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Two Phases of Labor Market Transition in Hungary: Inter-Sectoral Reallocation and Skill-Biased Technological Change

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TWO PHASES OF LABOR MARKET TRANSITION IN HUNGARY: INTER-SECTORAL REALLOCATION AND SKILL-BIASED TECHNOLOGICAL CHANGE

GÁBOR KÉZDI

Hungary has been a front-runner in the transition to capitalism. It has also experienced exceptionally radical changes in employment and relative wages. One main feature of these changes is an enormous increase in the returns to skill. This paper argues that it is instructive to divide the process into two periods, divided by around the year 1995. The first period experienced major destruction of low-skilled jobs and large inter-sectoral reallocation, partly toward skill-intensive industries. Employment started to rebound in the second period, which has also seen a pervasive skill upgrade in all sectors. The skill premium in earnings started to grow even faster in the second stage because increasing demand for skill met a more and more inelastic supply in the short run. Long-run supply effects have been, however, strong as college enrollment rates soared. Introduction of new (foreign) capital seems to be a major factor behind increasing demand for skill. Foreign direct investment into Hungary was by far the largest among the transition countries until the late 1990's, but other Central-Eastern European countries started to catch up since. This suggests that the Hungarian experience might be helpful to predict labor market trends in other transition economies, especially those that attract significant foreign capital.

A MUNKAERŐPIACI TRANZÍCIÓ KÉT FÁZISA MAGYARORSZÁGON: INTERSZEKTORÁLIS REALLOKÁCIÓ ÉS A KÉPESSÉGEKET FELÉRTÉKELŐ TECHNOLÓGIAI VÁLTOZÁS

KÉZDI GÁBOR

A munkaerőpiaci változásokat tekintve Magyarország a legradikálisabb átmeneti gazdaságok közé tartozik. Különösen igaz ez az iskolai végzettséggel összefüggő foglalkoztatási és kereseti egyenlőtlenségek terén: az iskola hozadéka rendkívüli mértékben megnőtt. Az alábbi tanulmány amellett érvel, hogy a folyamatokat érdemes két külön szakaszra osztani, amelyeket 1995 körül választhatunk ketté. Az első szakaszt az alacsony képzettséget igénylő munkahelyek tömeges megszüntetése és rendkívüli mértékű ágazatok közötti reallokaió jellemezte. Ez utóbbi részben magasabb képzettséget igényő ágazatok felé is irányult. A második szakaszban a foglalkoztatás csökkenése megállt, és minden ágazaton belül megfigyelhetjük a magasabb képzettségűek arányának növekedését. Az iskola bérekben mért hozadéka a második periódusban még gyorsabban nőtt, valószínűleg a rövid távon rugalmatlan kínálat miatt. Hosszú távon azonban erősek a kínálati reakciók, amit a megugró egyetemi-főiskolai beiskolázások mutatnak. A külföldi tőkének jelentős szerepe volt az iskola hozadékának emelkedésében. Minthogy Magyarország a 90-es évek végéig élenjárt a külföldi tőkebefektetések terén, a hazai munkaerőpiaci trendek segíthetnek a többi, később privatizáló átmeneti gazdaság helyzetének előrejelzéséhez.

Hungary has been one of the most successful countries in transforming its economy from state socialism to modern capitalism. It also experienced the largest decline in employment until the second half of the 1990's (Svejnar, 2002). Trends in employment were highly correlated with educational attainment. At the same time, returns to skill have increased substantially in terms of earnings. These trends affected all cohorts but the real winners are the young well educated.[1]

In this paper I try to identify the major factors behind these trends. In particular, my question is how much of the changes is specific to transition and how much is a result of worldwide skill-biased technological change. Berman, Bound, and Machin (1998) document similar trends in the developed world, with a lot smaller magnitude. They argue that the most plausible explanation for those trends is skill-biased changes in technology, which affected all manufacturing industries and all developed countries.

The evidence suggests that demand for skill increased dramatically in Hungary. Doubtless, many factors were responsible for this phenomenon. Price liberalization and restructuring of international trade had dramatically changed the structure of product demand. Free entrepreneurship and the rule of law had encouraged business in all sectors, especially in services. Capital has been scarce in transition economies, but foreign capital started to flow in. Part of foreign investment involved setting up new companies but privatization of existing companies was equally important. Despite widespread deregulation, competition in some industries remained low often for political reasons, which allowed non-competitive behavior to survive. All of these factors had potential impact on the demand for skill. Skill-biased technological change, whether induced by new foreign capital or domestic innovation, is therefore one of many possible factors behind changing labor demand.

I will argue that probably all the above factors played an important role in the first years of transition. However, Hungary entered a second phase that can be well described by pervasive skill-biased technological change alone. A large inter-sector reallocation of employment took place in the first period, partly towards skill-intensive industries. At the same time, most industries upgraded their skill composition either by firing the low skilled or selective hiring. In the second period, industrial reallocation did not add to the overall increase in skill intensity. Skill upgrading has been

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[1] See section 2 for more details.

pervasive since the mid-1990's but it has slowed down. At the same time, the skill premium accelerated substantially. The available evidence suggests that after 1995, increasing demand for skill met a quite inelastic supply in the short run. On the other hand, the dramatic changes had a strong effect on the long-run supply of skilled labor: college enrollment rates soared. I show evidence that introduction of new (foreign) capital has been a major factor behind increasing demand for skill ever since the early 1990's. Its effects could become overwhelming partly because the other effects diminished, and partly because foreign ownership grew substantial.

I utilize a large body of data for the analysis, from household surveys, wages surveys, and firm balances linked to individual earnings data. *Section 1* describes the data. In *section 2,* I provide a very brief overview of the main trends and establish the dominant role of labor demand (as opposed to labor supply) in a formal analysis. I also identify the two phases of transition and show how the two periods differ in terms of supply and demand shifts. In the third part I analyze changes in the industrial composition of labor demand and establish the pervasive nature of skill upgrade after 1995. In the fourth section I estimate reduced-from earnings equations on matched employer-employee data in order to disentangle the possible forces behind the skill premium. The last part concludes.

1. Data

There are several large surveys in Hungary that can help answering our questions. On the other hand, each contains only parts of the necessary information. For some of the analyses in the paper that partial information is enough. For others I combined aggregates from different sources, for comparable groups.

The analysis of employment data is based on cross-sectional household surveys, for years 1987, 1989, and yearly from 1992; wage (after-tax earnings) data from establishment-based but individual level wage surveys, for years 1986, 1989, 1992, and yearly form 1994. I use firm- and industry-level variables based on balance sheet information. These data are linked to the individual earnings data and are available for varying periods, most of them starting at 1992 but not available for 1996. For descriptive analysis and to answer demand-supply questions, I analyze repeated cross-sections of employment (from the household surveys) and earnings (from the Wage Surveys), aggregated by gender, age, and education. The same household survey data are used for analyzing changes in industrial skill composition. For analyzing the relationship between returns to skill, firm and industry characteristics I use cross-sectional samples of the individual wage surveys with linked firm and industry information.[2]

I define skill in two ways: nonmanual occupations and the two higher levels of education, 12 grades (baccalaureate) and college (or more). Most results are robust to the choice of the skill group, with natural differences: effects are strongest for college educated, weakest for those with 12 grades, and nonmanual workers show an average. In most of the paper I emphasize the results for the college educated.[3] Other measurement issues will be addressed along the analysis.

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[2] In terms of data sources, the paper makes use of five different surveys. These are the following. (1) The 1988 Household Income Survey Hungarian of the Central Statistical Office (CSO); it provides us with detailed employment data for the year 1987. (2) The 1990 Census provides us with participation, unemployment and self-employment data for the year 1989. Note that neither (1) nor (2) measure unemployment in a standard way. That is not an issue for 1987 as unemployment was non-existent those days, but the 1989 figures are susceptible to the problem. (3) From 1992 on, the CSO has been conducting a Labor Force Survey on a quarterly basis. Among other things, this survey contains standard measures of participation and unemployment, but it does not contain any information about earnings. I use the annual series of the Quarter 2 surveys because those are comparable in timing with the wage data (see next) and they suffer the least from seasonal effects. (4) The Wage Surveys of the National Labor Center provide us with the earnings data from 1986, 1989, 1992, and yearly from 1994 to 1999. The data are collected from the employers and they cover only wage/salary employees who work at firms with more than 10 employees (20 before 1995). (5) Firm and industry-level data from firm balance sheets with capital, labor utilization, revenues and ownership information, matched to the Wage Survey data. For more detailed description of the data see Ábrahám and Kézdi (2000), Halpern and Kőrösi (2000) and Kertesi and Köllő (1999 and 2001a). I thank Gyula Nagy for the most recent Labor Force Surveys, Gábor Kertesi and János Köllő for the Wage Surveys, and Gábor Kőrösi for the firm and industry-level data.

[3] The Hungarian education system is based on an 8-grade elementary school, a 3-grade vocational or 4-grade high-school training (11 and 12 grades, respectively), followed by college and university degrees. In 1999, 55% of the 30-34 years old completed 0-11 degrees of education, 31% had 12 degrees, and 14% had college or more. The same figures for the 55–59 years old are 65%, 22%, and 13%. Socialist Hungary had been successful in increasing the level education up to the 12th grade but not further. Since this paper focuses on the increasing returns to skill, differences among the unskilled will not be analyzed: the 0—11 grades group will not be disaggregated.

2. General trends: falling employment and increasing demand for skill

2.1 Employment

Total employment in Hungary decreased from 4.8 million in 1987 to 3.5 million in 1996. It increased to 3.7 million by 1999, as shown in *Table 1*. Virtually all the jobs were lost by the least educated. Between 1987 and 1996, employment of those with 11 grades or less fell from 3,1 to 1,9 million (-38%), compared to 1,17 to 1,09 million (-7%) for those with 12 grades, and 0,56 to 0,54 million (-5%) for the college educated. All (net) job destruction took place outside public administration, health, and education. Employment outside those sectors fell from 4 million in 1987 to 2.7 million in 1995, which meant one third of all jobs destroyed.

Figure 1 shows trends in labor market participation (employment + unemployment), employment, wage/salary employment (basically employment – self-employment), and full-time wage/salary employment rates, in the three education groups, among the 15–59 years old.[4] Not only changes in employment but changes in self-employment and part-time work are also correlated with education. The number of self-employed (not wage/salary employment) decreased for the less educated while increased substantially for the college educated, and the same is true for part-time employment.

The adjustment to dropping employment took place through both unemployment and nonparticipation. National unemployment rate rose from zero to 14 per cent by 1993 and declined to 8 per cent in 1999. Nonparticipation lags unemployment, which suggests that part of it is passive long-term unemployment. *Figure 2* shows the trends in unemployment rate and nonparticipation rate by education. Again, the three education groups experienced very different levels. The unemployment rate differences have been virtually constant throughout the whole period: for those with 0-11 grades of education it has been twice that of people with 12 grades and five times that of people with 13 or more grades. Differences in nonparticipation have also been stable between the most and the least educated.

[4] The upper bound of the age range reflects an average of pre-retirement age. Participation above 60 has been virtually zero, so focusing on the usual 15–74 years old population gives the same pictures shifted downwards. Those figures are available upon request.

At the same time, those with 12 grades started very close to the college educated but experienced a steady growth in nonparticipation.

2.2 Earnings

An important feature of the transition was a radical drop in the fraction of wage/salary employment. The early 1990's saw an enormous increase in self-employment and small company ownership, especially among the most educated. By the late 1990's non-wage employment among the less educated dropped behind pre-transition levels but remained high for the more educated. Incorporating oneself has been possible since the new legal framework for businesses of 1989, and it has become a popular way to avoid taxes and social security contributions. Although it was not feasible for all occupations, the large increase in the fraction of non-wage earners among the most educated, and especially among prime age college-educated men, implies a widespread phenomenon.

The benefits of incorporating oneself have been higher the more productive one was (probably in a progressive way), whereas the costs have been fairly fixed (or at least regressive). Therefore, higher productivity earners became self-employed or owners of small businesses with a higher probability. This phenomenon is unfortunate not only for government revenues but also for our empirical analysis. The earnings data we have are representative for the self-selected subpopulation of wage/salary earners in firms with at least 10 employees. The plausible direction of self-selection implies that the left-out subpopulation has had higher average earnings, probably even after controlling for observables. Since the trends differ by education, we probably underestimate not only skill-related earnings differences but also their increase during the 1990's.[5]

Those keeping in mind let us turn to changes in relative earnings. *Figure 3* shows after tax earnings relative to the year-specific average for the three education groups, by gender. At the aggregate level, earnings of the college educated rose from 1.4 times the average in 1986 to 1,7 times that in 1999. At the same time, people with less than 12 grades decreased from

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[5] Another possible problem is that wages under the socialist system were not taxed at the individual level. But we can probably ignore that for our analysis. In Hungary, personal income tax was introduced in 1987 in such a way that kept after-tax earnings unchanged for most of the work force. 1986 earnings are therefore comparable to after-tax earnings later.

0,9 of the average to 0,7 of that. Returns to skills have increased a lot more outside public administration, health, and education: the comparable figures are 1,5 to 2,1 for the college educated. These trends were substantially more pronounced among men. The slower growth in educated young women's relative wage is in large parts due to their large employment in public services, especially education and health. Outside public administration, health, and education, college-educated women and men have experienced more similar earnings growth.[6] Relative earnings of the best-educated men and women in the private sector soared after 1995, the starting year of economic recovery in Hungary. Together with slow employment growth for the group this suggests an increasing demand and a rather inelastic supply. The results in section 2,3 will show that this phenomenon has dominated the late 1990's in Hungary.

2.3 Two phases of demand and supply trends

Relative earnings and employment comove in the large demographic groups I examined in the previous section. Not surprisingly, this implies that the enormous changes in the Hungarian labor market were driven by labor demand. In this section I analyze the question in a more formal way. Such an analysis is valuable also because it allows one to distinguish periods in which supply and demand changes were different.

In what follows I analyze an aggregate panel for groups defined by age, gender, and education. Recall that the employment and wage aggregates come from different sources. Matched aggregates are valid observations for analysis only if those samples are representative to the groups. If moreover the survey variables are compatible through time, an aggregate panel database can be built from the yearly surveys. For more details about aggregate panel models, see Deaton (1997, Chapter 2). Compatibility of the variables is a key issue and is especially important when the analyzed country has witnessed the enormous changes transition economies did. Ábrahám and Kézdi (2000) address the issue for the datasets analyzed here and conclude that the data are compatible.

Estimation and statistical inference from the aggregate data is also complicated because each variable is an estimate itself and is therefore measured with sampling error. This measurement error is of classical na-

[6] In a different paper (Kézdi, 1999) I have provided a more detailed examined the relative decline of the skill premium in the government sector.

ture, and it therefore makes the estimator for β biased towards zero. The bias is likely to be severe in first-differenced panel models, because first differencing reduces variation in the true variables and magnifies the error variation (this point was first made by Griliches and Hausman, 1981). I derive the approximate bias and estimate it in the Appendix. The results indicate that the measurement error bias is substantial but it does not change the results qualitatively. Below I present point estimates and standard errors both with and without the bias correction.

By examining year-to-year changes of employment and wages in the aggregate panel, one can test for positive comovements in these disaggregated demographic groups. Moreover, one can estimate the relationship within larger groups or shorter periods. Obviously, all we observe are realized price and quantity points, not demand or supply curves. All we can do, therefore, is to assess whether changes in demand or supply dominated the market. Positive comovement of prices and quantities implies that the major factor is changes in demand, while negative comovement implies the dominance of supply.

I have estimated the following model:

$$\Delta \ln\left(\frac{L_{it} / P_{it}}{L_t / P_t}\right) = \alpha + \beta \Delta \ln\left(\frac{W_{it}}{\bar{W}_t}\right) + \varepsilon_{it}\,, \qquad (1)$$

where i denotes the observations (5-year age groups × gender × 3 education groups), t time, L is employment, P is population, W is monthly after tax earnings, L and P without i subscripts denote within-year sums, while $\bar{W}_p$ is within-year average.[7] β is a reduced-form elasticity: it measures the percentage change in relative employment that corresponds to a one per cent change in relative wages, on average. A negative elasticity indicates the dominance of supply factors; shifts in the demand curve were of less importance if any. A positive coefficient implies the importance of demand factors. Zero elasticity corresponds to no change in employment when wages change, on average.[8]

I estimated the model for the Hungarian labor market for the whole period and for 1986–1995 and 1996–1999 separately. The choice of 1995

[7] All variables are measured as yearly changes, so the 1989–1992 log changes were divided by three, the 1986–1989 log wage changes also by three, the 1987–1989 log employment changes by two, and the 1992–1994 changes by two.

[8] This approach for disentangling supply and demand factors has been standard in empirical labor economics since Katz and Murphy (1992).

that divides the two subperiods can be justified on two grounds. First, the results ex post justify this division in that the two periods show remarkable differences. Second, 1995 was the year when a major stabilization program was introduced, which included fiscal restrictions, changes in monetary policy, and privatization of banks ant public utilities to foreign strategic investors. Quite naturally, the results of the analysis are very similar if one splits the sample with one or two years away.

Table 1 contains the results and *Table A1* in the appendix the summary statistics.[9] If we look at the whole period, the results are insignificant in general (and they are also sensitive to weighting). On the other hand, in the two subperiods separately, the qualitative results are conclusive (and robust to weighting). Relative employment and relative wages comoved strongly until 1995, while changes in employment were not related to wages after 1995. According to the bias-corrected estimates, between 1986 and 1995, a one per cent change in relative wages corresponds to a 3-5 per cent change in relative employment on average, with a larger response for women. After 1995, however, changes in relative wages became unrelated to changes in relative employment on average and also for both genders.

Recall that the two different periods experienced an opposite trend in employment. What we have in the first period is a sharp fall in the employment of the less skilled and a small or zero decrease in the employment of the skilled, accompanied by a steady increase in the relative price of skill. The second period experienced a further increase in the skill premium and a slow employment growth of all education groups. Together with the especially high growth rate of the skill premium after 1995 (*Figure 3*), this indicates increasing demand for college-educated labor force and inelastic supply.

2.4 The content of increasing demand for educated labor and responses in long-run supply

Transition had dramatically different effect on the different cohorts. In general, labor market experience accumulated (or degrees earned) through

[9] Estimates for the non-governmental sector (outside public administration, health, and education) gave qualitatively the same results and are not shown here. Standard error estimates are robust to heteroskedasticity and residual serial correlation. Observations were weighted by share in total employment; unweighted results are basically the same.

the years of socialism devaluated substantially after 1990. Along with increasing returns to education, the devaluation of labor market experience is a general result from Mincer-type cross-sectional wage equations run on transition labor market data.[10] An important consequence is that the wage disadvantage of young people relative to older cohorts has diminished throughout the whole period. The trend has been the most pronounced among the highest educated. *Figure 4* shows the significant increase in the wage of the college-educated 25–29 old and 30–34 old relative to the college-educated 40–54 old. All improved their position compared to the middle aged during the whole time period (except for 30–34 year-old of women until the mid-1990's), and these trends accelerated after 1995.

Since the majority of the 30–34 years old in the second half of the 1990's started and even finished university before 1990, these results suggest that it is socialist labor market experience rather than socialist education that lost from its value for the older cohorts. On the other hand, the steeper rise for the 25–29 years old together with the acceleration of the wages of the 30-34 years old in the late 1990's might reflect that markets do value post-socialist university education more. At this point, I leave this question open for further research.

As we concluded before, increasing demand for educated labor after 1995 met an inelastic supply in the short run. The same conclusion holds if we look at younger cohorts only. A regression on year-to-year changes of aggregate wages on year-to-year changes of employment of the form of equation *(1)* for the 20–29 years old gives a reduced-form elasticity of 4,9 (2,4) for 1987–1994 and 0,28 (0,74) for 1995–1999. In the long run, however, supply is expected to adjust as an increasing number of young people choose higher levels of education.

Figure 5 shows that that is exactly what have been happening in Hungary. Enrollment rates in the high-school and college ages started to rise right after 1989, from 56 per cent for the 15–19 and 9 per cent for the 20–24 years old, to 85 per cent and 29 per cent, respectively, by 1999. Enrollment rates of those in their late 20s have increased as well. All this happened when the size of these age groups actually increased (except the 15–19 old in the late 1990's). Kertesi and Köllő (2001*a*) present more direct evidence about this phenomenon: from administrative data, they estimate that college *inflow* increased by 150 per cent between 1990 and 1999. Besides the expansion of the Hungarian educational institutions, an increase

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[10] See Kézdi and Köllő (1999) for a survey of this aspect of the transition literature and a deeper examination of the problem in Hungary.

demand for education is obviously responsible for the trends. The families realized that education matters more, and they started to behave accordingly.

3. Industrial reallocation and skill upgrading

3.1 Overview

Net job destruction in agriculture, mining, and manufacturing was enormous. In 1987, more than 55 per cent of all people were employed in agriculture, mining, and manufacturing. By 1999, that fraction decreased to 35 per cent. Agriculture and food manufacturing destroyed 60 per cent of its jobs; employment in mining fell by 80 per cent, and by 40 per cent in manufacturing. Employment in metals industries fell by 73 per cent, while textiles, paper and publishing, and machinery experienced the least severe losses. Machinery is the only branch of manufacturing that has been a net job creator since 1995, with a 25 per cent increase to 1999.

A nontrivial part of people who lost their jobs in the above mentioned sectors found employment elsewhere. Employment increased in most other sectors from the very beginning of the transition, with the exception of transportation, research, and culture. In terms of absolute numbers, trade, hotels and restaurants produced the highest employment growth. Employment in public administration, health, and education grew a little until 1995 and has slightly declined since.

Industries with falling employment had used a high fraction of unskilled workers. Same is true, however, for a few job creators, notably the trade and most service industries. In terms of numbers, the major reallocation of employment took place between unskilled industries between 1987 and 1999. On the other hand, by the end of the 1990s, skill-intensive industries outside direct government control have produced the most spectacular growth. Capital-intensive sectors shrunk the most in the first period but no such relationship remained to the second period except for the exceptional increase of two low-capital but high-skill industries, computer software and "other business". At the same time, earnings of the college educated by industry grew more or less independently of the change in their share in employment. A notable exception is their relationship between foreign ownership. Inflow of foreign capital is positively correlated with increasing demand for skill, both in terms of fraction in employment and relative wages.

The picture is, therefore, rather complex. On one hand, the major reallocation of employment in the first phase of transition occurred between low-skilled industries and away from capital-intensive sectors. This suggests major shifts in industry-specific labor demand that are not directly related to skill. On the other hand, virtually all industries have gone through a major skill upgrade and increased returns to skill. Growth in the fraction of skilled employment has been uncorrelated with growth in returns to skill, for reasons not clear yet. At the same time, increasing demand for skill was positively correlated with the inflow of foreign capital. These phenomena suggest not only a major and pervasive increase in the demand for skill but also industry-related shifts in the demand for skill and imperfect substitutability of skill between industries.

3.2 Within and between industry components of the changing skill composition

In order to disentangle the importance of within and between-industry shifts of the demand for skill, in this section I look at simple industrial decompositions of changes in the fraction of skilled labor. The decomposition looks at whether within or between-industry changes dominated the trends. Berman, Bound, and Machin (1998) decompose the fraction of skilled manufacturing employees for developed countries in the 1980's, which fraction increased on average everywhere. Their motivation is to see whether skill upgrading was pervasive in all industries. They find dominance of within-industry skill upgrading and they interpret it as evidence for pervasive skill-biased technological change and against the role of changes in the pattern of international trade. The former explanation is then further supported by the fact that the same branches of manufacturing increased the fraction of skilled labor in the different countries. Comparing their results to the Hungarian experience would shed light on to what extent transition could be thought of as a special case of worldwide pervasive skill-biased technological change versus inter-sectoral reallocation of employment due to other factors.[11] For technological change to be dominant

[11] Dramatic changes in international trade could be an important source of changing demand for industrial composition of output and therefore of labor input. Deregulation of prices could be another such factor.

transition industries have to acquire up-to-date technology. Also, the skill structure of the socialist industries should have been no systematically different from that of the developed economies before the 1980's.

The decomposition isolates changes in the overall fraction of skilled workers into two components: the effect of shift of employment between industries and average skill upgrading within all industries. Let *L* denote employment, which consists of skilled (*S*) and unskilled (*U*) workers. Let lower case *s* denote the fraction of skilled. Index *j* denotes industry, *t* denotes time.

$$L_{jt} = S_{jt} + U_{jt}, \qquad s_{jt} \equiv \frac{S_{jt}}{L_{jt}}, \qquad s_t \equiv \frac{S_t}{L_t} = \frac{\sum_j S_{jt}}{\sum_j L_{jt}} = \sum_j \frac{L_{jt}}{L_t} s_{jt}$$

Then, the change in the fraction skilled can be decomposed to a within and a between industry term the following way.

$$\Delta s_t = s_t - s_{t-1} = \sum_j \left(\frac{L_{jt}}{L_t} s_{jt} - \frac{L_{jt-1}}{L_{t-1}} s_{jt-1} \right)$$
$$= \sum_j \frac{s_{jt} + s_{jt-1}}{2} \left(\frac{L_{jt}}{L_t} - \frac{L_{jt-1}}{L_{t-1}} \right) + \sum_j \frac{L_{jt}/L_t + L_{jt-1}/L_{t-1}}{2} \left(s_{jt} - s_{jt-1} \right) \quad (2)$$
$$\equiv \Delta B_t + \Delta W_t$$

Table 2 presents the estimates for the average yearly between and within changes of the fraction of college-educated employees, in Hungary, in percentage points.[12] The first and second period of transition (before and after 1995) are analyzed separately. The modern standard of industrial classification (NACE) was introduced in 1992 so the beginning of the transition can be analyzed only by broader industry (see the previous section). The table shows results for the whole Hungarian economy and separately for manufacturing.

The results indicate that economy-wide skill upgrading was primarily a result of inter-sectoral reallocation of employment in first period of the

[12] Berman, Bound, and Machin (1998) look at the fraction of nonproduction workers. Skill upgrading is defined here as an increase in the fraction of college-educated workers because education is probably a better measure of skill than the production-nonproduction worker distinction but Berman et al. did not have that information available. The share of within-industry changes in Hungary is very similar whether one looks at people with 12 grades or more, or nonproduction workers.

transition but within-industry changes dominated the second period. Moreover, within changes were stronger in manufacturing even the first period.

The first period of transition was characterized by inter-sectoral reallocation of labor that favored skill-intensive industries. Earlier results show that the first period has also seen a large-scale reallocation between unskilled industries. The collapse of the socialist system probably changed many things that affected labor demand. It is, therefore, not surprising that changes in the skill-composition of employment cannot be explained simply by technological change. On the other hand, trends in the second period can be thought of as results of a pervasive skill-biased technological change that affected all Hungarian industries. Moreover, inter-industry reallocation of labor did not dominate skill upgrading in manufacturing even in the first period. Therefore, the pervasive technological change analogy seems to be valid in the case of manufacturing throughout the whole transition.

On the other hand, looking at which industries experienced larger skill upgrade than the others invokes caution against the simple technological change interpretation. Comparing the Hungarian experience to trends in the developed world for the 1970–80 and 1980–90 time periods reveals that if anything, there is a weak negative correlation between industry-specific changes in the skill composition.[13] For example, machinery, electronic machinery, printing and publishing, and transportation equipments are on the top of the international list but are among the zero skill upgrade industries in Hungary. At the other extreme, petrol refinery, paper products, and tobacco top the Hungarian list but are at the bottom in the developed world. Two reasons may be responsible for this. First, new technology introduced in Hungary may be different from new technology in the developed world. Second, the initial structure of the Hungarian economy might have been very different from the initial (pre-1970s) structure of the developed world.[14]

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[13] Berman at al. publish the average within-industry changes in the fraction of nonproduction workers for the 9 developed countries they examine. The zero or weak negative correlation with the Hungarian changes holds regardless of time period and the definition of skilled workforce.

[14] It may seem that another possible explanation is that the Hungarian analysis looks at a short time period when supply of skilled labor was fixed within the economy (see the previous sections). Changes in quantities, therefore, are not the best measures of changes in demand. Examining industry-specific wage dynamics might be more fruitful. As we have seen, however, the largest increase in the wage premium took

4. Skill premium and firm and industry characteristics

We can get more insight into why the skill premium has changed over time if we relate it to measured firm and industry characteristics. In order to do that I combined individual earnings data with firm and industry level data. In particular, I have estimated individual earnings functions with firm and industry level variables interacted with the employee's skill level. Formally, for each available survey year, I have estimated the following two equations on the firms sector (no public administration, health, education, and cultural activities).

$$\ln w_{ijk} = \alpha_k + \beta_1 s_{ijk} + F_{jk}'\beta_2 + s_{ijk} \times F_{jk}'\beta_3 + x_{ijk}'\gamma + \varepsilon_{ijk}, \text{ a} \qquad (3)$$

$$\ln w_{ijk} = \alpha_k + \beta_1 s_{ijk} + F_{jk}'\beta_2 + s_{ijk} \times F_{jk}'\beta_3 + I_k'\beta_4 + s_{ijk} \times I_k'\beta_5 + x_{ijk}'\gamma + \varepsilon_{ijk} \qquad (4)$$

i denotes the individual, *j* the firm, and *k* is the index of industry (3-digit SIC). *w* is after-tax total yearly earnings adjusted for inflation; *s* is a measure of skill of the individual, while *x* contains other individual characteristics (gender, potential labor market experience, its square, and a binary variable indicating 60 years old or older). For keeping things simple, the only measure of skill I present estimates for is college education.[15] *F* is a vector of firm characteristics, and *I* is a vector of industry characteristics, and both enter the equations interacted with the individual skill variable. The two equations were estimated separately because the industry level variables are available only for years 1992–1998 (except for 1996), while most firm level variables are available throughout the whole period.

The parameters of major interest are the interaction coefficients, β_3 and β_5. They show how the extra earnings advantage of the college educated over the other employees is related to the particular firm or industry variable, on top of the economy-wide college wage premium β_1. (To be more precise, the interpretation of β_1 is the wage premium for firms and industries with zero values of all *F* and *I* variables.) The non-interacted firm and industry coefficients β_2 and β_4 measure the earnings advantage of the non-college educated in relation with the variables. The overall earnings advantage of the college educated that is related to the firm or industry level variables is the sum of the pure and interaction parameters ($\beta_2+\beta_3$ and

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place in industries different from the most favored ones in the developed countries. Therefore I do not pursue this explanation.

[15] Results from alternative specifications are similar and are available upon request.

$\beta_4+\beta_5$). *Tables 3* and *4* present the estimated coefficients from the two equations, respectively, while *Tables A2* and *A3* show the summary statistics.

One of the most important results is an increasing effect of the firms' capital-labor ratio on the skill premium.[16] It is modest in magnitude: by the end of the 1990s, a one percent increase in the capital-labor ratio raises the earnings of the college-educated by 0.02 percent more than the earnings of the rest. This effect is however significant, robust to inclusion of industry-level variables, and shows a rather steady increase from around zero (*Table 3*). The trend of the overall wage advantage of employees in capital-intensive firms is the mirror image of that of the skill premium. Starting from a statistically significant positive value, it has gradually decreased to zero. This tells us that capital-intensive firms offered higher wages to everybody in the late 1980s, but only the most educated were able to keep this advantage. One interpretation of this phenomenon is a decreasing complementarity of capital and unskilled labor and an increasing capital-skill complementarity. Using a more structural approach, Kertesi and Köllő (2001b) arrive to a similar conclusion about the dynamics (though not the levels). On a subsample of large firms, they estimate elasticities of substitution between young skilled, older skilled, and unskilled labor, and capital (also known as Hicks-Allen elasticities). Their estimates suggest that capital and labor had been substitutes for all types of labor before the transition, but skilled labor has become largely independent of capital by 1999. These are clearly at odds with my interpretation of the estimated positive reduced-form coefficients, although those estimates are not large in magnitude, either. In any case, the trends are the same: skilled labor had become more complementary to (less substitutable for) capital.[17]

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[16] Note that the equations control for firm size so that variation in the ratio reflects variation in capital when everything else is held constant. Firm size is number of employees, and it is controlled in a nonlinear fashion. Adding linear employment to the equation does not change the coefficient on the capital-labor ratio.

[17] The interpretation of increasing capital-skill complementarity is not the only possible one. Also note that it is based on variation in the level but not the price of capital, and therefore it is not an appropriate measure of complementarity. On the other hand, measuring the user cost of capital is extremely problematic in economies in transition. As a result, identification through cross-sectional variation of some measure of it is questionable.

Labor productivity (GDP over employment) does not seem to be related to the skill premium itself.[18] The estimated coefficients are either zero or small negative, and always a lot smaller than the coefficient on the non-interacted variable. There is a steady increase in earnings advantage as labor productivity increases for everybody employed at the firm. By 1999, that advantage has become not only statistically but also economically significant: a one percent increase in labor productivity is associated with more than one fifth of a percent advantage in terms of after tax earnings. The results are robust across the two specifications. Average firm productivity seems to matter for everybody and the most educated don't seem to benefit more from it than others.

The ownership results are quite robust.[19] Employees of state-owned firms have earned slightly more than those under domestic private ownership in 1992 but increased their advantage to a significant 11 per cent by 1999. College-educated added further to that advantage in a way that parallels the overall increase, with virtually zero in 1992 but an additional 6 percent in 1999. Employees under dominant foreign ownership have had their steady 10-13 per cent advantage throughout the 1990s. The skill premium on top of all this, on the other hand, has increased from 7 to almost 16 percent. The interpretation of the ownership results is probably complex. State-owned firms probably operate under a soft budget constraint that allows paying more for everybody. The highest educated employees may have better bargaining power and that what the skill interaction shows. If state ownership is more prevalent in less competitive sectors, there is also excessive rent to be shared. This is indirectly supported by the fact that both the overall advantage and the skill premium are smaller if we control for the concentration level in the industry (*Table 4*).

Foreign ownership, on the other hand, is hardly associated with soft budget constraints. Rent sharing does not seem to be an important part of the picture either, since foreign ownership has the same effect if we hold constant the concentration of the industry. One possible interpretation of the results is that foreign ownership is associated with technology renewal.

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[18] As noted before, labor productivity is the (scaled) sum of capital's share and total factor productivity (TFP). Therefore, variation in labor productivity mostly reflects variation in total factor productivity when both employment and the capital to labor ratio is held constant. The interpretation of the coefficient, therefore, is probably close to TFP, the more natural notion of productivity.

[19] Ownership is not an issue for firms before 1990 since the overwhelming majority of firms was owned by the state.

New technology is more skill-intensive (the developed world has seen the consequences of this from the early 1980s, see for example the Berman et al. study), and it increases the marginal product of labor. Selection of the best employees to foreign firms may be therefore substantial, on characteristics that are not captured in the data.[20] Therefore the substantial earnings advantage for everybody. Marginal product differences among the highest educated may be the largest, and therefore selection among them may be the strongest. Kertesi and Köllő (2001*a*) provide some direct evidence in support of this interpretation. They analyze data from an EBRD survey conducted in 2000 in order to study technological study and its implications for labor demand.[21] The survey contains data from interviews with managers. Questions about technological innovations and their labor savings implications were asked, along with hiring preferences. Kertesi and Köllő estimate that foreign firms prefer younger workers significantly more than domestically owned firms, but this difference disappears when technological innovations are held constant. We know that young skilled employees earn a lot more these days compared to older skilled workers than in the past, and that is possibly because they adapt more easily to new technologies. Foreign firms prefer them for the reason they use newer technology.

New capital is part of new technology. Although there are elements of new technology that increase productivity without increasing the capital stock, part of the growth of labor productivity should be due to capital inflow. The fact that capital – skill complementarity is estimated to be small, if any, is therefore a puzzle. One possible explanation is that real value of capital is measured with error, and measurement error makes regression coefficients be biased toward zero. In that case, foreign ownership might be a better proxy for the market value of capital than the book value. That interpretation is obviously consistent with my results. Problem is that it is not possible to check its validity with the data at hand. We have no good information about how badly capital is measured, and its measurement error is probably not of a classical nature. Without additional data this question remains open.

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[20] Kertesi and Köllő (2001*a*) show that an even more pronounced difference can be found among the young and educated, which, according to the interpretation here, corresponds to an even stronger selection among them.

[21] They use the Hungarian subsample. Romanian and Russian firms were also interviewed. See EBRD (2000).

Firm size (measured in employment) was not very important before the transition but became a very strong and monotonic predictor of overall wages by 1999. Employees in small firms (11–20 people) earn 30 percent less than those in medium firms (51–300 people), who, in turn, earn7 percent less than employees in the largest firms (more than 3000 people). It is very possible that these figures reflect measurement problems: smaller firms may pay more in-kind or just out-of-the-books benefits in order to avoid high taxes. Controlling for industrial concentration does not change these figures, which also supports the measurement error interpretation. Measurement problems are, however, hard to evaluate as discussed before, and I do not attempt that here. On the other hand, the inverted U-shape of the skill premium (college-educated earned 15–20% less in large and small firms than in medium ones in 1999) remains a puzzle under that hypothesis. The phenomenon has been around since the late 1980s and has become slightly stronger since.

Industrial characteristics have modest and rather unstable association with overall earnings advantages and the skill premium. Contract work[22] is an exception although not a very important one (it is 1–2 percent of the aggregate turnover, see *Table A2*).[23] Contract work in an industry has been negatively associated with overall wages, with a decreasing disadvantage from around 10 to 4 percent. The skill premium has followed a completely opposite path from an imprecisely estimated 40% advantage in 1992 down to 2% in 1999. Apparently, the highest educated could draw some rent in those industries in the beginning but that opportunity has vanished. In 1992, concentration level in the industry has had a significant effect on overall wages with less so for college educated. By 1999, however, those rent opportunities has seemed to vanish, too. Remember though that state ownership and industrial concentration seem to interact and increase overall wages together. Sectors that were not dominated by state owned firms, however, industrial dominance does not seem to have a significant effect. Share of export in revenues has a small and unstable association with overall wage level and the skill premium after controlling for foreign ownership.

The results provide support for the role of technological innovation in the skill premium through foreign ownership. The increasing overall effect of firm productivity on wages was established, without significant rela-

[22] Production is based on imported technologies and material and under foreign control but without foreign ownership and capital inflow.

[23] High standard errors also reflect the small magnitude of contract work.

tionship to the skill premium. In addition, some week evidence was shown for capital-skill complementarity. Measurement problems however seem to undermine a more direct investigation.

5. Conclusion

A substantial increase in the demand for skill has dominated the Hungarian labor market since the beginning of the transition. The first period of transition (1987–1995) experienced major net job destruction, while employment started to rebound in the second period. The bias toward skilled labor has been steady through the two phases. In the first period, a major between-industry reallocation took place in terms of employment and also skill intensity. The second period was dominated by a pervasive skill upgrade in all non-governmental industries.

Increasing demand for skill met a fixed short-run supply in the late 1990s. In the long run, however, supply of skilled labor seems to be very elastic. College enrollment increased substantially, which indicates a strong feedback from the labor market to people's schooling decision.

Although selection issues and the reduced-form nature of the analysis does not permit causal inference, the result seem robust enough to make some conclusions. Introduction of new technology and new capital are among the most important factors behind increasing demand for skill. Direct measurement of these effects is not feasible, but foreign ownership can be used as a proxy for new technology and capital. Earnings at all skill levels are significantly higher in those firms, which suggests strong selection on unobserved skill. These results are even stronger for the highest educated. Together with the pervasive nature of the skill upgrading in all industries, this suggests that increasing returns to skill in Hungary fit into the worldwide trends of skill-biased technological change. On the other hand, the largest increase in the demand for skill has taken place in different industries than in the developed world. That suggests that either the new technology is of a different nature in Hungary, or the initial conditions were very different.

By the end of the 1990's, the Hungarian labor market showed trends that are remarkably similar to those in the developed world. Foreign capital played a significant role in bringing those changes about. This suggests that countries that will attract significant amount of foreign capital will possibly make the transition in the labor markets in similar ways.

An interesting question remains to be answered at the end. Is transition over in Hungary, at least from a labor market perspective? According to the definitions considered by Svejnar (2002), it probably is. Both labor demand and labor supply shows features that are similar to those experienced in most modern capitalist countries. At the same time, however, older and low-educated people seem to fit less into the new situation. From the viewpoint of social experience, therefore, it may take almost a whole generation for the transition to be over.

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APPENDIX

Estimating the measurement error bias due to survey estimates in the first regression model (change in log relative employment rate regressed on change in log relative wages)

Since both n and w are estimates from survey samples, the estimated β is biased toward zero. In this section, I estimate the bias. The assumption throughout is that both n and w are prone to excess variation independent of their true value, n^* and w^*, respectively. In our case, this is likely to be the case since both are survey means, and the excess variation is due to sampling error. Formally, we assume that

$$W_{it}=W_{it}^{*}+\xi_{it}\,, \qquad \xi_{it} \sim \text{i.i.d. with variance } \sigma_{\xi}^{2}$$

$$L_{it}/P_{it}=(L_{it}/P_{it})^{*}+\zeta_{it}\,, \qquad \zeta_{it} \sim \text{i.i.d. with variance } \sigma_{\zeta}^{2}$$

The OLS estimator of β is defined as

$$\hat{\beta}=\frac{Cov\left[\Delta\ln\left(\frac{L_{it}/P_{it}}{L_t/P_t}\right),\Delta\ln\left(\frac{W_{it}}{\bar{W}_t}\right)\right]}{Var\left[\Delta\ln\left(\frac{W_{it}}{\bar{W}_t}\right)\right]}$$

The bias occurs because, while the covariance in the denominator equals covariance of the true variables, the denominator is larger than the true variance because of the excess variation.

To keep things simple, I derive the results wihtout weighting. The weighted results are straightforward generalizations of the unweighted ones, by using weighted means, variances, and covariances.

Denominator:

$$Var\left[\Delta\ln\left(\frac{W_{it}}{\bar{W}_t}\right)\right]=Var\left[\ln\left(\frac{W_{it}}{\bar{W}_t}\right)\right]+Var\left[\ln\left(\frac{W_{it-1}}{\bar{W}_{t-1}}\right)\right]-2Cov\left[\ln\left(\frac{W_{it}}{\bar{W}_t}\right),\ln\left(\frac{W_{it-1}}{\bar{W}_{t-1}}\right)\right]$$

$$=Var\left[\ln\left(\frac{W_{it}}{\bar{W}_t}\right)\right]+Var\left[\ln\left(\frac{W_{it-1}}{\bar{W}_{t-1}}\right)\right]-2Cov\left[\ln\left(\frac{W_{it}}{\bar{W}_t}\right)^{*},\ln\left(\frac{W_{it-1}}{\bar{W}_{t-1}}\right)^{*}\right]$$

using the unbiasedness of the covariance, which will be established later. For each t, we have that

$$Var\left[\ln\left(\frac{W_{it}}{\bar{W}_t}\right)\right]=Var\left[\ln\left(W_{it}^*+\xi_{it}\right)\right]+Var\left[\ln\left(\bar{W}_t^*+\bar{\xi}_t\right)\right]-2Cov\left[\ln\left(W_{it}^*+\xi_{it}\right),\ln\left(\bar{W}_t+\bar{\xi}_t\right)\right]$$

Let us forget about the last term. The covariance is positive and small, and therefore this simplification will slightly *overstate* the bias. The two other terms can be expressed, using the delta-method, as

$$Var\left[\ln\left(W_{it}^*+\xi_{it}\right)\right]\approx\left[\left.\frac{\partial\ln\left(W_{it}^*+\xi_{it}\right)}{\partial\left(W_{it}^*+\xi_{it}\right)}\right|_{\bar{W}_t}\right]^2 Var\left[W_{it}^*+\xi_{it}\right]=\frac{1}{\left(\bar{W}_t^*+\bar{\xi}_t\right)^2}Var\left[W_{it}^*+\xi_{it}\right]\approx\frac{Var\left[W_{it}^*\right]+\sigma_\xi^2}{\bar{W}_t^2}$$

$$=\left[\left.\frac{\partial\ln\left(W_{it}^*\right)}{\partial\left(W_{it}^*\right)}\right|_{\bar{W}_t}\right]^2 Var\left[W_{it}^*\right]+\frac{\sigma_\xi^2}{\bar{W}_t^2}\approx Var\left[\ln\left(W_{it}^*\right)\right]+\frac{\sigma_\xi^2}{\bar{W}_t^2}$$

$$Var\left[\ln\left(\bar{W}_t^*+\bar{\xi}_t\right)\right]\approx\left[\left.\frac{\partial\ln\left(\bar{W}_t^*+\bar{\xi}_t\right)}{\partial\left(\bar{W}_t^*+\bar{\xi}_t\right)}\right|_{\bar{W},\bar{\xi}}\right]^2 Var\left[\bar{W}_t^*+\bar{\xi}_t\right]=\frac{1}{\left(\bar{W}_t^*+\bar{\xi}_t\right)^2}Var\left[\bar{W}_t^*+\bar{\xi}_t\right]\approx\frac{Var\left[\bar{W}_t^*\right]+\frac{1}{n}\sigma_\xi^2}{\bar{W}_t^2}$$

$$=\left[\left.\frac{\partial\ln\left(\bar{W}_t^*\right)}{\partial\left(\bar{W}_t^*\right)}\right|_{\bar{W}}\right]^2 Var\left[\bar{W}_t^*\right]+\frac{\sigma_\xi^2}{n\bar{W}_t^2}\approx Var\left[\ln\left(\bar{W}_t^*\right)\right]+\frac{\sigma_\xi^2}{n\bar{W}_t^2}$$

Therefore,

$$Var\left[\ln\left(\frac{W_{it}}{\bar{W}_t}\right)\right]\approx Var\left[\ln\left(W_{it}^*\right)\right]+\frac{\sigma_\xi^2}{\bar{W}_t^2}+Var\left[\ln\left(\bar{W}_t^*\right)\right]+\frac{\sigma_\xi^2}{n\bar{W}_t^2}=Var\left[\ln\left(\frac{W_{it}}{\bar{W}_t}\right)^*\right]+\frac{(n+1)\sigma_\xi^2}{n\bar{W}_t^2}$$

and so

$$Var\left[\Delta\ln\left(\frac{W_{it}}{\bar{W}_t}\right)\right]=Var\left[\ln\left(\frac{W_{it}}{\bar{W}_t}\right)^*\right]+\frac{(n+1)\sigma_\xi^2}{n\bar{W}^2{}_t}+Var\left[\ln\left(\frac{W_{it-1}}{\bar{W}_{t-1}}\right)^*\right]+\frac{(n+1)\sigma_\xi^2}{n\bar{W}_{t-1}{}^2}-2Cov\left[\ln\left(\frac{W_{it}}{\bar{W}_t}\right),\ln\left(\frac{W_{it-1}}{\bar{W}_{t-1}}\right)\right]$$

$$=Var\left[\Delta\ln\left(\frac{W_{it}}{\bar{W}_t}\right)^*\right]+\frac{(n+1)\sigma_\xi^2}{n\bar{W}^2{}_t}+\frac{(n+1)\sigma_\xi^2}{n\bar{W}_{t-1}{}^2}\approx Var\left[\Delta\ln\left(\frac{W_{it}}{\bar{W}_t}\right)^*\right]+2\frac{\sigma_\xi^2}{\bar{W}^2}$$

Numerator

Using the same tricks as before, it is fairly straightforward to show that

$$Cov\left[\Delta\ln\left(\frac{L_{it}/P_{it}}{L_t/P_t}\right),\Delta\ln\left(\frac{W_{it}}{\bar{W}_t}\right)\right]=Cov\left[\Delta\ln\left(\frac{L_{it}/P_{it}}{L_t/P_t}\right)^*,\Delta\ln\left(\frac{W_{it}}{\bar{W}_t}\right)^*\right].$$

The proof is left for the reader.

The bias

At the end of the day, we have that

$$p\lim\hat{\beta}=\frac{p\lim Cov\left[\Delta\ln\left(\frac{L_{it}/P_{it}}{L_t/P_t}\right),\Delta\ln\left(\frac{W_{it}}{\bar{W}_t}\right)\right]}{p\lim Var\left[\Delta\ln\left(\frac{W_{it}}{\bar{W}_t}\right)\right]}\approx\frac{Cov\left[\Delta\ln\left(\frac{L_{it}/P_{it}}{L_t/P_t}\right)^*,\Delta\ln\left(\frac{W_{it}}{\bar{W}_t}\right)^*\right]}{Var\left[\Delta\ln\left(\frac{W_{it}}{\bar{W}_t}\right)^*\right]+2\frac{\sigma_\xi^2}{\bar{W}^2}}=\beta\frac{Var\left[\Delta\ln\left(\frac{W_{it}}{\bar{W}_t}\right)^*\right]}{Var\left[\Delta\ln\left(\frac{W_{it}}{\bar{W}_t}\right)^*\right]+2\frac{\sigma_\xi^2}{\bar{W}^2}}$$

OLS is inconsistent: its limit is off approximately by the bias factor

$$Var\left[\Delta\ln\left(\frac{W_{it}}{\bar{W}_t}\right)^*\right]\Big/\left\{Var\left[\Delta\ln\left(\frac{W_{it}}{\bar{W}_t}\right)^*\right]+2\frac{\sigma_\xi^2}{\bar{W}^2}\right\}=\left\{Var\left[\Delta\ln\left(\frac{W_{it}}{\bar{W}_t}\right)\right]-2\frac{\sigma_\xi^2}{\bar{W}^2}\right\}\Big/Var\left[\Delta\ln\left(\frac{W_{it}}{\bar{W}_t}\right)\right]$$

It is the right-hand side of this equality that is estimable since the true variables are unobserved. We can estimate the bias if we have an estimate for σ_ξ^2. Since the W_{it} are sample means per cell, a consistent estimator for their sampling variance is the within-cell vraiance ($\mathrm{Var}_i(W_{it})$) devided by the sample size within the cell (n_i). The average within-cell variance ($\mathrm{avg.Var}_i(W_{it})$) and average sample size (avg. n_i) are going to be used as a first-order approximation. Evidently, the denominator (of the right-hand side expression) is known: it is the variance of the righ hand side variable (Var(RHS)). The square of the average wage ($W_t\mathrm{bar}^2$)is also known from the sample (again, its overall mean $W\mathrm{bar}^2$ will be used for first-order approximation). The calculated bias estimates for the relevant equations are shown in the next table:

Table: **Estimates for the Bias Factor of OLS.** 1 = unbiased.

	1986-1995	**1995-1999**	**1986-1999**
Weighted			
Whole Sample	,68	,46	,26
Men	,64	,44	,27
Women	,63	,53	,33
Unweighted	,64	,44	,27
Whole Sample	,49	,82	,72
Men	,52	,84	,76
Women	,49	,78	,67

The bias is substantial because there is a lot of wage variation within cells, and because the variance of the right-hand-side variable is small.

Table 1.

Percentage change in relative employment corrseponding to one percent change in relative wages: estimated reduced-form elasticities
(standard errors: small size italic)

	Raw estimates			Estimates corrected for measurement error bias		
	1986-1995	*1995-1999*	*1986-1999*	*1986-1995*	*1995-1999*	*1986-1999*
Whole Sample	1,95	0,00	0,26	2,87	0,00	1,00
	0,52	*0,38*	*0,28*	*0,76*	*0,83*	*1,08*
Men	1,86	0,00	0,34	2,91	0,00	1,26
	0,54	*0,22*	*0,16*	*0,84*	*0,50*	*0,59*
Women	2,81	-0,51	0,06	4,46	-0,96	0,18
	1,10	*0,93*	*0,86*	*1,75*	*1,75*	*2,61*

observations: yearly observations for age5 X gender X education3 cells
specification: dln(relative emp rate) = a + b*dln(relative wage)
weighted by share in employment

Table 2.

Robust standard errors with arbitrary clustering in the cells (i.e. allowing for any kind of heteroskedasticity and serial correlation in the error term)

	Share in total employment (%)	Share of college educated (%)	Capital per labor ratio	Yearly % change in employment		
	1987	1987	1987	1987–95	1995–99	1987–95
Agriculture, Food, Wood	21,5	4,7	0,3	-6,8	-1,1	-4,9
Mining	2,1	5,2	0,7	-8,1	-8,7	-8,3
Textiles, paper, pub.	7,2	3,9	0,2	-3,1	1,8	-1,4
Chemicals & petrol	2,8	10,1	1,0	-6,2	-1,7	-4,7
Non-metals manuf.	1,6	6,0	0,5	-7,1	-1,1	-5,1
Metals manufacturing	1,8	5,9	0,7	-8,3	-4,9	-7,2
Machinery	10,0	7,4	0,2	-5,8	6,2	-1,8
Electricity, gas, & water	4,2	7,7	1,6	-5,6	-1,6	-4,3
Construction	6,4	6,0	0,1	-3,9	4,2	-1,2
Trade, hotels, restaur.	10,3	7,0	0,2	1,6	3,8	2,3
Transportation	6,4	5,6	0,5	-3,1	-0,6	-2,2
Post and telecom.	1,4	7,8	0,6	1,1	-0,9	0,4
Financial act., insurance	2,6	12,8	1,0	2,2	-1,8	0,8
Computer software	0,3	45,1	0,4	-3,3	13,9	2,5
Other business services	1,3	28,2	0,1	4,5	12,3	7,1
Other services + n.e.c.	4,7	10,9	0,3	-5,8	-5,4	-5,7
Research and devel.	0,7	47,1	n.a.	-8,1	-3,6	-6,6
Public admin., defense	4,5	27,1	n.a.	2,3	2,1	2,2
Education	5,7	52,9	n.a.	2,4	-2,2	0,9
Health and social work	3,9	20,7	n.a.	2,6	0,3	1,9
Recreation, culture	1,6	36,8	n.a.	-0,8	-3,0	-1,6
TOTAL	**100,0**	**11,8**	**n.a.**	**-3,3**	**1,2**	**-1,8**

Table 3.

Average yearly percentage point changes in the fraction of college-educated workers, within and between industry

		Total	Between	Within	% within
Hungary all,	1987–1995	0,47	0,33	0,14	30 %
broad industry	1995–1999	0,28	- 0,09	0,37	132 %
Hungary all,	1992–1995	0,35	0,39	-0,04	-11 %
NACE2	1995–1999	0,28	- 0,10	0,38	136 %
Hungarian manufacturing*,	1987–1995	0,20	- 0,03	0,23	115 %
broad industry	1995–1999	0,18	- 0,03	0,21	137 %
Hungarian manufacturing,	1992–1995	0,09	0,02	0,07	78 %
NACE2	1995–1999	0,11	0,00	0,11	100 %

* without food, beverages, and tobacco.

Table A1.

Summary Statistics: Log change on relative employment rate and log change of relative wages. Weighted by employment. Means and standard deviations

		1986–1995	1995–1999	1986–1999
Whole Sample	mean $dln[(L_i/P_i)/ (L/P)]$	-0,0161	-0,0227	-0,0201
	std $dln[(L_i/P_i)/ (L/P)]$	*0,1176*	*0,2329*	*0,1953*
	mean $dln[W_i/W]$	-0,0094	-0,0053	-0,0069
	std $dln[W_i/W]$	*0,0173*	*0,0331*	*0,0279*
Men	mean $dln[(L_i/P_i)/ (L/P)]$	-0,0214	0,0053	-0,0051
	std $dln[(L_i/P_i)/ (L/P)]$	*0,0998*	*0,1369*	*0,1240*
	mean $dln[W_i/W]$	-0,0155	-0,0010	-0,0067
	std $dln[W_i/W]$	*0,0168*	*0,0348*	*0,0299*
Women	mean $dln[(L_i/P_i)/ (L/P)]$	-0,0075	-0,0704	-0,0450
	std $dln[(L_i/P_i)/ (L/P)]$	*0,1425*	*0,3344*	*0,2753*
	mean $dln[W_i/W]$	-0,0021	-0,0105	-0,0071
	std $dln[W_i/W]$	*0,0151*	*0,0300*	*0,0254*

Table A2.

Individual earnings equation estimates. College education interacted with firm-leve variables (capital-labor ratio, labor productivity, firm size, and ownership). Firms sector only. Hungary, 1986–1999. blank cells: not available

Standard errors in small size italic

	1986	**1989**	**1992**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
ln(K/L) × college	-0,005 *0,004*	-0,009 *0,004*	0,015 *0,004*	0,007 *0,002*	0,012 *0,003*		0,020 *0,003*	0,021 *0,003*	0,029 *0,003*
ln(K/L)	0,026 *0,002*	0,011 *0,002*	0,018 *0,001*	0,005 *0,001*	0,009 *0,001*		0,016 *0,001*	-0,002 *0,001*	-0,002 *0,001*
ln(gdp/L) × college	-0,023 *0,005*	-0,007 *0,005*	-0,005 *0,005*	0,038 *0,004*	0,009 *0,004*		-0,010 *0,005*	0,001 *0,004*	-0,016 *0,004*
ln(gdp/L)	0,071 *0,002*	0,087 *0,002*	0,106 *0,002*	0,061 *0,001*	0,122 *0,002*		0,174 *0,002*	0,202 *0,002*	0,217 *0,002*
owner:state × college			0,013 *0,013*	0,101 *0,010*	0,065 *0,010*		0,089 *0,012*	0,038 *0,012*	0,065 *0,012*
owner:dom.private × college			ref. *ref.*	ref. *ref.*	ref. *ref.*		ref. *ref.*	ref. *ref.*	ref. *ref.*
owner:foreign × college			0,071 *0,017*	0,105 *0,011*	0,127 *0,009*		0,167 *0,011*	0,117 *0,010*	0,157 *0,010*
owner:state			0,015 *0,004*	0,020 *0,004*	0,017 *0,003*		0,051 *0,004*	0,076 *0,005*	0,113 *0,004*
owner:dom.private			ref, *ref,*	ref, *ref,*	ref, *ref,*		ref, *ref,*	ref, *ref,*	ref, *ref,*
owner:foreign			0,137 *0,006*	0,177 *0,004*	0,085 *0,003*		0,130 *0,004*	0,102 *0,004*	0,134 *0,004*
size: 11-20 × college					-0,127 *0,014*	-0,181 *0,014*	-0,170 *0,016*	-0,166 *0,014*	-0,104 *0,014*
size: 21-50 × college	-0,058 *0,054*	-0,110 *0,031*	-0,093 *0,023*	-0,009 *0,016*	-0,042 *0,014*	-0,147 *0,016*	-0,061 *0,016*	-0,099 *0,016*	-0,114 *0,015*
size: 51-300 × college	0,034 *0,010*	0,001 *0,011*	-0,025 *0,011*	-0,009 *0,010*	0,002 *0,010*	0,013 *0,012*	0,035 *0,013*	0,015 *0,012*	0,022 *0,012*
size: 301-1000 × college	ref. *ref.*	ref. *ref.*	ref. *ref.*	ref. *ref.*	ref. *ref.*	ref. *ref.*	ref. *ref.*	ref. *ref.*	ref. *ref.*
size: 1001-3000 × college	-0,035 *0,008*	-0,074 *0,009*	-0,062 *0,011*	-0,063 *0,013*	-0,033 *0,012*	-0,088 *0,014*	-0,050 *0,015*	-0,061 *0,013*	-0,061 *0,014*
size: 3001+ × college	-0,112 *0,008*	-0,118 *0,009*	-0,129 *0,012*	-0,151 *0,012*	-0,133 *0,012*	-0,109 *0,013*	-0,150 *0,016*	-0,127 *0,014*	-0,126 *0,013*
size: 11-20					-0,203 *0,005*	-0,326 *0,005*	-0,283 *0,006*	-0,299 *0,005*	-0,281 *0,005*
size: 21-50	-0,037 *0,024*	0,028 *0,013*	-0,029 *0,008*	-0,126 *0,006*	-0,162 *0,005*	-0,248 *0,006*	-0,225 *0,006*	-0,245 *0,006*	-0,259 *0,006*
size: 51-300	-0,031 *0,003*	0,005 *0,004*	-0,040 *0,004*	-0,106 *0,004*	-0,079 *0,003*	-0,128 *0,004*	-0,077 *0,004*	-0,087 *0,004*	-0,093 *0,004*
size: 301-1000	ref. *ref.*	ref. *ref.*	ref. *ref.*	ref. *ref.*	ref. *ref.*	ref. *ref.*	ref. *ref.*	ref. *ref.*	ref. *ref.*
size: 1001-3000	0,020 *0,003*	0,004 *0,003*	0,045 *0,004*	0,007 *0,004*	0,021 *0,004*	0,016 *0,005*	0,036 *0,005*	0,046 *0,005*	0,044 *0,005*
size: 3001+	0,056 *0,003*	0,027 *0,003*	0,072 *0,004*	0,068 *0,005*	0,072 *0,005*	0,060 *0,005*	0,034 *0,007*	0,074 *0,006*	0,073 *0,005*
college	0,537 *0,010*	0,659 *0,008*	0,700 *0,014*	0,684 *0,010*	0,613 *0,009*	0,860 *0,009*	0,711 *0,012*	0,746 *0,011*	0,743 *0,012*

additional variables not shown here: gender, 12 grades of education (0-11 grades: reference), potential labor market experience, its square, age>=60 binary variable, 22 industry dummies.

Table A3.

Summary statistics for the earnings equations. College education interacted with firm-leve variables (capital-labor ratio, labor productivity, firm size, and ownership). Firms sector only. Hungary, 1986-1999. blank cells: not available.

Means and *Standard deviations*

	1986	1989	1992	1994	1995	1996	1997	1998	1999
dep. var: ln(w)	9,156 *0,398*	9,087 *0,408*	8,965 *0,433*	8,942 *0,474*	8,788 *0,462*	8,661 *0,528*	8,706 *0,586*	8,709 *0,586*	10,802* *0,614**
ln(K/L) × college	-0,116 *0,467*	-0,097 *0,433*	-0,015 *0,400*	0,004 *0,838*	0,048 *0,504*		0,084 *0,568*	0,102 *0,652*	0,129 *0,625*
ln(K/L)	-1,354 *0,908*	-1,065 *0,970*	-0,366 *1,226*	-0,231 *2,551*	0,131 *1,408*		0,338 *1,451*	0,381 *1,720*	0,592 *1,479*
ln(gdp/L) × college	-0,137 *0,481*	-0,095 *0,365*	-0,041 *0,329*	0,031 *0,427*	0,057 *0,377*		0,118 *0,493*	0,143 *0,542*	0,172 *0,597*
ln(gdp/L)	-1,635 *0,613*	-1,106 *0,662*	-0,672 *0,856*	-0,063 *1,144*	0,116 *0,882*		0,505 *0,937*	0,672 *0,938*	0,814 *0,958*
owner:state × college			0,073 *0,260*	0,045 *0,208*	0,023 *0,149*		0,024 *0,154*	0,018 *0,132*	0,022 *0,147*
owner:dom.private × college			ref. *ref.*	ref. *ref.*	ref. *ref.*		ref. *ref.*	ref. *ref.*	ref. *ref.*
owner:foreign × college			0,012 *0,109*	0,021 *0,144*	0,043 *0,202*		0,042 *0,200*	0,049 *0,215*	0,049 *0,216*
owner:state			0,776 *0,417*	0,420 *0,493*	0,264 *0,441*		0,264 *0,441*	0,184 *0,387*	0,218 *0,413*
owner:dom.private			ref, *ref,*	ref, *ref,*	ref, *ref,*		ref, *ref,*	ref, *ref,*	ref, *ref,*
owner:foreign			0,085 *0,278*	0,143 *0,350*	0,282 *0,450*		0,237 *0,425*	0,267 *0,442*	0,265 *0,441*
size: 11-20 × college					0,012 *0,111*	0,018 *0,133*	0,016 *0,126*	0,019 *0,138*	0,022 *0,146*
size: 21-50 × college	0,000 *0,020*	0,002 *0,040*	0,004 *0,064*	0,010 *0,099*	0,012 *0,107*	0,010 *0,100*	0,014 *0,118*	0,011 *0,103*	0,014 *0,117*
size: 51-300 × college	0,014 *0,117*	0,020 *0,140*	0,025 *0,157*	0,044 *0,205*	0,029 *0,167*	0,030 *0,171*	0,031 *0,173*	0,031 *0,174*	0,032 *0,175*
size: 301-1000 × college	ref. *ref.*	ref. *ref.*	ref. *ref.*	ref. *ref.*	ref. *ref.*	ref. *ref.*	ref. *ref.*	ref. *ref.*	ref. *ref,*
size: 1001-3000 × college	0,023 *0,149*	0,024 *0,152*	0,018 *0,134*	0,015 *0,123*	0,016 *0,125*	0,017 *0,128*	0,018 *0,134*	0,020 *0,138*	0,017 *0,129*
size: 3001+ × college	0,025 *0,155*	0,022 *0,146*	0,026 *0,159*	0,019 *0,137*	0,021 *0,144*	0,020 *0,142*	0,022 *0,146*	0,021 *0,143*	0,021 *0,143*
size: 11-20					0,098 *0,297*	0,142 *0,349*	0,127 *0,333*	0,156 *0,363*	0,175 *0,380*
size: 21-50	0,002 *0,047*	0,009 *0,094*	0,030 *0,170*	0,077 *0,266*	0,092 *0,289*	0,084 *0,278*	0,106 *0,308*	0,085 *0,280*	0,112 *0,315*
size: 51-300	0,134 *0,341*	0,195 *0,396*	0,242 *0,429*	0,393 *0,488*	0,275 *0,447*	0,269 *0,443*	0,269 *0,443*	0,262 *0,440*	0,254 *0,436*
size: 301-1000	ref. *ref.*	ref. *ref.*	ref. *ref.*	ref. *ref.*	ref. *ref.*	ref. *ref.*	ref. *ref.*	ref. *ref.*	ref. *ref.*
size: 1001-3000	0,264 *0,441*	0,261 *0,439*	0,198 *0,398*	0,137 *0,344*	0,137 *0,344*	0,143 *0,350*	0,149 *0,356*	0,140 *0,347*	0,116 *0,321*
size: 3001+	0,298 *0,457*	0,239 *0,426*	0,250 *0,433*	0,180 *0,384*	0,185 *0,388*	0,166 *0,372*	0,167 *0,373*	0,157 *0,364*	0,163 *0,369*
college	0,091 *0,288*	0,095 *0,294*	0,099 *0,299*	0,110 *0,313*	0,112 *0,315*	0,116 *0,320*	0,122 *0,327*	0,125 *0,330*	0,129 *0,335*

* 1999 earnings are not adjusted for inflation. That does not affect the estimates because it is an additive term in logs ant therefore shows up in the regression constant only. additional variables not shown here: gender, 12 grades of education (0-11 grades: reference), potential labor market experience, its square, age>=60 binary variable, 22 industry dummies.

Table A4.

Estimates of the individual earnings equations. College education interacted with firm-leve variables (capital-labor ratio, labor productivity, firm size, and ownership) and NACE3 industry-level variables (share of export in revenues, share of contract-jobs in revenues, industry concentration by gdp). Firms sector ronly. Hungary, 1992–1998.

Standard errors in small size italic.

	1992		1994		1995		1997		1998	
ln(K/L) × college	0,005	*0,004*	0,007	*0,002*	0,011	*0,003*	0,020	*0,004*	0,019	*0,003*
ln(K/L)	0,023	*0,001*	0,004	*0,001*	0,008	*0,001*	0,016	*0,001*	-0,003	*0,001*
ln(gdp/L) × college	-0,002	*0,005*	0,039	*0,004*	0,019	*0,005*	0,008	*0,005*	0,010	*0,005*
ln(gdp/L)	0,096	*0,002*	0,058	*0,001*	0,128	*0,002*	0,187	*0,002*	0,206	*0,002*
owner:state × college	0,016	*0,013*	0,087	*0,010*	0,066	*0,010*	0,092	*0,013*	0,020	*0,012*
owner:dom.private × college	ref.	*ref.*	ref.	*ref.*	ref.	*ref.*	ref.	*ref.*	ref.	*ref.*
owner:foreign × college	0,106	*0,018*	0,097	*0,012*	0,125	*0,010*	0,137	*0,012*	0,111	*0,010*
owner:state	0,005	*0,004*	0,017	*0,004*	0,011	*0,003*	0,049	*0,004*	0,076	*0,005*
owner:dom.private	ref.	*ref.*	ref.	*ref.*	ref.	*ref.*	ref.	*ref.*	ref.	*ref.*
owner:foreign	0,126	*0,006*	0,176	*0,004*	0,079	*0,003*	0,116	*0,004*	0,105	*0,004*
size: 11-20 × college					-0,132	*0,014*	-0,173	*0,016*	-0,189	*0,014*
size: 21-50 × college	-0,087	*0,023*	-0,037	*0,016*	-0,054	*0,014*	-0,077	*0,016*	-0,131	*0,016*
size: 51-300 × college	-0,036	*0,011*	-0,024	*0,011*	-0,011	*0,011*	0,020	*0,013*	-0,020	*0,012*
size: 301-1000 × college	ref.	*ref.*	ref.	*ref.*	ref.	*ref.*	ref.	*ref.*	ref.	*ref.*
size: 1001-3000 × college	-0,052	*0,012*	-0,077	*0,013*	-0,056	*0,013*	-0,049	*0,016*	-0,095	*0,014*
size: 3001+ × college	-0,106	*0,015*	-0,156	*0,015*	-0,117	*0,013*	-0,141	*0,018*	-0,141	*0,016*
size: 11-20					-0,202	*0,005*	-0,280	*0,006*	-0,302	*0,005*
size: 21-50	-0,028	*0,008*	-0,126	*0,006*	-0,161	*0,005*	-0,221	*0,006*	-0,245	*0,006*
size: 51-300	-0,031	*0,004*	-0,105	*0,004*	-0,076	*0,003*	-0,073	*0,004*	-0,091	*0,004*
size: 301-1000	ref.	*ref.*	ref.	*ref.*	ref.	*ref.*	ref.	*ref.*	ref.	*ref.*
size: 1001-3000	0,031	*0,004*	0,003	*0,004*	0,021	*0,004*	0,037	*0,005*	0,044	*0,005*
size: 3001+	0,036	*0,005*	0,075	*0,005*	0,072	*0,005*	0,037	*0,007*	0,085	*0,006*
(export/rev) × college	-0,104	*0,030*	-0,085	*0,026*	0,010	*0,022*	0,076	*0,023*	-0,054	*0,019*
(export/rev)	0,198	*0,012*	-0,033	*0,011*	0,002	*0,010*	0,033	*0,010*	-0,024	*0,010*
(contract/rev) × college	0,429	*0,216*	0,137	*0,072*	0,161	*0,092*	0,063	*0,075*	0,017	*0,073*
(contract/rev)	-0,110	*0,048*	-0,123	*0,022*	-0,026	*0,024*	-0,055	*0,020*	-0,044	*0,018*
concentration × college	-0,039	*0,017*	-0,018	*0,015*	-0,049	*0,015*	-0,037	*0,018*	0,010	*0,019*
concentration	0,107	*0,006*	0,060	*0,005*	0,036	*0,005*	0,015	*0,007*	0,009	*0,008*
college	0,729	*0,014*	0,713	*0,012*	0,627	*0,011*	0,698	*0,014*	0,761	*0,012*

additional variables not shown here: gender, 12 grades of education (0-11 grades: reference), potential labor market experience, its square, age>=60 binary variable, 22 industry dummies

Table A5.

Summary statistics for earnings equations. College education interacted with firm-leve variables (capital-labor ratio, labor productivity, firm size, and ownership) and NACE3 industry-level variables (share of export in revenues, share of contract-jobs in revenues, industry concentration by gdp). Firms sector ronly. Hungary, 1992-1998

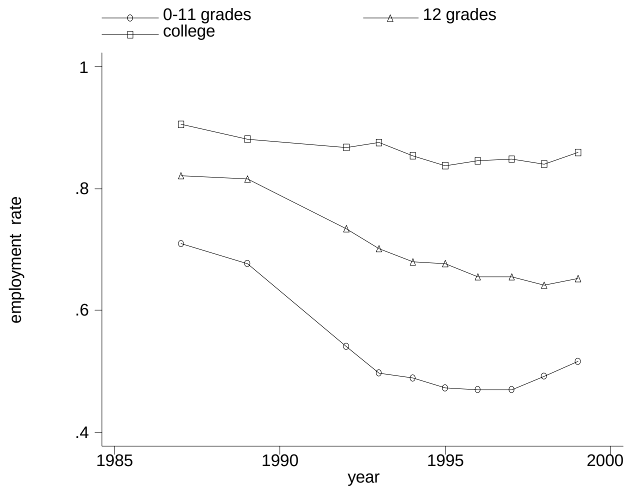
Means and Standard deviations

	1992		**1994**		**1995**		**1997**		**1998**	
dep.var: ln(w)	8,965	*0,433*	8,942	*0,474*	8,788	*0,462*	8,706	*0,586*	8,709	*0,586*
ln(K/L) × college	-0,015	*0,400*	0,004	*0,838*	0,048	*0,504*	0,084	*0,568*	0,102	*0,652*
ln(K/L)	-0,366	*1,226*	-0,231	*2,551*	0,131	*1,408*	0,338	*1,451*	0,381	*1,720*
ln(gdp/L) × college	-0,041	*0,329*	0,031	*0,427*	0,057	*0,377*	0,118	*0,493*	0,143	*0,542*
ln(gdp/L)	-0,672	*0,856*	-0,063	*1,144*	0,116	*0,882*	0,505	*0,937*	0,672	*0,938*
owner:state × college	0,073	*0,260*	0,045	*0,208*	0,023	*0,149*	0,024	*0,154*	0,018	*0,132*
owner:dom.private × college	ref.	*ref.*	ref.	*ref.*	ref.	*ref.*	ref.	*ref.*	ref.	*ref.*
owner:foreign × college	0,012	*0,109*	0,021	*0,144*	0,043	*0,202*	0,042	*0,200*	0,049	*0,215*
owner:state	0,776	*0,417*	0,420	*0,493*	0,264	*0,441*	0,264	*0,441*	0,184	*0,387*
owner:dom.private	ref.	*ref.*	ref.	*ref.*	ref.	*ref.*	ref.	*ref.*	ref.	*ref.*
owner:foreign	0,085	*0,278*	0,143	*0,350*	0,282	*0,450*	0,237	*0,425*	0,267	*0,442*
size: 11-20 × college					0,012	*0,111*	0,016	*0,126*	0,019	*0,138*
size: 21-50 × college	0,004	*0,064*	0,010	*0,099*	0,012	*0,107*	0,014	*0,118*	0,011	*0,103*
size: 51-300 × college	0,025	*0,157*	0,044	*0,205*	0,029	*0,167*	0,031	*0,173*	0,031	*0,174*
size: 301-1000 × college	ref.	*ref.*	ref.	*ref.*	ref.	*ref.*	ref.	*ref.*	ref.	*ref.*
size: 1001-3000 × college	0,018	*0,134*	0,015	*0,123*	0,016	*0,125*	0,018	*0,134*	0,020	*0,138*
size: 3001+ × college	0,026	*0,159*	0,019	*0,137*	0,021	*0,144*	0,022	*0,146*	0,021	*0,143*
size: 11-20					0,098	*0,297*	0,127	*0,333*	0,156	*0,363*
size: 21-50	0,030	*0,170*	0,077	*0,266*	0,092	*0,289*	0,106	*0,308*	0,085	*0,280*
size: 51-300	0,242	*0,429*	0,393	*0,488*	0,275	*0,447*	0,269	*0,443*	0,262	*0,440*
size: 301-1000	ref.	*ref.*	ref.	*ref.*	ref.	*ref.*	ref.	*ref.*	ref.	*ref.*
size: 1001-3000	0,198	*0,398*	0,137	*0,344*	0,137	*0,344*	0,149	*0,356*	0,140	*0,347*
size: 3001+	0,250	*0,433*	0,180	*0,384*	0,185	*0,388*	0,167	*0,373*	0,157	*0,364*
(export/rev) × college	0,017	*0,076*	0,016	*0,069*	0,018	*0,077*	0,020	*0,089*	0,022	*0,098*
(export/rev)	0,182	*0,183*	0,161	*0,168*	0,182	*0,186*	0,192	*0,216*	0,201	*0,239*
(contract/rev) × college	0,000	*0,008*	0,001	*0,018*	0,004	*0,666*	0,001	*0,019*	0,001	*0,017*
(contract/rev)	0,005	*0,026*	0,010	*0,062*	0,022	*1,247*	0,009	*0,072*	0,006	*0,071*
concentration × college	0,038	*0,155*	0,042	*0,160*	0,043	*0,162*	0,045	*0,162*	0,046	*0,162*
concentration	0,435	*0,332*	0,428	*0,325*	0,430	*0,318*	0,404	*0,312*	0,371	*0,287*
college	0,099	*0,299*	0,110	*0,313*	0,112	*0,315*	0,122	*0,327*	0,125	*0,330*

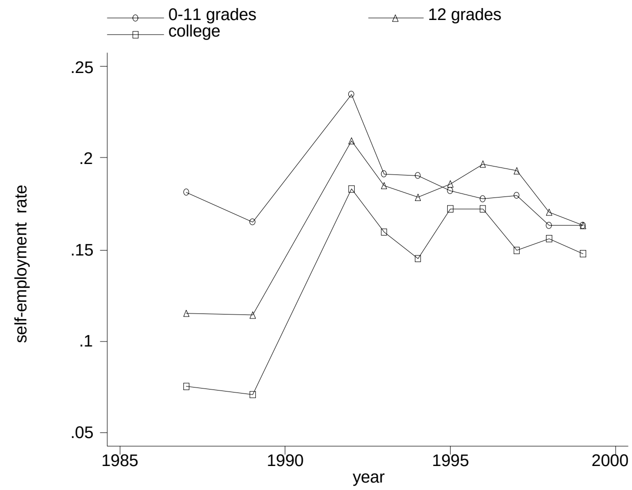
additional variables not shown here: gender, 12 grades of education (0-11 grades: reference), potential labor market experience, its square, age>=60 binary variable, 22 industry dummies.

Figure 1.

Employment rate (employment over population) and self-employment rate (non wage/salary employment over employment) in the three education groups, among the 15–59 old. 1987–1999.



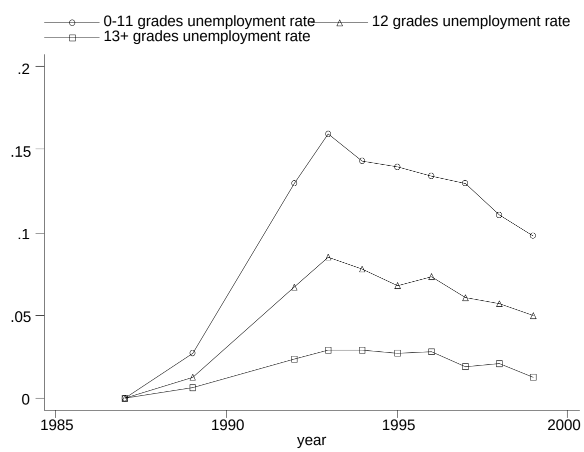
Employment rate



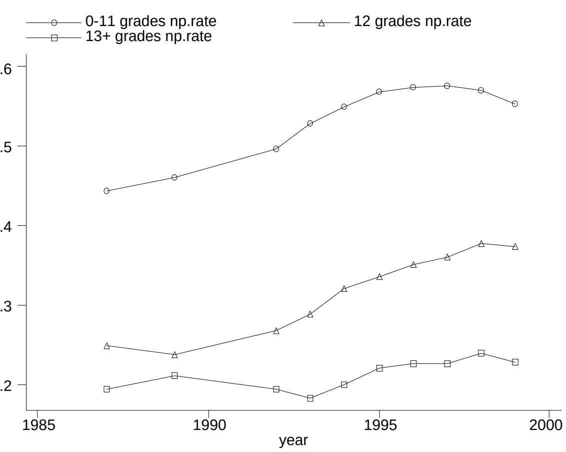
Self-employent rate

Figure 2.

Unemployment rate and nonparticipation rate in the three education groups, among the 15–59 old. 1987–1999.



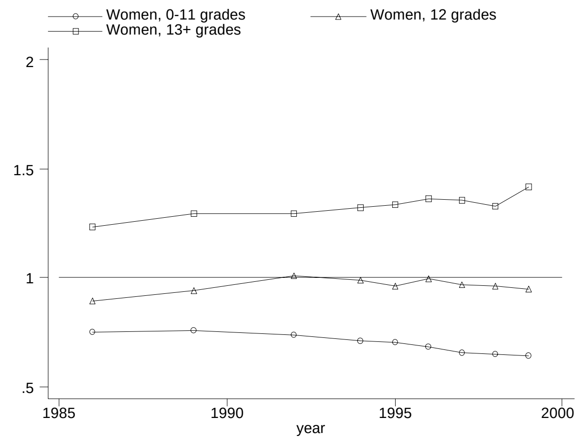
Unemployment rate



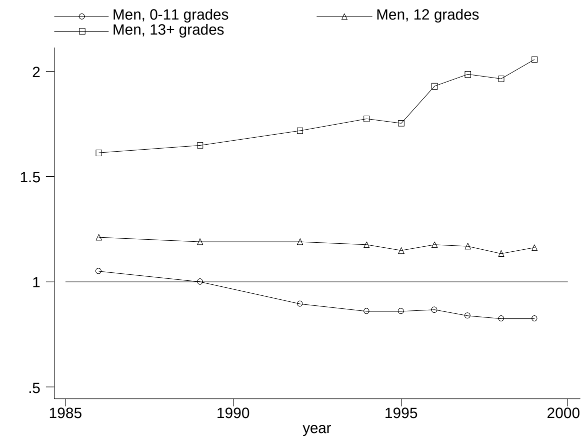
Nonparticipation rate

Figure 3.

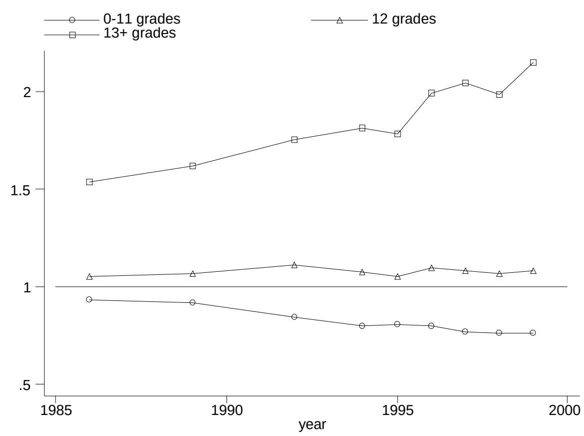
Relative Wages Among the 15–59 old (compared to average wage in the year), by education and gender 1986–1999.



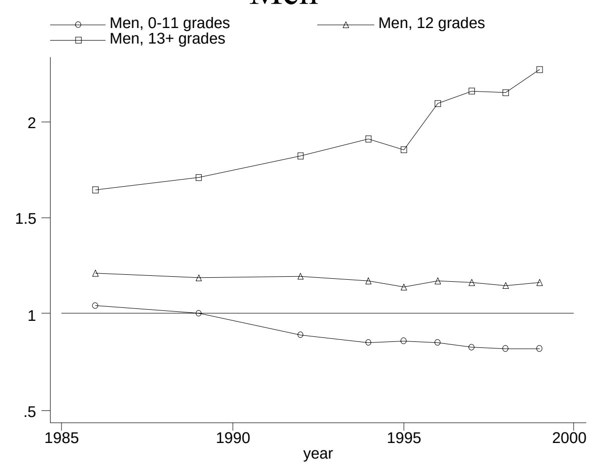
Women



Men



Women

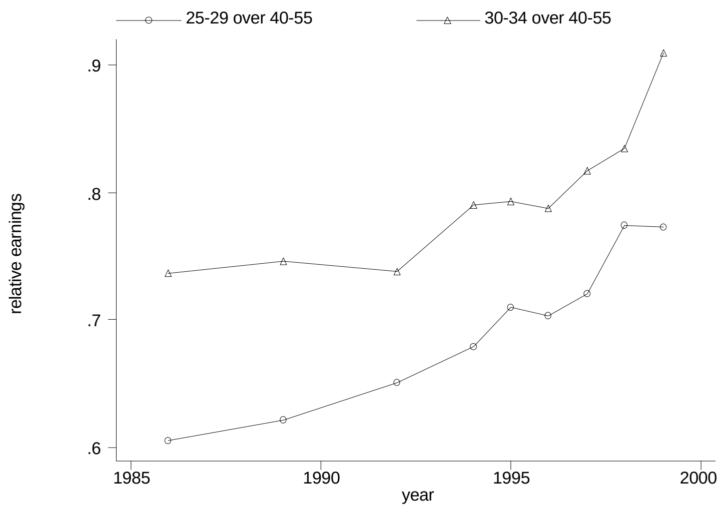


Men

Outside public administration, health, and education

Figure 4.

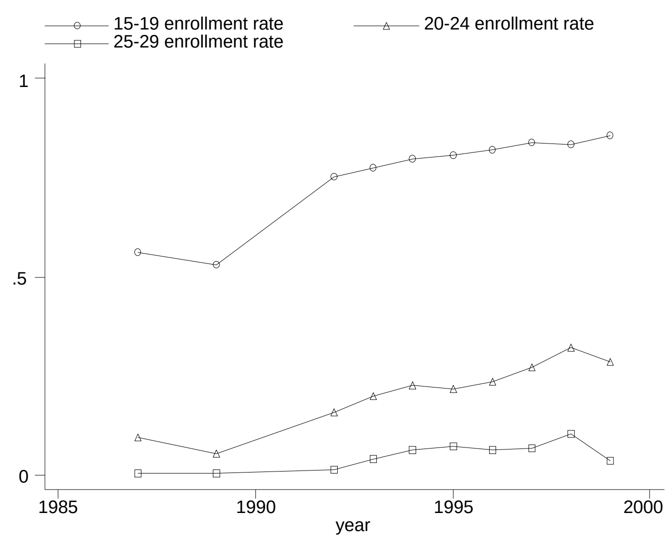
Wage of the college-educated 25-29 and 30-34 years old over the wage of the college-educated 40-54 years old in Hungary



After-tax earnings of young college educated over middle-aged college educated

Figure 5.

School enrollment rates among the 15-19, 20-24, and 25-29 years old in Hungary



School enrollment rates