

# Returns to skills and the speed of reforms: Evidence from Central and Eastern Europe, China, and Russia

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We dedicate this paper to the memory of Mark C. Berger, who died in 2003 at the peak of his career. Mark Berger was the PhD student of Belton Fleisher and the PhD advisor of Klara Sabirianova. He will long be remembered as a noted contributor to our understanding of labor economics, as a devoted teacher and advisor, and as an outstanding member of his community.

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**Fleisher, Belton M., Sabirianova, Klara, and Wang, Xiaojun**—Returns to skills and the speed of reforms: Evidence from Central and Eastern Europe, China, and Russia

Using metadata from 39 studies of 11 countries, we explore the growth in returns to schooling during transition across Central and Eastern European countries, Russia, and China. China differs from the other countries in exhibiting a relatively slow increase in returns to schooling. We investigate the relative importance of the slow decay of the effects of wage grids compared to the return to the ability that educated individuals have in taking advantage of economic disequilibria caused by reform. Both explanations receive empirical support. We also investigate the systematic effects of sample characteristics, estimation methods, and model specifications on estimated returns to schooling. *Journal of Comparative Economics* 33 (2) (2005) 351–370. The Ohio State University, 1945 N. High St., Columbus, OH 43210, USA; University of Michigan, USA; University of Hawaii at Manoa, 2424 maile Way 527, Honolulu, HI 96822, USA.

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## 1. Introduction

One of the defining characteristics of economies operating under the Soviet, Central and Eastern European, and Chinese planning schemes in the post-World War II era is the imposition of wage grids that were introduced to effect income leveling policies. These policies were favored by the Communist government of the Soviet Union and were adopted in various forms in the Soviet satellites and by China (Meng, 2000; Münich et al., 2005a, 2005b). The wage compression imposed by the grids effectively reduced private returns to schooling as measured conventionally. Estimated returns prior to reform were less than 5% in all countries except Hungary and Slovenia, which operated under considerably less rigid economic regimes than did most of the rest of Central and Eastern Europe countries and Russia (CEER). Returns to schooling in China were in the 5 to 6% range in the early 1950s, but fell to nearly zero by the end of the Cultural Revolution (Fleisher and Wang, 2005).

Rapidly in most cases but slower in China and in some countries of the former Soviet Union, economic reforms led to enterprises operating under fewer constraints. With fewer wage controls, returns to schooling should have increased. While this expectation has been fulfilled to a large extent, the time path of returns to schooling has not been uniform. Studies of CEER indicate a tendency for returns to schooling to rise almost immediately following reform, albeit at different speeds. However, most studies of China in the period covering approximately the first 15 years of its economic transition report low rates of return to schooling compared not only to industrialized and industrializing countries but also to CEER.<sup>1</sup>

Post-reform time paths of major economic variables were also quite different among the transition economies. In China, a relatively small proportion of workers experienced declining real incomes in the early transition whereas, in CEER, the opposite was true. This striking contrast raises several issues, including the role of economic reforms, the speed of relaxation of the old planning constraints, and the new forms of ownership in promoting changes in relative wages. Did these forces lead to different time paths in returns to schooling within the CEER and the larger variation between CEER and China, and were their impacts different? The path of returns to schooling in transition economies has evolved in two phases (Sabirianova Peter, 2003). The early phase encompasses the period in which the transition economies moved from wage setting under

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<sup>1</sup> Zhang and Zhao (2002) and Fleisher and Wang (2005) provide summaries of the estimated returns to schooling in China. The reviews of the estimated rates of return in CEER countries are found in numerous studies, including Boeri and Terrell (2002), Brainerd (1998), Münich et al. (2005a), and Rutkowski (2001).

the wage grids toward a phase in which wages reflect the relative marginal products of skilled and unskilled workers. In the latter phase, the path of relative wages is expected to match more closely the path of relative marginal products of skilled and unskilled, or highly educated and less educated, workers. This paper deals primarily with wage adjustments during the initial, disequilibrium phase of economic transition in CEER and China.

One obvious hypothesis to explain wage adjustments during the first phase is that the speed of relative wage adjustment to the ratio of marginal products reflects the speed of the relaxation of legal, regulatory, and institutional constraints on wage-setting behavior. Thus, the higher the speed of reforms, the faster should returns to schooling be adjusted to market rates.<sup>2</sup> A second hypothesis explaining the relatively rapid increase in returns to schooling in CEER is that structural transformations, disruptions, and economic disequilibria are important factors so that the rapid increase in returns to schooling during the first phase reflects the ability of highly-educated individuals to respond to changing opportunities in a disequilibrium situation (Schultz, 1975). The two hypotheses, namely the speed of reforms and disequilibrium, are not mutually exclusive. We compare their relative importance with metadata from 39 studies of 11 transition economies, linking these data to a rich set of measures on reform progress and macroeconomic volatility.

Throughout the paper, we define the beginning of reform on the basis of political, legislative, and administrative changes that indicate a departure from the intent to control the economy according to an official plan and the promotion of policies that allow or encourage evolution toward a market economy. These dates are associated closely with the beginning of comprehensive price and trade liberalization programs in CEER and with the year following the end of the Cultural Revolution in China.<sup>3</sup> The rest of the paper proceeds as follows. In the next section, we describe the metadata on returns to schooling in transition economies. In Section 3, we discuss various measures of the speed of reforms and macroeconomic volatility. In Section 4 we present an empirical model with which we attempt to account for cross-section and over-time variation in rates of return as a function of reform processes, i.e., timing, speed, and volatility, estimation methods, and sample characteristics. Section 5 reports empirical findings and Section 6 provides a summary of the results.

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<sup>2</sup> We note that variation in initial conditions could also play an important role. This is related to the speed of reforms hypothesis in that the countries having economies that were market-based under Communism had less catching-up to do once the transition to a market economy was underway but also potentially less to gain from catching up. At one extreme, Hungary was among the least-distorted economies operating in the Soviet bloc; on the other hand, the economies of Romania in Eastern Europe and China were much more severely constrained under socialist planning. For rural China, which was heavily distorted under planning but reformed rapidly at the end of the Mao era, Yang (2005) presents evidence that rural households benefited significantly if one or more of their members had obtained a relatively high level of schooling. In our empirical model of returns to schooling, we control for cross-country differences in initial conditions.

<sup>3</sup> The start of reforms is determined as follows: 1979 for China, 1990 for Hungary and Poland, 1991 for the Czech and Slovak Republics and Slovenia, and 1992 for Estonia, Romania, Russia and Ukraine.

## 2. Metadata on returns to schooling in transition economies

In this paper, we use meta-analysis that integrates the results of several studies of the returns to schooling in transition economies.<sup>4</sup> Our data set contains 529 different returns to schooling obtained from 39 studies in 11 transition economies.<sup>5</sup> Table 1 presents the descriptive statistics for this sample of studies, the full listing of which is reported in [Appendix A](#). Returns to schooling are estimated mainly by ordinary least squares (OLS). Only 6.4 percent of the estimates are obtained by instrumental variables (IV) or two-stage least squares (2SLS) methods, due to the lack of valid instruments in many data sets on transition economies. Most estimates are obtained directly from the coefficients on the years of schooling; only 4.7 percent of the estimates are imputed based on specifications with the level of schooling. Imputations are performed for countries having no direct estimates of the returns to the year of schooling, as opposed to the level of schooling, such

Table 1  
Characteristics of the metadata on returns to schooling

Metadata characteristics	All	Pre-reform period	Reform period
<b>Observations</b>			
Number of countries	11	10	11
Number of studies	39	19	39
Number of estimates	529	101	428
<b>Proportion of estimates</b>			
<i>Methods of estimations</i>			
Non-OLS estimation	0.064	0.020	0.075
Imputed values	0.047	0.059	0.044
<i>Specifications of the earnings function</i>			
Industry of employment included	0.350	0.376	0.343
Occupation included	0.129	0.059	0.145
Firm characteristics included	0.223	0.059	0.262
Adjusted for hours	0.144	0.000	0.178
<i>Sample characteristics</i>			
Sample of men and women	0.533	0.426	0.558
Men sample	0.244	0.287	0.234
Women sample	0.223	0.287	0.208
Employer-based sample	0.070	0.040	0.077
Household-based sample	0.930	0.960	0.923

Note: The start of reforms is given as: 1979 for China, 1990 for Hungary and Poland, 1991 for Bulgaria, the Czech and Slovak Republics and Slovenia, 1992 for Estonia, Romania, Russia and Ukraine.

<sup>4</sup> Ashenfelter et al. (1999) and Denny et al. (2002) provide meta-analyses of returns to schooling for a large sample of countries. Only the latter study includes transition countries, but the estimates of the returns to schooling do not vary over time.

<sup>5</sup> The original number of estimates exceeds 550 but, for the purpose of our analysis, we exclude countries with insufficient data to establish a time trend in returns to schooling. Among the excluded countries are Macedonia, Vietnam, and the countries of Central Asia. We also exclude three outliers from the studies on China; these are (−0.067) in 1977 for a very small sample of 668 workers from one China village reported by Li and Zhang (1998); extremely high estimates of 0.326 and 0.356 for China in 1995 also for a very small sample of 590 Chinese women reported by Li and Luo (2004).

as Estonia, Poland, and Slovenia. Standard errors or t-statistics of the coefficient on the years of schooling are reported in 74.4 percent of all studies. Almost all studies rely on self-reported or employer-reported nominal wages, although in a few cases adjustments have been made for payments in kind or for access to cheap goods in short supply priced below market, such as housing, quality consumer goods, and automobiles. To the extent that the proportion of such non-reported income, including bribes and under-the-table payments for medical services is positively correlated with schooling, studies that ignore these aspects underestimate the true return to schooling.

In addition to traditional covariates, such as years of schooling and both linear and quadratic terms of experience, many earnings functions include individual characteristics that might affect the estimated returns to schooling. In our sample, the industry of employment is included as a regressor in 35 percent of the estimates. Firm characteristics, such as size, age, and ownership, are included in 22.3 percent of the estimates. Having occupational dummies in the earnings functions is less common (12.9 percent). Only a few estimates control for hours of work (14.4 percent) using either hourly wage rate on the left-hand side or including log of hours on the right-hand side of the earnings function. No hourly data have been used in the pre-reform period, but these data are becoming increasingly more available for the transition countries over time. Occasionally, earnings functions control for ethnicity, party membership, school quality, language, marital status, parental income, health, and family background. Compared to the common use of the ability controls in many US studies (Ashenfelter et al., 1999), we did not find any study in transition economies that controls explicitly for ability measures.

Sample size varies significantly; the largest samples come from administrative data, and the smallest samples are drawn in the pre-reform period in China and Russia. The samples are based mainly on household surveys, with 7 percent derived from surveys of employers or from administrative data. Roughly half of the estimates are based on combined samples of men and women, with the other half based on gender-specific samples.

Table 2 reports average returns to schooling for 11 countries by year from 1975 through 2002. Between 1 and 9 countries are represented in each year and a substantial number of estimates come from the early 1990s. The overall trend of returns to schooling is positive, as expected, and highly significant with a noticeable increase in the mean and variance of the returns to schooling over time. The time path of returns to schooling has not been uniform across countries or steady within countries over time, as Table 3 indicates. Initial reform years are indicated in column 1. In the countries' respective pre-reform periods, schooling rates ranged from a low of 1.5 percent in China to a high of 6.3 percent in Hungary, a country that did not adhere to the strict model of Soviet planning. The estimated returns to schooling under Communist wage grids were considerably below typical estimates for a market economy.<sup>6</sup> During the early reform period, defined as the first five years in Table 3, schooling returns increased in China, but from an extremely low level to one that remained far below those in other transition economies. These returns rose much more

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<sup>6</sup> Card (1999) reviews a range of studies in which most of the estimated schooling effects using recent US data are well above the estimates for the pre-transition period.

Table 2

Average returns to schooling in transition economies

Year	Mean	Std. dev.	No. of countries	No. of studies	No. of estimates
1975	0.016	0.003	1	1	9
1978	0.014	0.002	1	1	9
1981	0.025	0.000	1	1	1
1984	0.035	0.015	3	3	21
1985	0.029	0.013	3	5	14
1986	0.045	0.014	5	8	15
1987	0.040	0.010	4	6	15
1988	0.039	0.008	4	8	24
1989	0.045	0.016	6	9	18
1990	0.045	0.010	4	5	18
1991	0.049	0.017	7	10	37
1992	0.058	0.019	9	14	44
1993	0.054	0.011	8	8	30
1994	0.063	0.020	7	11	43
1995	0.085	0.035	9	13	39
1996	0.075	0.017	8	15	44
1997	0.068	0.029	8	8	26
1998	0.075	0.025	6	8	33
1999	0.100	0.025	3	3	9
2000	0.085	0.036	5	8	48
2001	0.093	0.017	1	1	9
2002	0.072	0.025	3	4	23
Total	0.061	0.029	11	39	529

in percentage points in the other countries for which comparisons can be made.<sup>7</sup> The only exception in CEER is Hungary, where the returns were much higher prior to reform than in the other planned economies. Some variation is noticeable in the time paths of rates of return among the CEER countries, particularly between low-return countries, e.g., Romania and Ukraine, and the other CEER countries. However, the biggest gap in the first phase is between the CEER countries on the one hand and China on the other.<sup>8</sup>

### 3. Returns to schooling, the speed of reforms, and macroeconomic disequilibrium

The central issue is to what extent cross-country variation in the growth of returns to schooling in transition economies can be explained by the speed of market reforms, initial conditions, and by the degree of macroeconomic volatility during the early reform period.

<sup>7</sup> We have calculated the statistical significance of the change in returns to schooling for each country for which we have sufficient data. Between the pre-reform and early reform periods, an increase in returns to schooling was statistically significant at the 1% level in the Czech Republic, Poland, Russia, and Slovenia and at the 8% level in Romania and the Slovak Republic, but it was not significantly different from zero in Hungary. Between the pre-reform and late-reform periods, all countries except Ukraine exhibit a significant increase in returns to schooling.

<sup>8</sup> The gap in returns to schooling between China and Russia will appear somewhat smaller if we use 1987, which is the beginning of Gorbachev's gradual economic reforms, or perestroika, as the start of Russian reforms.

Table 3  
Returns to schooling and reform starting points

Country	Reform starting point	Pre-reform period	Early reform period	Late reform period
Bulgaria	1992	na	0.054 (0.004)	0.065 (0.004)
China	1979	0.015 (0.003)	0.025 (0.000)	0.061 (0.033)
Czech Republic	1991	0.041 (0.011)	0.071 (0.024)	0.083 (0.024)
Estonia	1992	0.021 (0.000)	0.061 (0.008)	na
Hungary	1990	0.063 (0.011)	0.077 (0.027)	0.098 (0.024)
Poland	1990	0.049 (0.006)	0.070 (0.009)	0.076 (0.006)
Romania	1992	0.039 (0.008)	0.050 (0.014)	0.065 (0.021)
Russia	1992	0.037 (0.009)	0.075 (0.011)	0.090 (0.011)
	1987	0.029 (0.004)	0.042 (0.008)	0.082 (0.013)
Slovak Republic	1991	0.043 (0.016)	0.065 (0.020)	0.097 (0.023)
		0.057 (0.003)	0.080 (0.008)	0.092 (0.001)
Ukraine	1992	0.044 (0.021)	na	0.048 (0.021)
	1987	0.040 (0.019)	0.049 (0.024)	0.047 (0.021)

Notes: (i)  $N = 539$ . (ii) Standard deviations are in parentheses. (iii) Early reform period is defined as first five years of reforms. (iv) The reform starting point is defined as the beginning of comprehensive price and trade liberalization programs in CEER and the year following the end of Cultural Revolution in China. (v) For Russia and Ukraine we also consider an alternative starting point: beginning of “perestroika” or gradual economic reforms in 1987.

To define reform progress, we consider four broad dimensions: liberalization of prices and wages, private ownership, enterprise reforms, and the openness of the economy. We employ quantitative measures such as the proportion of GDP produced in the private sector and the share of foreign direct investment (FDI) in GDP as well as qualitative indices developed by the European Bank for Reconstruction and Development (EBRD), such as the degree of price and trade liberalization, large-scale privatization, and enterprise restructuring.<sup>9</sup> The EBRD indices are available for all CEER countries for 1991 to 2002. To extend the series, we sought experts’ opinions on the indices for the pre-reform period and for China. Additionally, we developed our own index of wage liberalization to assess the countries’ departure from the wage grid towards market-based wage determination.<sup>10</sup> All

<sup>9</sup> Definitions of all reform measures and data sources are available upon request.

<sup>10</sup> The index of wage liberalization is constructed on the base of experts’ opinions and documented institutional changes in the labor market.

Table 4  
Measures of the speed of reforms during the early reform period

	Liberalization of			Large-scale	Enterprise	FDI	Private sector	Speed of
	wages	prices	foreign trade	privatization	reforms	(% GDP)	share of GDP	reforms
<i>End of period</i>								
Bulgaria	3	2	4	2	2	0.69	0.50	0.25
China	1.3	1.3	1.3	1	1	0.28	0.02	−1.15
Czech Republic	4	3	4	4	3	4.93	0.70	1.30
Estonia	4	3	4	4	3	3.45	0.70	1.28
Hungary	4	3	4.3	3	3	2.76	0.55	0.98
Poland	3	3	4	3	3	1.85	0.55	0.84
Romania	3	3	3	2.7	2	0.79	0.55	0.45
Russia	4	3	4	3	2	0.62	0.60	0.80
Slovak Republic	3.7	3	4	3	3	1.23	0.60	0.93
Slovenia	3	3	4	2.7	2.7	0.8	0.50	0.67
Ukraine	3	3	3	2	2	1.17	0.50	0.26
<i>5-year change</i>								
Bulgaria	2	1	3	1	1	0.67	0.30	1.39
China	0.3	0	0	0	0	0.28	0.02	0.04
Czech Republic	3	2	3	3	2	4.72	0.58	2.50
Estonia	2	1	2	3	2	3.45	0.60	2.10
Hungary	1	1	1.3	2	1	2.12	0.40	1.36
Poland	2	2	3	2	2	1.83	0.26	1.91
Romania	1	1	2	1	1	0.65	0.30	1.15
Russia	2	2	3	2	1	0.62	0.55	1.95
Slovak Republic	2.7	2	3	2	2	1.23	0.48	2.13
Slovenia	1	0	1	1.7	1.7	0.77	0.39	1.18
Ukraine	1	2	2	1	1	1.17	0.40	1.38

*Note:* Early reform period is defined as first five years of reforms.

*Sources:* EBRD Transition Reports (various issues), 2003 World Development Indicators; UNCTAD; National Statistical Yearbooks.

reform indicators range from 1 to 4, with 1 indicating little or no change from rigid central planning and 4 indicating that the level of reform is consistent with a well-functioning market economy.

Table 4 contains several measures of the speed of reforms in CEER and China in the early reform period. In addition to the end-period values, we show the change in reform measures during the first five years of transition. We use factor analysis to derive an overall measure of the speed of reforms, which is a composite of all seven interrelated reform indices and variables. The value of this factor for each country, relative to the mean for all countries, is shown in the last column. After five years from the start of transition, all CEER countries became essentially market economies, with free prices and wages, open foreign trade, almost completed large-scale privatization, and a significant share of the private sector in GDP. However, the big bang reform that describes much of CEER has not characterized China, where the Chinese Communist Party has retained political power throughout the economic transition. The Chinese approach to transition has been aptly described as growing out of the plan by Barry Naughton (1995) and by Deng Xiaoping's phrase of crossing the river by groping for stones (Qian and Wu, 2003). Several years into



Table 5  
Macroeconomic performance during the early reform period

Country	5-year cumulative percentage			Annual standard deviation		
	Real GDP growth	Inflation	Real wage growth	Real GDP growth	Inflation	Real wage growth
Bulgaria	−31.6	4231.6	−42.0	4.4	114.8	26.7
China	47.8	16.7	15.1	2.1	2.4	3.3
Czech Republic	−4.7	152.2	−1.4	6.5	20.2	15.3
Estonia	−23.6	5134.7	−35.7	10.7	460.7	23.7
Hungary	−15.7	209.5	1.8	5.5	6.3	1.8
Poland	−3.4	2887.3	−28.4	6.1	242.2	12.2
Romania	7.9	4704.4	−10.4	6.3	100.2	13.1
Russia	−37.0	322,430.7	−55.3	4.9	691.3	21.5
Slovak Republic	−15.3	171.8	−19.2	9.2	21.7	15.0
Slovenia	−2.8	1107.2	−8.8	6.5	83.0	13.1
Ukraine	−52.8	5,389,377.0	−48.9	5.4	1883.4	24.3

Notes: (i) Early reform period is defined as first five years of reforms. (ii) The start of reforms is given as: 1979 for China, 1990 for Hungary and Poland, 1991 for Bulgaria, the Czech and Slovak Republics and Slovenia, and 1992 for Estonia, Romania, Russia and Ukraine.

Sources: 2003 World Development Indicators, IMF, and National Statistical Yearbooks.

the reform era, China not only had less liberal price, wage, and foreign trade regimes than any of the CEER countries, but it also exhibited the smallest increase in the degree of liberalization, except for Slovenia, which had less rigidly controlled prices initially. After five years of reforms, China had moved much less rapidly in the privatization process outside agriculture and rural enterprises than many of the CEER countries. Although some tentative management reforms and budget tightening among state-owned enterprises were undertaken (Johnson, 1990; Groves et al., 1995), soft budget constraints in state-owned enterprises were common until well into the 1990s, almost 20 years after the end of the Cultural Revolution (Appleton et al., 2002).

In contrast to China, all CEER countries enacted and carried out policies to liberalize prices, wages, and foreign trade; however, significant differences in the speed of privatization and enterprise reforms appear within the CEER group. For example, the EBRD ranked privatization results in Romania, Slovenia, and Ukraine low compared to other countries in the region. Romania, Russia, and Ukraine still retained soft budget constraints and the enforcement of bankruptcy legislation remained weak well into the reform period, whereas other countries hardened budget constraints and promoted corporate governance effectively.

In contrast to its relatively slow movement toward free markets, China experienced the most rapid economic growth among these transition economies. Table 5 contains data on real GDP growth, real wage growth, and inflation over the first five reform years. China experienced the largest real GDP growth and real wage growth during the first five transition years, while real wages declined in all CEER countries except Hungary. Table 5 also illustrates that the effects of a loss of macroeconomic control defined as the fraction of total output produced under the Plan were felt much more sharply in CEER than in China. In China, where the early transition was more gradual, inflation was lower than in any CEER country. Other measures of macroeconomic volatility, i.e., the standard deviations of real

GDP growth and real wage growth, and the level and standard deviation of consumer inflation over the early reform period, also indicate less volatility in China than in the CEER, the only exception being the standard deviation of real wage growth Hungary. This variation in the volatility of economic development across countries and between CEER and China may explain cross-country differences in returns to schooling in the early reform period. According to [Schultz \(1975\)](#), a rapid increase in returns to schooling may reflect the ability of highly-educated individuals to exploit opportunities that emerge in periods of disequilibrium. Hence, both disequilibrium and the speed of adjustment should determine the payoff to schooling during the transition process.

#### 4. An empirical model of cross-country differences in returns to schooling

In this section, we present an empirical framework for explaining the cross-country and over-time variation in returns to schooling based on differences in the speed of reforms and the volatility of economic change. First, we specify a baseline equation for the returns to schooling as a function of reform timing, methods of estimation, specifications of the earnings functions, and sample characteristics, i.e.,

$$r_{it} = \alpha_0 + \alpha_1 \tau_{it} + \alpha_2 \tau_{it} TE_{it} + \alpha_3 \tau_{it} TL_{it} + \alpha_4 C_i + \gamma_1 M_{it} + \gamma_2 P_{it} + \gamma_3 S_{it} + \varepsilon_{it}. \quad (1)$$

In Eq. (1),  $r_{it}$  represents the estimates of the returns to schooling for country  $i$  in year  $t$ ,  $C_i$  is a country dummy variable,  $TE_{it}$  is the early transition period defined as the first five years since the reforms started,<sup>11</sup>  $TL_{it}$  is the late transition period,  $\tau_{it}$  is the time trend relative to the country-specific reform starting point with  $\tau_{it} = 1$  the beginning of reforms, and  $\varepsilon_{it}$  is an error term that is independently and identically distributed  $E(\varepsilon) = 0$ . Other variables control for the methods of estimation,  $M_{it}$ , the specifications of the estimated earnings functions,  $P_{it}$ , and sample characteristics  $S_{it}$ .<sup>12</sup>

The baseline equation enables us to compare trends in returns to schooling between pre-reform, early, and late transition periods. In addition, we can identify the extent to which alternative estimation methods, model specifications, and different sample characteristics affect systematically the estimates of the returns to schooling. The estimated coefficients of the country dummy variables will reveal if cross-country differences in the average returns to schooling are significant, *ceteris paribus*. We estimate the baseline equation both by regular unweighted OLS and by using weighting techniques in which estimates of returns to schooling having smaller standard errors and derived from larger samples receive proportionately larger weights, as [Denny et al. \(2002\)](#) suggest.

The extended model provides information on factors that may account for cross-country differences revealed in the baseline estimates. In the first extension, we add various mea-

<sup>11</sup> We have used alternative definitions of the early reform period as the first three and four years since the beginning of reforms. Our results are robust to these alternative specifications.

<sup>12</sup> The variables  $M_{it}$  include dummies for non-OLS estimation and imputed estimates from the coefficients on the type of education. The variables  $P_{it}$  are dummy variables indicating whether the estimated earnings functions include industries, occupations, firm characteristics, and hours of work.  $S_{it}$  is a vector of controls for household-based and employer-based samples and gender-specific samples.

sures of reform progress and macroeconomic volatility as follows:

$$r_{it} = \alpha_0 + \alpha_1 \tau_{it} + \alpha_2 \tau_{it} TE_{it} + \alpha_3 \tau_{it} TL_{it} + \alpha_4 C_i + \alpha_5 X_{it} + \alpha_6 Z_{it} + \gamma_1 M_{it} + \gamma_2 P_{it} + \gamma_3 S_{it} + \varepsilon_{it}, \quad (2)$$

where  $X_{it}$  is a vector of variables that reflect a country's progress towards a market economy and  $Z_{it}$  is a vector of variables measuring macroeconomic volatility. Since many of these variables are highly correlated, we employ alternative specifications that include at least one measure of reform progress and one measure of macroeconomic volatility. In addition, we use the two composite measures of the speed of reforms and the volatility of reforms derived from the factor analysis. We hypothesize that the returns to schooling is positively related to both the progress of economic reform economic volatility, *ceteris paribus*.

Our measures of reform progress, or market development, are cumulative in nature and reflect not only the state of reforms at any given point of time but also changes accumulated over the past pre-reform and reform years. Thus, these variables may not measure the speed of reforms for the countries that adopted market socialism and were already partially liberalized before the transition started, e.g. Hungary and Slovenia. In a further extension of the baseline model, we distinguish between the effects of initial conditions and the effects of the speed of reforms on the returns to schooling as follows<sup>13</sup>:

$$r_{it} = \alpha_0 + \alpha_1 \tau_{it} + \alpha_2 \tau_{it} TE_{it} + \alpha_3 \tau_{it} TL_{it} + \alpha_4 X_{i0} + \alpha_5 \Delta X_{i5} + \alpha_6 Z_{it} + \gamma_1 M_{it} + \gamma_2 P_{it} + \gamma_3 S_{it} + \varepsilon_{it}, \quad (3)$$

where  $X_{i0}$  is a vector of initial conditions and  $\Delta X_{i5}$  is a vector of the speed of reforms variables. We modify the measures of reform progress as in Eq. (2) to reflect the speed of reforms, using the difference between the value of the market development index in the fifth year of reforms ( $X_{i5}$ ) and the value of the market development index in the last year of the old system ( $X_{i0}$ ).

## 5. The estimation results

Both OLS and weighted-least squares-estimates of the baseline regression are reported in Table 6. Since we find no principal differences between the two sets of estimated coefficients, the remaining discussion is based on the OLS estimates with country fixed effects. All estimated coefficients meet customary significance standards, unless otherwise indicated. On average, rates of return increase by 0.2 of a percentage point per year during the respective countries' planning periods, as the coefficient on the trend variable indicates. Rates of return increase by 0.5 of a percentage point per year during early reform and by 0.3 of a percentage point during the late reform. Thus, returns to schooling are estimated to have the highest rate of growth during the early period of the transition to a market

<sup>13</sup> By including country dummies in Eq. (2), we control for initial conditions even though the effect of initial conditions is not directly observable.

Table 6

Returns to schooling in early and late reform periods, fixed effects

Variables	Unweighted OLS		Weighted OLS	
	Coeff.	Robust std. error	Coeff.	Robust std. error
Constant	0.044***	0.002	0.045***	0.002
Time	0.002***	0.001	0.003***	0.001
Time * <i>TE</i>	0.003***	0.001	0.002**	0.001
Time * <i>TL</i>	0.001**	0.001	0.001	0.001
Non-OLS estimation	0.049***	0.006	0.048***	0.004
Imputed values	0.004	0.003	0.005*	0.003
Industry included	−0.004***	0.002	0.000	0.001
Occupation included	−0.016***	0.002	−0.016***	0.002
Firm characteristics included	−0.003	0.002	−0.005**	0.002
Adjusted for hours	0.001	0.003	0.001	0.002
Men sample	−0.007***	0.001	−0.006***	0.002
Women sample	0.007***	0.002	0.007***	0.002
Sample of employers	0.015***	0.004	0.015***	0.003
Countries				
Bulgaria	−0.001	0.004	−0.003	0.004
China	−0.028***	0.002	−0.037***	0.003
Czech Republic	0.004	0.003	0.009***	0.003
Estonia	0.002	0.006	0.000	0.005
Hungary	0.021***	0.004	0.021***	0.003
Poland	0.011***	0.002	0.011***	0.002
Russia	0.011***	0.002	0.008***	0.002
Slovak Republic	0.005	0.004	0.000	0.004
Slovenia	0.021***	0.004	0.018***	0.004
Ukraine	−0.022***	0.003	−0.025***	0.003
<i>F</i> -test for 3 time variables	147.63		156.68	
<i>F</i> -test for 10 country dummies	43.99		52.02	
<i>N</i>	529		529	
<i>R</i> <sup>2</sup>	0.781		0.879	

Notes: (i) The dependent variable is returns to schooling. (ii) In weighted OLS regression, weights are given by the inverse of the standard error of the estimate of the returns of schooling. (iii) The abbreviation *TE* = early transition period defined as first five years since the start of reforms; the abbreviation *TL* refers to the late transition period. The benchmark is the pre-planning period. (iv) The time trend is relative to the country-specific reform starting point (time = 1 at the beginning of reforms, 0 the year before the beginning, −1 second year before, and so on). (v) Romania is the omitted country.

\* Significance at the 10% level.

\*\* Idem., 5%.

\*\*\* Idem., 1%.

economy. Even after controlling for the timing of reform, methods of estimation, the specifications of the estimated earnings functions, and sample characteristics, cross-country differences in return to schooling remain significant with China and Ukraine having the lowest rates. Estimates reported in studies in which years of schooling are imputed are marginally larger, but only the weighted-OLS coefficient is statistically significant and only at the 10% level. When occupation is included, estimated returns to schooling are considerably smaller for well-known reasons. When the industry of employment is included, the

statistically significant estimated return to schooling is lower by 0.4 of a percentage point in unweighted regressions, but it is no different in weighted-OLS regressions. Inclusion of firm characteristics such as size, age, and ownership lowers the estimated returns to schooling by 0.3 of a percentage point in the unweighted regression, although the coefficient is insignificant, and by 0.5 of a percentage point in the weighted regression with a significant coefficient. When earnings data are adjusted for hours worked, estimated returns to schooling are not significantly larger, which is somewhat surprising given the analysis of [Schultz \(1988\)](#). Estimates based on all-male samples are somewhat smaller and those based on all-female samples are somewhat larger than those in which both genders are represented in the data, which is consistent with studies from the US and other countries ([Dougherty, 2003](#)).

The largest effects on returns to schooling result from non-OLS estimation, mainly using IV techniques, and using a sample that is employer-based rather than worker-based. This result is generally consistent with the difference between IV and OLS estimates reported in several studies by [Card \(2001\)](#). The interpretation of this gap remains unresolved in the literature and, as Card emphasizes, interpreting IV estimates as unbiased indicators of the impact on wages of additional schooling requires caution. [Heckman et al. \(2004\)](#) urge extreme caution in drawing causal inferences from classical IV estimates. The employer-based results are consistent with the view that measurement and recall errors are important in schooling data and that employer data are more accurate than worker recollection in measuring years of schooling, as [Card \(2001\)](#) and [Griliches \(1977\)](#) discuss. We also note that, if unreported under-the-table payments to skilled and professional workers led to underestimation of returns to schooling under planning, employer-reported data would not yield higher estimated rates of return, which is opposite to what our meta-data reveal. We find no evidence that increases in estimated returns to schooling over time are attributable to the use of IV or other advanced estimation procedures in the later period.

The regressions reported in [Table 7](#) account for cross-country differences in the rates of return to schooling by adding to the benchmark regression, one at a time, seven alternative measures of the speed of economic reform and seven alternative measures of macroeconomic volatility. The regression in the last column uses the summary measures of speed of reform and volatility obtained by factor analysis from the other seven measures. We expect the level and speed of reforms to represent the relaxation of legal, regulatory, and institutional constraints on wage-setting behavior, causing returns to schooling to adjust to market rates, while macroeconomic volatility increases the payoff to schooling as described by [Schultz \(1975\)](#). All the coefficients on the speed of reform and macroeconomic volatility variables are of the expected signs and statistically significant. When the speed of reforms and the volatility variables are added to the baseline regression, the *F*-statistic for the joint significance of the time variables falls by nearly one-half. Adding these variables also reduces substantially the *F*-statistic for the joint country effect. For the baseline regression reported in column 1 of [Table 6](#), the *F*-statistic for significance of the country dummies as a group is 43.99. In [Table 7](#), this statistic falls to between 27.63 and 41.74, depending on the specification. Furthermore, the cross-country differences in the estimated returns to schooling, including China–CEER differences, falls significantly when the speed-of-reform variables are added to the baseline model, although this result is not shown in [Table 7](#).

Table 7  
Panel A. Returns to schooling, the speed of reforms, and macroeconomic volatility, fixed effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Private sector share of GDP	Liberalization of wages	Liberalization of prices	Foreign trade liberalization	Large-scale privatization	Enterprise reforms	FDI share of GDP	Speed of reforms
Speed of reforms	0.020*** (0.005)	0.004*** (0.002)	0.008*** (0.002)	0.002* (0.001)	0.003* (0.001)	0.005*** (0.001)	0.001** (0.000)	0.006*** (0.002)
	Mean (real GDP growth)	Mean (inflation)	Mean (real wage growth)	Annual inflation	Std.dev. (real GDP growth)	Std.dev. (inflation)	Std.dev. (real wage growth)	Volatility of reforms
Volatility/100	−0.054** (0.027)	0.001** (0.001)	−0.039** (0.016)	0.001** (0.000)	0.190*** (0.054)	0.001** (0.000)	0.064*** (0.016)	0.367*** (0.128)
Time/100	0.099* (0.054)	0.058 (0.061)	0.056 (0.061)	0.111* (0.062)	0.059 (0.055)	0.150*** (0.057)	0.139** (0.054)	0.068 (0.057)
Time * <i>TE</i>	0.002** (0.001)	0.003*** (0.001)	0.001 (0.001)	0.003*** (0.001)	0.003*** (0.001)	0.001 (0.001)	0.002** (0.001)	0.002* (0.001)
Time * <i>TL</i>	0.002*** (0.001)	0.002*** (0.001)	0.002** (0.001)	0.002*** (0.001)	0.002*** (0.001)	0.001* (0.001)	0.001* (0.001)	0.002*** (0.001)
Constant	0.039*** (0.003)	0.035*** (0.004)	0.028*** (0.004)	0.038*** (0.003)	0.028*** (0.003)	0.039*** (0.003)	0.037*** (0.003)	0.047*** (0.002)
<i>F</i> -test for 3 time variables	54.97	62.25	22.46	78.78	54.65	89.55	48.12	37.48
<i>F</i> -test for 10 country dummies	27.63	33.52	34.13	36.30	30.87	29.03	41.74	32.33
<i>N</i>	529	529	529	529	529	529	529	529
<i>R</i> <sup>2</sup>	0.788	0.785	0.792	0.783	0.789	0.786	0.788	0.789

(continued on next page)

Table 7 (continued)

Panel B. Changes in returns to schooling (estimated regression coefficients  $\times$  one standard deviation of the respective variables)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Private sector share of GDP	Liberalization of wages	Liberalization of prices	Foreign trade liberalization	Large-scale privatization	Enterprise reforms	FDI share of GDP	Speed of reforms
Speed of reforms	0.0050	0.0043	0.0064	0.0023	0.0030	0.0037	0.0022	0.0050
	Mean (real GDP growth)	Mean (inflation)	Mean (real wage growth)	Annual inflation	Std.dev. (real GDP growth)	Std.dev. (inflation)	Std.dev. (real wage growth)	Volatility of reforms
Volatility/100	−0.0029	0.0018	−0.0022	0.0011	0.0031	0.0020	0.0040	0.0027

Notes: (i) The dependent variable is returns to schooling. (ii) Robust standard errors are in parentheses. (iii) All specifications include the same set of variables as in Table 6, including country fixed effects. (iv) Changes in returns to schooling show changes in the mean value of returns to schooling in response to one standard deviation increase in the corresponding measure of the speed of reforms and volatility. (v) *TE* = early transition period defined as first five years since the start of reforms; *TL* = late transition period. (vi) Time = time trend relative to the country-specific reform starting point (Time = 1 at the beginning of reforms). (vii) Means and standard deviations are calculated over three periods.

\* Significance at the 10% level. \*\* Idem., 5%. \*\*\* Idem., 1%.

Table 8

Returns to schooling, initial conditions, and the speed of reforms

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Private sector share of GDP	Liberalization of wages	Liberalization of prices	Foreign trade liberalization	Large-scale privatization	Enterprise reforms	FDI share of GDP	Speed of reforms
Initial conditions	0.052*** (0.008)	0.014*** (0.001)	0.020*** (0.002)	0.019*** (0.002)	0.013*** (0.003)	0.029*** (0.003)	0.050*** (0.006)	0.030*** (0.003)
5-year difference	0.047*** (0.006)	0.013*** (0.001)	0.016*** (0.001)	0.013*** (0.001)	0.014*** (0.001)	0.016*** (0.001)	0.001* (0.001)	0.015*** (0.001)
	Mean (real GDP growth)	Mean (inflation)	Mean (real wage growth)	Annual inflation	Std.dev. (real GDP growth)	Std.dev. (inflation)	Std.dev. (real wage growth)	Volatility of reforms
Volatility/100	−0.050* (0.029)	0.001* (0.001)	−0.087*** (0.016)	0.001 (0.001)	−0.012 (0.059)	0.003*** (0.000)	0.116*** (0.017)	0.562*** (0.118)
<i>N</i>	529	529	529	529	529	529	529	529
<i>R</i> <sup>2</sup>	0.704	0.729	0.704	0.751	0.711	0.710	0.674	0.737

Notes: (i) The dependent variable is returns to schooling. (ii) All specifications include the same set of variables as in Table 6, except for country fixed effects. (iii) Means and standard deviations are calculated over three periods.

\* Significance at the 10% level. \*\*\* Idem., 1%.

An alternative way to assess the explanatory power of the speed of reform and volatility variables is to use the estimated coefficients to project the impact of a unit change in the value of a regressor on the dependent variable. Given the arbitrary nature of the units of measurement of the regressors, we use one standard deviation as the unit. The estimated coefficient of privatization, as measured by the private share of GDP, implies that a one standard deviation increase in the private sector share leads to a 0.5 of a percentage point increase in the returns to schooling, *ceteris paribus*. Using the estimated coefficients reported in column (8) of Table 7, a one standard deviation increase in the speed of reforms factor is associated with an 0.5 of a percentage point increase in the rate of return to schooling, while a one standard deviation increase in the volatility factor is associated with a 0.27 of a percentage point increase in the return to schooling. These findings suggest that both reform speed and volatility are positively associated with an increase in the rate of return, but reform speed has a larger quantitative impact.

A complementary approach to investigating the factors associated with cross-country differences in return-to-schooling estimates focuses on the state of the respective economies at the beginning of reform and is reported in Table 8. We replace the country dummies with the initial levels of the reform variables used in the regressions of Table 7 and add their changes over the first five reform years.<sup>14</sup> All coefficients on the speed of reforms variables are statistically significant and have the expected positive sign. The effect of the speed of reforms measured as the five-year differences is consistent with the earlier estimates in which the speed of reforms is measured as the attained level of market reform progress. Moreover, initial conditions have a substantial effect on the estimated returns to schooling; the higher is the level of liberalization at the start of reforms, the higher are the initial returns. Countries with less administrative regulations on wages and prices during the planning period are estimated to have higher schooling returns. The volatility variables have the same signs as in Table 7, with the exception of the inflation rate and the standard deviation of real GDP growth that become statistically insignificant. To compare China with the other countries, we apply the estimated coefficients of the initial private sector share of GDP and the five-year differences in this variable. For example, Russia began its reform with approximately 5% of GDP produced in the private sector and ended with a 55% share, or a change of 50 percentage points. On the other hand, China scored near zero on both counts. Using these values, the implied difference in the returns to schooling between the two countries due to differences in the rate of privatization would be 2.8 percentage points.

## 6. Conclusion

This paper reports the results of a meta-analysis of studies of the returns to schooling in several Central and Eastern European countries, Russia, and China. Our empirical model permits us to account for cross-section and over-time variation in rates of return as a function of the timing, speed, and volatility of the transition from plan to market in addition

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<sup>14</sup> Alternatively, we calculated the speed of reforms as the total number of years required to achieve a given level of market development. Although not reported, these results are roughly similar to the ones presented in Table 8.



to the estimation methods used and sample characteristics. We find that both the speed of economic transformation and the degree of economic disequilibrium measured by macro-economic volatility explain differences in the increase in the rates of return to schooling over time and across countries. While both processes are commingled, we identify important independent effects of these two forces, namely that both speed of reforms and volatility are positively associated with returns to schooling, *ceteris paribus*, and the quantitative impact of speed of reforms is perhaps twice as large as that of volatility. The effects of sample characteristics and estimation techniques are consistent with the results of other meta-studies of returns to schooling. Larger estimated returns to schooling are obtained by non-OLS, mainly IV, techniques and using a sample that is employer-based rather than worker-based. However, we find no evidence that the increasing trend in estimated returns to schooling is attributable to the use of more sophisticated econometric techniques.

Although the explanatory powers of country dummy variables and of a time trend are reduced significantly when the speed of reforms and volatility variables are incorporated in the regressions, their regression coefficients remain statistically significant. China is an outlier in that its rapid economic growth is associated with returns to schooling that remain below world average for comparable countries. Unfortunately, we have no direct measures of factor productivity in China that can be compared with those in other transition economies. Thus, we cannot test directly the hypothesis that China could sustain the allocative inefficiency associated with low returns to schooling because it started the transition process from a position of low productivity relative to its frontier. If this hypothesis were true, the slow growth of the relative pay of skilled and educated workers may be compensated by overall real growth for most workers.<sup>15</sup>

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<sup>15</sup> Several hypotheses that have been advanced to explain China's relatively rapid growth compared with that of CEER countries during the transition. Solow (2003) argues that China's relatively low per-capita income at the beginning of reform is consistent with potential large gains from adopting and adapting existing technologies already available elsewhere. Adding China's high savings rate and its opening to foreign direct investment, an environment conducive to rapid productivity growth is likely. Consistent with Solow (2003), Sachs (1994) asserts that China's high proportion of agricultural labor and relatively small quantity of industrial capital at the beginning of reform allowed new investment without the overwhelming burden of reforming existing state enterprise. Similarly, Young (2003) cites the transfer of agricultural workers to the industrial sector as a principal source of China's economic growth during reform. Fleisher and Yang (2004) show that the marginal productivity gap between agriculture and rural industry and between rural and urban industry were large and remain so. Blanchard (1997) provides another, but not mutually exclusive, explanation by focusing on the disruption of supplies of essential commodities caused by the abrupt demise of state-owned enterprises in CEER and impeding the private sector from increasing production.

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## Appendix A. Sources of metadata

*China:* Byron and Manaloto (1990), Giles et al. (2004), Gregory and Meng (1995), Heckman and Li (2004), Jamison and van der Gaag (1987), Johnson and Chow (1997), Li (2003), Li and Luo (2004), Liu (1998), Maurer-Fazio (1999), Meng and Kidd (1997), Fleisher and Wang (2005), Wu and Xie (2002), Yang (2005), Zhang and Zhao (2002);

*Czech and Slovak Republics, Bulgaria, Hungary, Poland, Russia:* Brainerd (2000);

*Czech and Slovak Republics:* Chase (1998), Filer et al. (1999);

*Czech Republic:* Flanagan (1998), Jurajda (2003), München et al. (2005a, 2005b), Vecernik (2001);

*Estonia:* Noorkoiv et al. (1998);

*Hungary:* Campos and Jolliffe (2002), Kollo (2002), Varga and Galasi (2002);

*Poland:* Keane and Prasad (2002), Rutkowski (1996, 1997, 2001);

*Romania:* Andrén et al. (2005), Earle et al. (2002);

*Russia:* Brainerd (1998), Sabirianova Peter (2003);

*Russia and Ukraine:* Gorodnichenko and Sabirianova Peter (2005);

*Slovenia:* Orazem and Vodopivec (1997), Vodopivec (2002);

*Ukraine:* Gorodnichenko (2004).

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