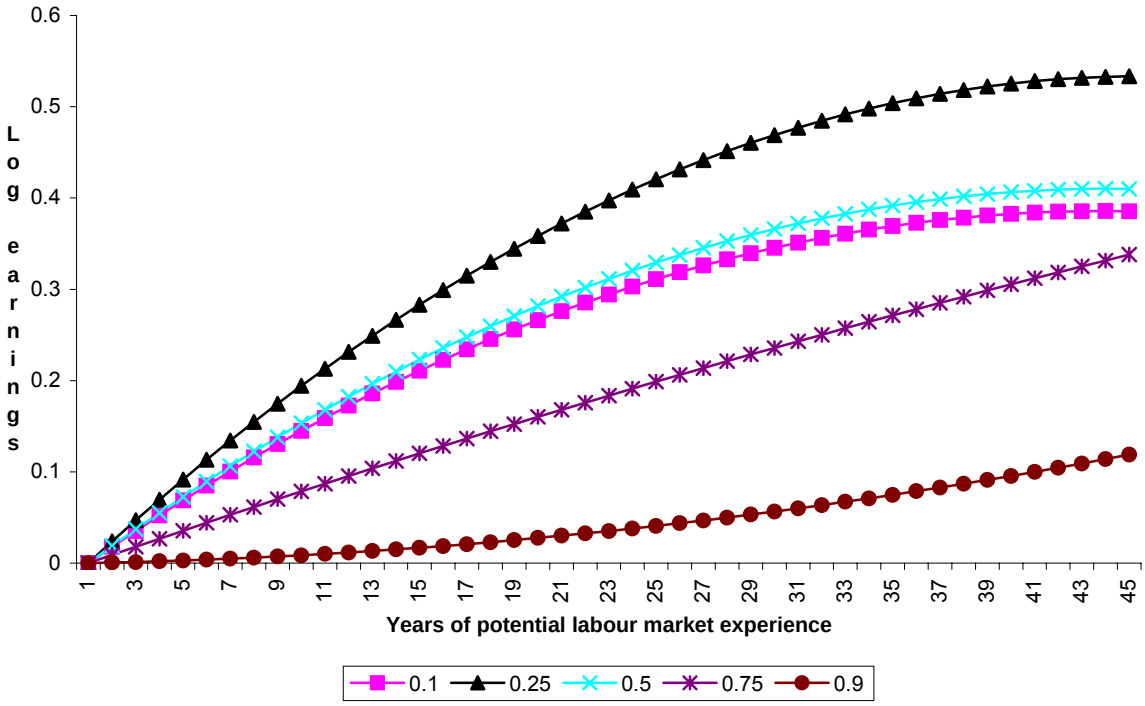


Figure 2. Experience profiles for Hungary, 2000



APPENDIX 5

The field of study groups have been generated using the occupational information available in the datasets, ISCO-88 and FEOR-93, for Germany and Hungary respectively. To make cross-country comparison possible, the occupational composition of the field of study groups is identical across the two countries. That is, in a first step, the university graduates belonging the main occupational group of "Professionals", who represent over 50 percent of all university graduates in the 2000 samples for both countries, have been allocated to eight fields of study groups in both countries according to their occupational background. The reason behind using the "Professionals" only in estimation is that the field of study can only be imputed for this main occupational group (using the ISCO-88 and FEOR-93 classification codes). In a second step, these eight categories have been merged into three broad categories for the German subsample in order to assure a sufficient number of observations for econometric analysis. The resulting field of study groups reflect the ISCED classification of university education and are tailored to the datasets due to considerations about (a) sample size (b) characteristics of the education systems (as well as earnings prospects) which allow the subdivision of some broad fields of study/merging of some narrow fields of study. Table 10 presents the resulting field of study groups for the two countries with Group "Social sciences, Humanities and Arts" being the most heterogeneous one in terms of both educational background and earnings prospects in both countries.

The final group "Other professionals" for Hungary consists of (a) those fields of study which account for approximately 1 percent of the sample (namely occupations belonging to the "Health and Welfare" category) and (b) those occupations for which the exact field of study cannot be determined (namely "Other technical professionals", "Tertiary education teaching professionals" and "Administrative professionals"). Table 11 provides information of the exact occupational composition of the "Other professionals" category. Note that for Germany, those who would otherwise belong to the Group of "Other professionals" because the field of study cannot be inferred from the occupation, namely "Administrative professionals" and "Tertiary education teaching professionals", are omitted form the analysis. Furthermore, the subgroups of „Pharmacists" and „Social workers" have been allocated to the Group of "Natural sciences" and "Social sciences, Humanities and Arts" respectively. This allocation procedure is preferred to generating a fourth group of "Other professionals" with a small number of observations.

Table 10. Occupational composition of the filed of study groups in Germany and Hungary

Occupation	Field of study	
	Hungary	Germany
All secondary education teaching professionals (general and vocational)	(1) Training for secondary school teachers	(1) Education
Primary education teaching professionals, Pre-primary education teaching professionals, Special education teaching professionals	(2) Training for primary school and other teachers	
Historians, Sociologists, Anthropologists and related professions, Philologists, Translators, Interpreters, Psychologists, Librarians and related information professionals, Authors, Journalists, Sculptors, Painters, Composers, Musicians, Singers, Actors, Directors	(3) Social sciences, Humanities and Arts	(2) Social sciences, Humanities and Arts
Economists, Accountants, Other business professionals, Lawyers, Judges, Legal professionals not elsewhere classified	(4) Economics, Business and Law	
Biologists, Biochemists, Zoologists, Pharmacologists, Physicists, Meteorologists, Chemists, Other scientists not elsewhere classified, Mathematicians, Computing professionals	(5) Science, Mathematics and Computing	(3) Natural sciences
All engineering professionals, Architects	(6) Engineering	
Medical doctors, Dentists, Veterinarians	(7) Medicine and Veterinary Medicine	
Health and welfare professionals (nursing and midwifery professionals, pharmacists, social work and counselling professionals), Other technical professionals, Tertiary education teaching professionals, Administrative professionals	(8) Other professionals	–

Table 11. Occupational composition (%) of "Other professionals" for Hungary, 2000

"Other professionals"	
(1) Health and Welfare	11. 00
(2) Other technical professionals	14. 53
(3) Tertiary education teaching professionals	14. 98
(4) Administrative professionals	59. 49
Observations	622

Finally, Tables 12 and 13 present some sample information, for males and females separately, for Germany and Hungary respectively.

Table 12. Weighted descriptive statistics for the group of "Professionals" for Germany, 2000

	Overall	Male	Female
Mean monthly gross earnings	4, 177. 94	4, 574. 47	3, 461. 00
Field of Study (%)			
(1) Education	30. 26	20. 25	48. 38
(2) Social sciences, Humanities and Arts	35. 03	31. 96	40. 58
(3) Natural sciences	34. 72	47. 79	11. 04
Informal component of human capital			
Mean years of experience	16. 78	17. 18	16. 05
Gender (%)			
Male	64. 41		
Female	35. 59		
Sector (%)			
Private	49. 57	55. 97	37. 98
Public	50. 43	44. 03	62. 02
Mean age	41. 20	41. 63	40. 42
Observations	263	187	76

Table 13. Weighted descriptive statistics for the group of "Professionals" for Hungary, 2000

	Overall	Male	Female
Mean monthly gross earnings	659. 35	760. 23	554. 25
Field of Study (%)			
(1) Training for secondary school teachers	19. 91	12. 60	27. 52
(2) Training for primary school and other teachers	7. 72	4. 01	11. 60
(3) Social sciences, Humanities and Arts	4. 08	3. 39	4. 70
(4) Economics, Business and Law	14. 65	14. 30	15. 01
(5) Science, Mathematics and Computing	7. 81	11. 71	3. 73
(6) Engineering	16. 22	24. 78	7. 92
(7) Medicine and Veterinary Medicine	18. 34	17. 43	19. 30
(8) Other professionals	11. 27	11. 68	10. 86
Informal component of human capital			
Mean years of experience	17. 28	16. 71	17. 89
Gender (%)			
Male	51. 02		
Female	48. 98		
Sector (%)			
Private	41. 60	54. 67	27. 98
Public	58. 40	45. 33	72. 02
Mean age	40. 28	39. 71	40. 89
Observations	6, 243	3, 194	3, 049

Notes: 1) Earnings are denoted in Euro. 2) Experience is measured as years of potential labour market experience, i.e. "age – years of schooling – 6".