Earnings, Schooling, and Economic Reform: Econometric Evidence From Hungary (1986–2004)

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How does the relationship between earnings and schooling change with the introduction of comprehensive economic reform? This article sheds light on this question using a unique data set and procedure to reduce sample-selection bias. The evidence is from consistently coded, nonretrospective data for about 4 million Hungarian wage earners. Returns to skill increased 75 percent from 1986 to 2004 (that is, during the period stretching from communism to full membership in the European Union). The winners were those with a college or university education and those employed in the services sector (which here excludes those in public services). The reform losers were those in construction and agriculture, those with only a primary or vocational education (who experienced a decline in returns to their education), and younger workers who acquired most of their education after the main reforms were in place. JEL Codes: I20, J20, J24, J31, O15, O52, P20.

The rise and demise of communism are two of the most important economic events of the twentieth century. One of communism's indisputable

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achievements was an egalitarian distribution of income, which was accomplished in large part by wage compression. Returns to skill were determined centrally, with wages set below equilibrium.

The transition from a centrally planned to a market-based economy was expected to have powerful effects. First, the liberalization of labor markets was expected to significantly raise returns to skill, as these were artificially compressed under communism. Second, at least until the collapse of communism, a large share of the labor force used vastly outdated technologies, and those specific skills would not be expected to be valued in a market economy. Third, such skill deterioration would have been accompanied by a devaluation of the labor market experience acquired during communism. Finally, the transition from a centrally planned to a market economy would involve sharp reductions in government education expenditures, which could translate into lower quality education.[1] The aim of this article is to present econometric evidence that throws light on these effects using unique data from Hungary from 1986 (before the fall of communism) to 2004 (the year Hungary became a member of the European Union).

The paucity of published studies about a country as important as Hungary is surprising. Although one of the most liberalized economies in the Soviet bloc, Hungary started the transition from communism with a gradualist approach to reform, albeit with a welcoming attitude toward foreign investors.[2] In addition to focusing on an economy that has not received attention commensurate with its importance,[3] this article is one of the few examining labor markets in transition economies to use sufficiently large and representative samples of wage earners before, during, and after the introduction of massive economic reform.[4] The data cover almost

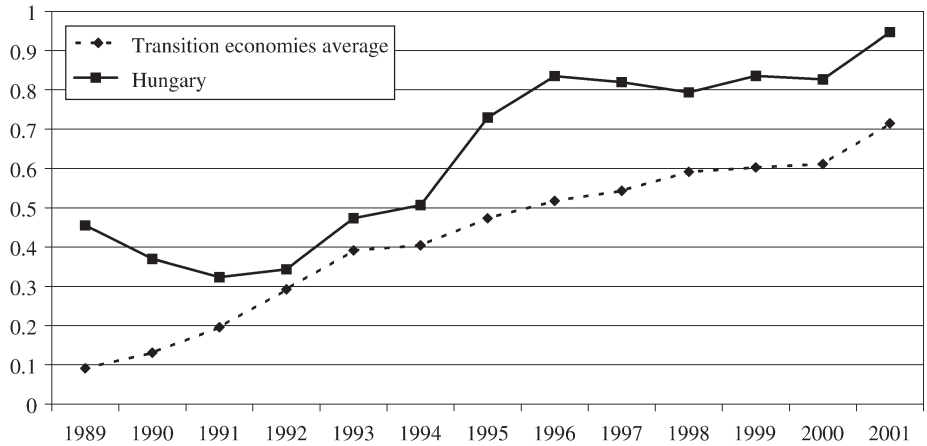
1. These effects are seldom independent. Although socialism compressed earnings, it may have rewarded different skills in nonpecuniary terms. The anecdotal evidence points to vacations and access to consumer goods as such rewards.

2. Further details about macroeconomic developments and labor market reform in Hungary are provided in Supplemental Appendix S.1, available at http://wber.oxfordjournals.org/

3. Svejnar (1999), Boeri and Terrell (2002), and Fleisher, Sabirianova, and Wang (2005) provide excellent reviews of the literature on returns to schooling in transition economies, whereas Card (1999) reviews this literature for nontransition economies. See Supplemental Appendix S.2 for a brief discussion of the literature.

4. Although voluminous, this literature has few studies that present estimates for the period before and after reform because of data availability constraints. Most data collected before 1989 have to be extensively recoded. The primary data used for this study are unique in this respect: they were recoded to current standard international classifications. Two of the main drawbacks of these data are that they do not contain information on self-employment or actual hours worked. Fleisher, Sabirianova, and Wang (2005) note the lack of studies that deal with under-reported economic activity or the informal sector. They report that only about 14 percent of estimates of returns to skills in transition economies are corrected for hours worked and that "when earnings data are adjusted for hours worked, estimated returns to schooling are not significantly larger" (p. 363). Empirical evidence from the economic reform literature is scarce. For reviews of this literature, see Rodrik (1996) and Harrison and Hanson (1999). Studies tend to compare the effects at two points in time (before and after), focus on a single aspect of reform (for instance, trade liberalization), and assume that the reform was effectively implemented and

FIGURE 1. Liberalization Index: Hungary and Transition Economies Average, 1989–2001.



Source: Campos and Horvath (2006).

4 million wage earners from 1986 to 2004 and, using a technique based on DiNardo, Fortin, and Lemieux (1996), also permit addressing the bias from selection on observables.

The results show that returns to a year of schooling increased by 75 percent, from 6.1 in 1986 to 10.7 percent in 2004. General secondary, college, and university education show the largest gains in returns from 1986 to 2004, whereas vocational and primary education show a decline in returns. Service employees experienced the largest gains in returns to skill, whereas construction and agricultural employees experienced the smallest gains.

How do these findings relate to the introduction of the massive economic reform mentioned earlier? Liberalization of the Hungarian economy was somewhat more intense than that of other transition economies (figure 1), and the results suggest that a link can be made between the progressively rising returns to schooling and the progressive liberalization of the Hungarian economy. Returns to skill increased rapidly overall, but the increase was much smaller for those employed in construction and agriculture and those with vocational (narrow) secondary education. These findings support the notion that the changes in returns to education during the transition may be taken as an indicator of the deepening of the reform process.

sufficient time has transpired to measure its impact. This study tries to overcome these difficulties by studying an unambiguously broad and effective reform at multiple points before and after its introduction.

I. Data and The Empirical Specification

The data used in the analysis are from the Wage and Earnings Survey of the National Labor Center in Hungary and contain information on wages, education, type of employment, and other demographic details. Data for the seven years 1986, 1989, 1992, 1995, 1998, 2001, and 2004 cover the communist and transition periods.[5] Wage earners are selected following a systematic, random-selection procedure (for details see Supplemental Appendix S.3). With assistance from the National Labor Center and the Hungarian Central Statistical Office considerable effort went into ensuring that variables were coded consistently over time, work that involved substantial recoding of the data.[6]

Wage equations are estimated using a standard Mincer equation:

$$\ln(w_i) = \beta_1 S_i + \beta_2 E_i + \beta_3 E_i^2 + \beta_4 X_i + \varepsilon_i, \tag{1}$$

where subscript i denotes the individual, w is wages, S is years of schooling (type of education in some specifications), E is potential experience, and X contains a set of variables to control for institutional and demographic characteristics as well as spatial price differences. Each variable is described in more detail below.

The monthly value of wages used in the analysis is the sum of the official base wage received and other payments to the employee (rewards given in the reference month, provisions, overtime work, shift work, and other special payments). In addition, the value of wages includes a prorated estimate of irregular payments (1/12 of irregular payments in the previous year).

Two measures of schooling are examined. The first is a vector of six dummy variables that denote the highest type of schooling completed. The school types include primary, three types of secondary (vocational, technical, and gymnasium or general), college, and university.[7] In 2004, 17 percent of wage earners had only primary schooling or less, whereas 21 percent had a college or university education. Of the remaining 62 percent of wage earners who had completed some form of secondary schooling, slightly less than half

5. The number of observations varies across the years of the survey and is lowest for 1992. Two factors account for the decline in the 1992 sample size. First, there was a planned reduction in sample size for 1992, which was driven by changes in the sample design. Second, the nonresponse rate increased immediately after the collapse of communism. Because the survey takes place in the first semester, 1992 is the first data point after the fall of communism (the 1989 survey was carried out before the collapse of the regime). The sample size increases again in 1995, as smaller firms were added to the frame. For example, in 1986 one of seven manual laborers was selected into the sample. Starting in 1992, all manual laborers born on the 5th and 15th of each month (or approximately 2 out of every 30 manual employees) were selected.

6. Campos and Žlábková (2001) give details on how consistent definitions of industry, ownership, and occupation codes were obtained.

7. The omitted category is individuals with less than primary schooling.

had attended vocational school (29 percentage points of the total). The second measure of schooling is an estimate of years of school attainment, which is created by converting the data on highest school type completed into years of schooling. The average value of this variable increased from 9.7 in 1986 to 11.5 years in 2004. Potential experience is constructed as the wage earner's age minus six years and minus the number of years of schooling.

The variables designated by X include a set of eight dummy variables to control for differences across industries,[8] a dummy variable for large firms (more than 300 employees), and a gender dummy variable to control for the large difference in wages across the sexes. The set of control variables also contains a dummy variable for each of Hungary's 19 counties and the capital, Budapest. These spatial variables control for any variation that is specific to Budapest or a specific county. In particular, these dummy variables control for spatial variation in prices, which is likely to be significant since wages and prices in Budapest are higher than in other regions. The county dummy variables will also control for region-specific differences in labor markets, which are potentially important since unemployment rates are lower in Budapest and the counties along the Budapest–Vienna highway and along the Austrian border. Similarly, the county dummy variables will control for the potential measurement problem that a year of schooling may result in different levels of human capital accumulation over different regions if there are differences in schooling quality across regions.

The controls for firm size and industry, as well as the county fixed effects, reduce the potential for omitted-variable bias in the estimation of equation (1). Having data that were collected using the same survey instrument also significantly improves the credibility of measured changes. That avoids the question, common when data come from different sources, of whether changes over time reflect actual changes in the population or simply the use of different survey instruments. These are important advantages to using the Wage and Earnings Survey data.

The primary disadvantage of using the survey data is that the choice of variables is small and thus the ability to empirically address violations of the ordinary least squares (OLS) assumptions is limited.[9] In particular, if education is correlated with the residual, which can occur for several reasons, including if people select into (or out of) the sample based on some characteristic correlated with education, then the OLS estimator is biased. For example, if people with high returns are more likely to be wage earners and those with expected low returns opt out of the sample, this would induce correlation and result in

8. The eight classifications are: industry, construction, transportation and telecommunications, trade, water, services, health and social services, and public services. The excluded classification is agriculture.

9. As already noted, the lack of information on actual hours worked and on self-employment, albeit common in this literature, is also an important drawback of the data.

sample-selection bias.[10] This source of bias is typically corrected by modeling the selection decision, which requires data on the individuals who have opted out of the wage market. Because the survey provides information only on wage earners, this approach is unavailable. However, unique features of the labor market in 1986 provide important information that can be exploited to reduce sample-selection bias.

In centrally planned economies workers had limited ability to select in or out of the wage market. In principle, everyone of working age was required to work, official unemployment was close to zero, and the opportunity to choose to work in nonwage employment was highly limited. This lack of freedom to select out of the wage market implies that the pre-transition, 1986 estimates of wage equation (1) will be less susceptible to sample-selection bias.[11]

Access to the 1986 pre-transition data is a unique feature of this analysis and helps to mitigate selection bias in the later, post-1986 years. The principal assumptions are that sample-selection bias was minimal in 1986 and that the decision to participate in the wage market after 1986 is correlated with age, gender, and schooling demographics.[12] Changes in these demographic variables in the post-1986 data are assumed to come from people selecting in and out of the wage market. The data are then reweighted to have the same demographic composition as in 1986, thereby purging labor supply changes from the data. This reweighting results in a counterfactual conditional wage distribution that corrects for (reduces) overt sample-selection bias.

This method is similar to that developed by DiNardo, Fortin, and Lemieux (1996), who propose a semiparametric estimation strategy to answer questions such as: what would the distribution of wages be if workers' attributes had remained as before? They note that the methodological contribution of their paper is to show that the estimation of such counterfactual densities can be "greatly simplified by the judicious choice of a reweighting function" (p. 1009).[13] The current study generates a baseline density by treating the 1986 sample as

10. For the former Democratic Republic of Germany, Hunt (2002) finds that the 10 percentage point improvement in the gender wage gap between 1990 and 1994 is a result of the reduction in participation of low-wage women in the labor market.

11. Munich, Svejnar, and Terrell (2002, p. 6) note that "In addition to regulating wages, the central planners regulated employment and admissions to higher education. With minor exceptions, all able-bodied adults were obliged to work. Jobs were provided for everyone and employment security was assured." Horvath and others (1999) show that while the registered unemployment rate in Hungary increased with the launching of reforms, in 1990 this rate was only 1.4 percent. Fazekas and Koltay (2006, p. 234) show rapidly declining rates of labor market participation, falling from 75.9 in 1990 to 61.4 percent in 2000. See Supplemental Appendix S.1 for further details.

12. Svejnar (1999) and Boeri and Terrell (2002) observe that early retirement schemes, youth unemployment, and the reduction of female labor force participation rates are stylized facts of the post-1989 transition.

13. DiNardo (2002, p. 16) argues that "It is therefore clear that this propensity score reweighting is merely a special case of the Heckman selection framework."

the one with the least severe sample-selection bias and reweights the other 6 years according to the demographic distribution of the 1986 sample. More specifically, each of the survey samples is partitioned by sex, six age categories (under 30, 30–34, 35–39, 40–44, 45–49, $\geq$50), and the seven school types described above, for a total of 84 sex-age-education categories. The proportion of the population that belongs to each of these categories in year t is then defined as:

$$v_k^t \equiv \frac{\sum_{\mathrm{i}}^{j_k} \omega_{\mathrm{i},k}^t}{\sum_{\mathrm{i}}^{j_k} \sum_k^K \omega_{\mathrm{i},k}^t}, \tag{2}$$

where the k subscripts runs from 1 to K and represents the 84 sex-age-education categories, i subscripts the individual observation and runs from 1 to j_k for each of the k categories, and $\omega_{i,k}$ represents the weight or expansion factor for individual i in category k.

To reweight the data, so that the demographic composition in later years matches the composition for 1986, new weights are constructed for each year:

$$\varpi_{\mathrm{i},k}^t = \left(\frac{v_k^{86}}{v_k^t}\right)\omega_{\mathrm{i},k}^t, \forall k \in K. \tag{3}$$

The v^{86} term in the numerator adjusts the weights to reflect the demographic composition in 1986, and the v^t in the denominator normalizes the adjustment to ensure that the sum of unadjusted weights equals the sum of adjusted weights.

Consider for example that low-educated young males constitute a larger proportion of the sample in 1986 than in 1995. This method adjusts their 1995 weights upward (in this example) to ensure that they represent the same proportions across both years. One difficulty with this approach is that it does not allow for any true population changes in the sex, age, and education composition of the sample.[14] Although this affects the interpretation of the results, it is in some ways a desirable characteristic. Changes in returns to education can result from changes in the composition of the labor force and from the way the labor market rewards education, conditional on labor market characteristics. Reweighting the data to the 1986 demographic composition purges changes in the labor supply from the analysis so that the focus is on market changes in the demand for wage labor and on whether firms are responding to reforms by providing greater returns to investment in human capital.

14. The Hungarian Central Statistical Office reports that population declined by about 2 percent between 1990 and 1998 and also aged slightly.

II. Results

To examine how returns to schooling changed from 1986 to 2004, county fixed-effects estimates of equation (1) are provided in tables 1–4. Panel B of table 1 provides fixed-effects estimates for all firms with more than 50 employees. Panel A and all the other tables report fixed-effects estimates for the same sample weighted according to the formula above and therefore corrected for selection on observables. The standard errors listed in all tables are corrected for heteroscedasticity of unknown form through the use of the sandwich variance estimator.[15] The disadvantage, as noted by Kauermann and Carroll (2001), is that the sandwich variance estimator is inefficient and often results in estimated standard errors that are too conservative (large). Given the large sample sizes, the cost of the sandwich or robust variance estimates are not qualitatively important, and the benefit of consistency is desirable.

The results from Panel B of table 1 show that the uncorrected returns to a year of schooling increased 123 percent, from a return of 6.1 in 1986 to 13.6 percent in 2004, and the increase is statistically significant. Once corrected for sample selection on observables, the increase in returns is smaller, suggesting the existence of the positive correlation between education and the decision to participate in the wage sector that was discussed above. Panel A shows that the selection-corrected return to schooling for wage earners from firms with 50 or more employees increased by only 75 percent, from 6.1 in 1986 to 10.7 percent in 2004. This result supports the hypothesis that central planners undervalued education and that the market has quickly corrected this undervaluation.[16]

Comparing the panels shows that sample-selection bias is positive and quite large throughout the period of analysis. The direction of the bias is consistent with the notion that people who expect to receive higher returns in the wage market choose to enter, whereas those who expect lower returns opt out. The decision of workers to select in and out of the sample appears to happen quickly. By 1992, the magnitude of the bias is more than 10 percent and remains above this level throughout the 1990s.[17]

Table 1 also provides evidence of decreasing returns to experience throughout the transition from a centrally planned to a market economy. This result

15. An advantage of the Wage and Earnings Survey design is that the sample was selected in a single stage, and thus there is no need to correct estimates of the sampling variance for any design-induced dependence.

16. The declining size of the male coefficient indicates that the premium to male earners has fallen over time, indicating relative improvement for women in the labor force. Jolliffe and Campos (2005) examine the changing gender wage gap over time in detail using traditional Oaxaca decompositions.

17. The analysis in this article is restricted to firms with 50 or more employees. While this restriction corrects for the change made to the sample frame in 1995, it has the disadvantages of excluding from the analysis wage earners in smaller firms. Examination of the full sample reveals that the restriction on the sample does not qualitatively affect the results.

TABLE 1. Returns to Years of Schooling, 1986–2004: Spatial and Industry Fixed-effects Estimation of Equation (1)

	1986	1989	1992	1995	1998	2001	2004
Panel A: Selection-corrected estimates							
Years of schooling	0.061 (0.0004)	0.073 (0.0004)	0.082 (0.0009)	0.098 (0.0009)	0.104 (0.0012)	0.108 (0.0012)	0.107 (0.0010)
Gender dummy variable (male = 1)	0.280 (0.0022)	0.295 (0.0024)	0.216 (0.0070)	0.169 (0.0043)	0.163 (0.0055)	0.171 (0.0050)	0.178 (0.0042)
Potential experience	0.028 (0.0003)	0.021 (0.0004)	0.024 (0.0011)	0.020 (0.0008)	0.018 (0.0010)	0.013 (0.0010)	0.015 (0.0008)
Experience squared/100	−0.041 (0.0007)	−0.028 (0.0008)	−0.031 (0.0024)	−0.018 (0.0018)	−0.015 (0.0024)	−0.011 (0.0024)	−0.014 (0.0018)
Firm size dummy (300+ employees = 1)	−0.009 (0.0051)	−0.002[a] (0.0022)	−0.024 (0.0093)	−0.139 (0.0042)	−0.171 (0.0051)	0.123 (0.0056)	0.142 (0.0047)
Number of observations	149,274	383,720	48,261	371,882	334,207	346,217	431,391
R^2	0.45	0.40	0.39	0.38	0.38	0.40	0.40
Panel B: Uncorrected estimates							
Years of schooling	0.061 (0.0004)	0.078 (0.0004)	0.096 (0.0007)	0.112 (0.0007)	0.117 (0.0007)	0.126 (0.0006)	0.136 (0.0005)
Gender dummy variable (male = 1)	0.280 (0.0022)	0.279 (0.0022)	0.154 (0.0042)	0.141 (0.0036)	0.136 (0.0038)	0.180 (0.0029)	0.173 (0.0027)
Potential experience	0.028 (0.0003)	0.026 (0.0003)	0.029 (0.0007)	0.025 (0.0006)	0.025 (0.0007)	0.022 (0.0005)	0.024 (0.0005)
Experience squared/100	−0.041 (0.0007)	−0.037 (0.0007)	−0.036 (0.0015)	−0.028 (0.0013)	−0.030 (0.0015)	−0.031 (0.0011)	−0.034 (0.0009)
Firm size: ≥300 employees	−0.009 (0.0051)	0.001[a] (0.0019)	−0.014 (0.0054)	−0.138 (0.0034)	−0.162 (0.0034)	0.147 (0.0031)	0.123 (0.0029)
Number of observations	149,274	383,720	48,261	371,882	334,207	346,217	431,391
R^2	0.45	0.41	0.43	0.43	0.44	0.45	0.49

Note: Numbers in parentheses are standard errors robust to heteroscedasticity of unknown form. Dependent variable is the log of monthly wages. Sample consists of all firms with 50 or more employees. The eight industry dummy variables are jointly significant and are excluded from the table. County fixed effects are also jointly significant. All listed point estimates are significant with a $p < 0.01$ except for the firm-size dummy variable, which is significant with a $p < 0.05$ for all years, but 1986 and 1989.

[a]The only statistically insignificant point estimate.

Source: Authors' analysis based on the Wage and Earnings Survey data described in the text.

appears to support the notion that labor market experience acquired under communism loses value after the introduction of economic reform.[18] There is still little research focusing on the returns to experience in the labor market before, during, and after reform (Fleisher, Sabirianova, and Wang 2005), an area in need of in-depth research.

Under communism, a substantial share of the labor force was employed in large state-owned industrial enterprises. Government subsidies enabled these firms to survive with minimal technological modernization. Consequently, at the outset of transition a considerable share of the workforce had skills that were relevant for production technologies that were obsolete in the rest of the world (certainly in the Organization for Economic Co-operation and Development countries). Returns to the skills of manufacturing workers would thus be expected to be lower than returns to the skills of workers in other sectors (especially services). Table 2 shows estimates of the returns to skill from 1986 to 2004 in eight sectors.

The largest increases in returns to schooling are found in the service industries (excluding those in public services), with returns increasing 91 percent from 1986 to 2004. Correspondingly, the share of college-educated workers in the service industry doubled from 6 to 12 percent, suggesting an increase in demand for greater skills. Returns declined in construction (45 percent) and increased slightly in agriculture (27 percent). Similarly, the share of college-educated workers in these two industries declined from 42 to 6 percent. These results are consistent with the notion that the planned economy undervalued skilled labor used in the production of nonphysical goods and services.

There are several possible explanations for the varying returns to types of schooling during transition. One is that different types of schooling produce different skill sets, and these skills may be more or less well suited to the needs of the new market economy. A related explanation is that the government traditionally steered students into certain types of schools, and this planned aspect of the economy no longer provided the correct mix of skills. Both explanations are based on the idea that the changing market environment produced changes in the market value of certain skills. These hypotheses ignore the fact that under the planned economy returns to skills were set by planners and were not determined by the market. Prior to the transition wage setting was used to favor certain industries and certain types of labor. Labor who had been trained in technical and vocational schools and was involved in the production of certain goods tended to be more highly valued, whereas labor who had been more academically trained and less likely to be working in the physical production of goods was less highly valued. Presumably, the market economy

18. We are grateful to an anonymous referee for pointing out the need for care in interpreting returns to experience using cross-sectional data. If returns to experience are rising, but at a diminishing rate, cross-sectional returns might underestimate the life-cycle returns for newer cohorts (see, for example, Noorkôiv and others 1998).

TABLE 2. Selection-Corrected Returns to Years of Schooling by Sector, 1986–2004: Spatial Fixed-effects Estimation of Equation (1)

Sector	1986	1989	1992	1995	1998	2001	2004	Change 1986–2004 (percent)
Industry	0.070 (0.0011)	0.070 (0.0015)	0.073 (0.0025)	0.095 (0.0024)	0.097 (0.004)	0.114 (0.0026)	0.107 (0.0023)	53
Construction	0.058 (0.0013)	0.066 (0.0023)	0.068 (0.0044)	0.082 (0.0045)	0.096 (0.0075)	0.063 (0.0071)	0.032 (0.007)	−45
Agriculture	0.052 (0.0007)	0.041 (0.0014)	0.053 (0.0029)	0.067 (0.0029)	0.065 (0.004)	0.061 (0.0037)	0.066 (0.0051)	27
Transport and communications	0.080 (0.0045)	0.080 (0.0057)	0.098 (0.0082)	0.115 (0.0068)	0.125 (0.0088)	0.120 (0.0025)	0.112 (0.0036)	40
Trade	0.071 (0.0014)	0.078 (0.0025)	0.086 (0.0035)	0.106 (0.0038)	0.136 (0.0042)	0.085 (0.0036)	0.096 (0.0025)	36
Services	0.064 (0.0015)	0.075 (0.002)	0.088 (0.0033)	0.105 (0.0029)	0.126 (0.003)	0.112 (0.003)	0.122 (0.0028)	91
Health and social services	0.058 (0.0006)	0.080 (0.0003)	0.073 (0.0025)	0.097 (0.0014)	0.083 (0.0012)	0.074 (0.0009)	0.079 (0.001)	38
Public services	0.078 (0.0006)	0.108 (0.0005)	0.102 (0.0011)	0.115 (0.0007)	0.113 (0.0011)	0.110 (0.0007)	0.110 (0.0007)	40

Note: Numbers in parentheses are standard errors robust to heteroscedasticity of unknown form. Dependent variable is the log of monthly wages. Estimated returns are from separate regressions for each industry. Sample consists of all firms with 50 or more employees. The remaining results from the estimation of equation (1) are suppressed for brevity. All point estimates for the experience and gender variables are statistically significant. All listed parameters are statistically significant with a $p < 0.001$.

Source: Authors' analysis based on the Wage and Earnings Survey data described in the text.

rewards the value added by labor and is indifferent as to whether the added value is in a physical commodity or a service.

Although there was a large increase in the return to a year of schooling overall during this period, the wage premium to primary and vocational schooling declined between 1986 and 2004 (table 3). Wage earners who completed university, college, or secondary general education experienced the largest percentage changes in the wage premium. These results are consistent with the view that the planned economy undervalued labor used in the production of nonphysical goods and services relative to the market economy.

One indication that students are responding to the changing structure of returns by school type is that the share of students in general education increased from 24 in 1990 to 28 percent in 1997 (Fretwell and Wheeler 2001). This finding provides empirical evidence supporting the theoretical argument of Nelson and Phelps (1966) and Schultz (1975) that general education may enhance an individual's ability to adapt to a changing market environment. In contrast, the value of training in specific technical skills is more dependent on market fluctuations. When skills training is well targeted to the specific demands of the market, returns are high; when market and technology conditions change, there will be a time lag before curricula can adjust to provide the newly demanded mix of skills.

The final issue explored is whether there is evidence of qualitative changes in schooling after 1989. One hypothesis is that after 1989 schools responded to changing market needs and provided more marketable skills. A competing theory is that the quality of education has deteriorated because of the large declines in education budgets for many countries, including Hungary, during the transition period. Total public expenditures on education as a percent of gross domestic product increased in Hungary from 5.7 in 1989 to 6.6 percent in 1992, but then fell by 35 percent during the next 5 years, reaching a low of 4.4 percent in 1997 (Berryman 2000). As a result of the declining expenditures on education after 1992, studies note that many teachers have had to take on second jobs (Fretwell and Wheeler 2001) and that academic performance has been declining (World Bank 1997).

Although the Wage and Earnings Survey data include no direct measures of school quality, it is possible to provide limited supporting evidence.[19] Until 1992, all wage earners acquired their schooling before the transition or while education expenditures were increasing. By 2004, the youngest wage earners in the sample had acquired most of their schooling during the post-1989 years, and much of it during the post-1992 period of declining expenditures. Contrasting the returns for the youngest wage earners in the sample with those

19. There is an extensive literature on school quality in nontransition countries. See, among others, Behrman and Birdsall (1983), Betts (1995), Card and Krueger (1992), and Glewwe (1999).

TABLE 3. Selection-corrected Wage Premiums by School Type, 1986–2004: Spatial and Industry Fixed-effects Estimation of Equation (1)

School type	1986	1989	1992	1995	1998	2001	2004	Change 1986–2004 (percent)
Primary	0.085 (0.0049)	−0.025 (0.0058)	0.068 (0.0114)	0.074 (0.0127)	0.101 (0.0192)	0.166 (0.01832)	0.048 (0.0161)	−44
Secondary, vocational	0.209 (0.0053)	0.087 (0.0063)	0.226 (0.0156)	0.209 (0.0132)	0.222 (0.0203)	0.296 (0.0189)	0.163 (0.0169)	−33
Secondary, technical	0.381 (0.0054)	0.388 (0.0063)	0.207 (0.0126)	0.519 (0.0136)	0.546 (0.0201)	0.552 (0.0184)	0.421 (0.0162)	11
Secondary, general	0.303 (0.0059)	0.259 (0.0064)	0.464 (0.0122)	0.475 (0.0141)	0.507 (0.0202)	0.514 (0.0184)	0.391 (0.0160)	29
College	0.554 (0.0068)	0.531 (0.0063)	0.765 (0.0128)	0.835 (0.0136)	0.869 (0.0199)	0.989 (0.0185)	0.939 (0.0163)	69
University	0.720 (0.0057)	0.741 (0.0067)	0.981 (0.0145)	1.055 (0.0153)	1.166 (0.0218)	1.260 (0.0191)	1.195 (0.0166)	66

Note: Numbers in parentheses are standard errors robust to heteroscedasticity of unknown form. Dependent variable is the log of monthly wages. Sample consists of all firms with 50 or more employees. The remaining results from the estimation of equation (1) are suppressed for brevity. All point estimates for the experience and gender variables are statistically significant. The firm-size and industry dummy variables and the county fixed effects are jointly significant. All listed parameters are statistically significant with a $p < 0.001$. The point estimate for primary schooling in 1992 has the smallest t-statistic, with a value of 10.6.

Source: Authors' analysis based on the Wage and Earnings Survey data described in the text.

for all others permits observation of whether the market considers schooling attained in the transition years more or less highly (table 4).

In 1986, the returns to schooling for wage earners, 20 years old and younger, were about 61 percent less than the returns for wage earners more than 20 years old. In the early years of transition, this gap narrowed, and by 1992 the difference stood at 17 percent. The difference in returns increased over the next 6 years, and by 1998 wage earners who were schooled in the post-1989 years had returns that were 163 percent less than the returns for those who received most of their schooling before 1989. During the first few years of transition, the youngest wage earners experienced the largest increases in the returns to schooling; after 1992, the returns to education stagnated for the youngest workers whereas it continued to increase for older workers.[20] This is consistent with the hypothesis of declining school quality and, if correct, could have negative repercussions for future economic growth and the earnings potential of the generation that received its education during the post-transition years.[21]

There are, however, additional plausible explanations for this finding. It might be that over time young people are increasingly likely to pursue post-secondary schooling. If so and if these are the most able, then it would likely be that the more able youth were sorted out of the under-20 cohort earnings equation. Another possibility is that the higher estimated returns for the older group may be due to the increasing share of more educated (college and university) workers in this group. A third possible explanation is that the results reflect changes in returns to experience that are difficult to distinguish from changes in the quality of education. Finally, young workers may be the most adversely affected by market regulations that constrain job creation, and the slowdown and slight reversal of liberalization in the late 1990s could be taken as support for this hypothesis. Although the data do not permit discriminating among these hypotheses, none appear to suggest that young workers are natural winners from market reforms.

III. Conclusions

This article analyzed the effects of the introduction of economic reform—the transition from a centrally planned to a market economy—on the labor market. It tried to improve on the existing reform literature by focusing on a highly effective reform, defined broadly and covering the periods before, during, and after its implementation. One important result found in the analysis is that returns to schooling are relatively large throughout the transition in

20. As the number of graduates from institutions of higher education in Hungary increased over the transition period, an alternative explanation for the decline in returns to education for the young is a simple supply-side story.

21. See Fan, Overland, and Spagat (1999) for a theoretical discussion of this possibility.

TABLE 4. Comparison of Selection-Corrected Returns to Education by Age: Spatial and Industry Fixed-effects Estimation of Equation (1)

	1986	1989	1992	1995	1998	2001	2004
≤20 years	0.038 (0.0040)	0.051 (0.0062)	0.070 (0.0112)	0.075 (0.0114)	0.040 (0.0152)	0.074 (0.0167)	0.061 (0.0165)
>20 years	0.061 (0.0004)	0.073 (0.0004)	0.082 (0.0010)	0.099 (0.0009)	0.105 (0.0012)	0.108 (0.0012)	0.107 (0.0010)
R^2							
≤20 years	0.22	0.24	0.17	0.17	0.24	0.25	0.28
>20 years	0.43	0.39	0.38	0.38	0.38	0.40	0.42

Note: Numbers in parentheses are standard errors robust to heteroscedasticity of unknown form. Dependent variable is the log of monthly wages. Sample consists of all firms with 50 or more employees. Listed point estimates are significant with all $p < 0.01$. The remaining results from the estimation of equation (1) are suppressed for brevity.

Source: Authors' analysis based on the Wage and Earnings Survey data described in the text.

Hungary (which is a standard example of gradual reform), at around 10 percent and above since 1995. The returns to a year of schooling increased by 75 percent, from 6.1 in 1986 to 10.7 percent in 2004, according to our preferred (selection-corrected) estimates. Although these returns are larger than those available for other transition economies and for Western Europe, they are credible estimates for several reasons.

Although many Eastern European countries have education levels that are on par with those in Western Europe, average wages continue to be lower. Since estimated returns to schooling are measured as percentage changes in wages, if Western and Eastern European markets were to provide similar returns to schooling in wage levels, this would mean higher returns from estimating Mincer equations such as equation (1). The prior assumption here is that if markets are truly liberalized, rates of return will be higher in transition economies than in Western Europe until there is some convergence in wage levels.

The difference found in estimates may be in part due to some unique characteristics of the survey. The data were collected using the same survey instrument over the years 1986–2004, covering the pre-transition as well as the transition years. Studies that are based on multiple survey instruments for temporal analysis face the difficult question of whether the observed change results from changes in the examined population or changes in the survey instrument. Further, the data were recoded to current standard international classifications to minimize errors in comparisons over time.

The unique characteristics of the Wage and Earnings Survey data allow for the exploration of the important issue of school quality. Because the sample sizes are large, wage equations for a small sub-sample of very young workers in each of the 7 years can be estimated. The analysis reveals that the returns to education for the generation that received much of its schooling after 1989 declined during the mid and late 1990s, while returns for older workers continued to increase.

Wage and Earnings Survey data impose difficult estimation issues, however, that are similar to those that arise with any labor force survey data when estimating returns to schooling. As with essentially all labor force surveys, the researcher has no information on the population that chose not to participate in the wage market and therefore cannot control for sample-selection bias. The approach used in this article to correct for this potential bias has been to exploit the somewhat unusual availability of representative data from 1986, well before the transition began and when workers had very limited choice about whether to participate in the wage sector. The estimation strategy was to use the demographic composition (based on 84 sex-age-schooling classifications) of the 1986 data as a basis for identifying which types of people disproportionately select in or out of the sample in later years.

The analysis showed that the 75 percent increase in returns to a year of schooling between 1986 and 2004 is evidence that the planned economy

undervalued education and that liberalization has allowed markets to correct this. Examining returns by type of schooling rather than an aggregate measure of years of schooling sheds further light on whether the type of schooling received in pre-transition Hungary proved to be appropriate for the liberalized, post-1989 market. The common assumption is that socialist economies undervalued and undersupplied general education. The analysis strongly supports this view. Since 1989 an increasing proportion of students have been choosing to attend general school over vocational and technical school. Despite the increasing supply of students in general schooling, the estimated wage premiums to university and college education increased more than 60 percent between 1986 and 2004, whereas the premiums to secondary vocational training decreased 33 percent.

The empirical evidence in this article supports the belief that the liberalized economy has responded to market forces and is providing large returns for human capital investments. The evidence also suggests that wage earners are responding to the changes in the market and making better investment choices. All of this bodes well for future growth. The potential caveat to this conclusion, though, is that the declines in public expenditures on education may have resulted in a decline in the quality of this investment, and the markets seem to have responded to this.

Supplementary Material

Supplementary material is available online at http://wber.oxfordjournals.org/

References

Behrman, Jere, and Nancy Birdsall. 1983. "The Quality of Schooling: Quantity Alone is Misleading." *American Economic Review* 73(5):928–46.

Berryman, Sue. 2000. *Hidden Challenges to Education Systems in Transition Economies.* World Bank, Washington, D.C.

Betts, Julian. 1995. "Does School Quality Matter? Evidence from the National Longitudinal Survey of Youth." *Review of Economics and Statistics* 77(2):231–50.

Boeri, Tito, and Katherine Terrell. 2002. "Institutional Determinants of Labor Reallocation in Transition." *Journal of Economic Perspectives* 16(1):51–76.

Card, David. 1999. "The Causal Effect of Education on Earnings." In O. Ashenfelter, and D. Card eds., *Handbook of Labor Economics*. Vol. 3. Amsterdam: Elsevier.

Card, David, and Alan Krueger. 1992. "Does School Quality Matter? Returns to Education and the Characteristics of Public Schools in the United States." *Journal of Political Economy* 100(1):1–40.

Campos, Nauro, and Dana Žlábková. 2001. "The Wrong Mix: A First Look at Occupational Mobility during the Hungarian Transition." Discussion Paper 59. Prague, Czech Republic: Center for Economic Research and Graduate Education of Charles University, Economics Institute.

Campos, Nauro, and Roman Horvath. 2006. "Reform Redux: Measurement, Determinants and Reversals." Discussion Paper 2093. Bonn, Germany: Institute for the Study of Labor.

DiNardo, John. 2002. "Propensity Score Reweighting and Changes in Wage Distributions." Ann Arbor, Mich.: University of Michigan, Department of Economics.

DiNardo, John, Nicole Fortin, and Thomas Lemieux. 1996. "Labor Market Institutions and the Distribution of Wages, 1973–1992: A Semiparametric Approach." *Econometrica* 64(5):1001–44.

Fan, Simon, Jody Overland, and Michael Spagat. 1999. "Human Capital, Growth and Inequality in Russia." *Journal of Comparative Economics* 27(4)618–43.

Fazekas, Karoly, and Jeno Koltay eds. 2006. *The Hungarian Labour Market: Review and Analysis*. Budapest, Hungary: Institute of Economics.

Fleisher, Belton M., Klara Sabirianova, and Xiaojun Wang. 2005. "Returns to Skills and the Speed of Reforms: Evidence from Central and Eastern Europe, China, and Russia." *Journal of Comparative Economics* 33(2):351–70.

Fretwell, David, and Anthony Wheeler. 2001. *Hungary: Secondary Education and Training*. World Bank, Washington, D.C.

Glewwe, Paul. 1999. *The Economics of School Quality Investments in Developing Countries: An Empirical Study of Ghana*. New York: St. Martin's Press.

Harrison, Ann, and Gordon Hanson. 1999. "Who Gains from Trade Reform? Some Remaining Puzzles." *Journal of Development Economics* 59(1):125–54.

Horvath, Reka, Arpad Abraham, Tibor Horvath, and Tams Kopeczi-Bocz. 1999. *Background Study on Employment and Labour Market in Hungary*. Barcelona: European Training Foundation.

Hunt, Jennifer. 2002. "The Transition in East Germany: When is a Ten Point Fall in the Gender Wage Gap Bad News?" *Journal of Labor Economics* 20(1):148–69.

Jolliffe, Dean, and Nauro Campos. 2005. "Does Market Liberalisation Reduce Gender Discrimination? Econometric Evidence from Hungary, 1986–1998." *Labour Economics* 12(1):1–22.

Kauermann, Göran, and Raymond Carroll. 2001. "A Note on the Efficiency of Sandwich Covariance Matrix Estimation." *Journal of the American Statistical Association* 96(456):1387–496.

Munich, Daniel, Jan Svejnar, and Katherine Terrell. 2002. "Returns to Human Capital under the Communist Wage Grid and during the Transition to a Market Economy." Working Paper 272a. Ann Arbor, Mich.: University of Michigan, Stephen M. Ross Business School, William Davidson Institute.

Nelson, Richard, and Edmund Phelps. 1966. "Investment in Humans, Technological Diffusion, and Economic Growth." *American Economic Review* 56(2):69–75.

Noorkôiv, Rivo, Peter Orazem, Allan Puur, and Milan Vodopivec. 1998. "Wage Dynamics in Estonia, 1989–1995." *Economics of Transition* 6(2):481–503.

Rodrik, Dani. 1996. "Understanding Economic Policy Reform." *Journal of Economic Literature* 34(1):19–41.

Schultz, Theodore. 1975. "The Value of the Ability to Deal with Disequilibria." *Journal of Economic Literature* 13(3):827–46.

Svejnar, Jan. 1999. "Labor Markets in the Transitional Central and East European Economies." In Orley Ashenfelter, and David Card eds., *Handbook of Labor Economics*. Vol. 3. Amsterdam: Elsevier.

World Bank. 1997. "The Effect of Education Decentralization Reforms on Resource Allocation, Quality, and Equity in Hungarian Schools." In *Abstracts of Current Studies: Labor Markets and Education*. World Bank, Washington, D.C.