How much human capital does Eastern Europe have? Measurement methods and results

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Abstract

There is a general consensus that human capital is a major determinant of economic development. However, the range of available human capital variables is very wide both in technical and theoretical sense, causing different human capital measures to be sometimes just loosely correlated. This is partly because they capture different aspects of human capital ranging from the resources devoted to human capital creation (without keeping account of market forces) to attaching a monetary value based on the market value of labour. Hence, different measures can lead to very different results and conclusions. This difference is especially prevalent in Eastern Europe which experienced a massive expansion of formal education in the 20th century which was not always paired by demand from the market or the efficiency of institutions. Consequently, while looking at the attainment figures only, one finds that Eastern Europe has about 70-80% of the USA's human capital in per capita terms in the 1990s. By using methods that measures the market value of human capital, however, this estimate reduces to 10-20%.

Keywords: Human capital, labour market, Eastern Europe

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Introduction

There is a general consensus that human capital is a major determinant of economic development. The majority of empirical and theoretical literature suggests a relationship among human capital endowment, social indicators, institutions and economic growth, making the estimation of human capital stock an important research topic in contemporary economics.

The range of available human capital variables is very wide both in technical and theoretical sense, causing different human capital measures to be sometimes just loosely correlated. Such variation in human capital related variables and proxies makes cross-country comparisons difficult, even though this is unavoidable if one seeks to explain income differences by variation in human capital endowment. For a large part these differences can be explained by the lack of clear distinction among proxies (variables thought to be related to human capital) and direct estimates of the human capital stock. Today's most popular human capital proxies, especially those related to educational attainment, reflect the amount or share of resources devoted to formal education in relative terms (relative to the total population) or expressed in terms of non-monetary measurement unit (years of schooling or number of students), but fail to capture what value is assigned to human capital by the market. Obviously, the value of a factor of production includes not only its quantity but its price as well, and therefore these proxies ignore an important component of human capital. Since the market value of human capital depends not only on educational attainment but also on

institutions, technology and the quantity of other factors of production, neglecting these factors causes misperceptions regarding the level of human capital stock in different economies: different measures can lead to very different results and conclusions.

In this paper we present and compare the estimates of the human capital stock in Eastern Europe created by different techniques. We choose this region not only because until recently it has not been given the proper attention in the literature, but because we expect that here the differences among the estimated human capital stocks by various methods will be especially large. The reason is that, even though Eastern Europe experienced a massive expansion of formal education in the 20th century, this process was not driven by market mechanisms, but rather by bureaucratic means. This, paired with central planning after 1945, supposedly led to a less efficient formation of human capital, i.e. lower returns to human capital and structural mismatch between supply and demand.

The paper follows the following structure: in section 2 we review the historical measures of human capital, i.e. proxies that are available for longer periods, often covering more than one century. This is followed by the variables related to educational attainment in section 3, while section 4 focuses on cost and income based methods, which allow one to express the estimated human capital stock in terms of currency units. In section 5 we compare the results from these different methods to find out how much human capital Eastern Europe has relative to Western Europe and the United States. Section 6 has the conclusions.

Historical measures and age-heaping

By historical measures, we mean those variables that are thought to be correlated with human capital endowment and are available over very long periods (often several hundred years). The greatest challenge of researching human capital in the very long-run is the poor

availability of data: often one simply needs to use what is available and therefore one should not expect or demand too much accuracy from the results. Here we mention three measures that have been used to approximate the amount of human capital in different societies and make cross-country comparisons possible even in the early modern period: the number of people who could sign a document (Johansson, 1981; Schofield, 1981; Houston, 1983; Reis, 2005), the number of published books (Baten and Van Zanden, 2007; Buringh and Van Zanden, (work in progress)), and the historical measurement of age heaping (Zelnik, 1961; Budd and Guinnane, 1991; A'Hearn, Baten and Crayen, 2006, Baten and Crayen, 2007).

Even though the number of books published in a country should be related to the development of its human capital, this measure is subject to certain biases. The first source of bias is that publishing and printing books requires a state of the art technology; countries with better printing capacities had an obvious advantage over the peripheries. This applies mainly to the 15^{th}-16^{th} centuries, since the technology of printing diffused relatively quickly in Europe (the first book was printed in 1473 in Hungary, just two decades after Gutenberg). The second factor that may strongly influence how many books are published in a country is politics: autocratic regimes often prohibited the publication of books that they considered too sensitive for one reason or another and these were usually printed in more tolerant countries, especially in England and the Low Countries. Looking at Table 1, which reports the number of books published per 1000 inhabitants in the core and the periphery of Europe throughout the Early Modern Period, one may sight the effect of both biases: we have no reason to believe that such tremendous difference in the number of books published in Western- and Eastern/Northern-Europe is attributable solely to difference in human capital endowment and the demand for books.

Table 1

Next, we turn to the historical measurement of age heaping. Age heaping is the tendency of the respondents in surveys to round their ages to the closest number ending on 5 or 0.[1] One can use the survey data to calculate the Whipple-index, which can be used as a measure of literacy/human capital. The index is calculated by taking the sum of all persons that report their age ending on 5 or 0, and dividing this by one-fifth of the number of respondents. In other words, the Whipple-index is the percentage of those respondents who falsely reports their age, under the assumption that ages ending on 5 and 0 have the same distribution in all age cohorts. In case of no age heaping one should find a Whipple index close to 100, and any higher value indicates a growing number of false reports. Age heaping measurement has not been developed as a historical measure, but rather as a proxy of literacy applied to developing countries and consequently has been adopted by the UN. It is reported for the first time in the UN's Demographic Yearbook Special Census Topics for the years 1985-2003.

The Whipple-index has gained popularity among economic historians too: most of the historical age heaping studies focus on the eighteenth and nineteenth century when the quickly developing bureaucracy had already produced military records and tax registers. Baten and Crayen (2007) report estimates of the Whipple-index for several regions for the period 1820-1940. Their results suggest the presence of a slow convergence in terms of numeracy/literacy and probably human capital endowment between Eastern Europe and the industrialized countries. In 1820 the Whipple index in Eastern Europe is roughly 200, while

[1] This tendency is subject of cultural differences, however, which is a major fallacy of age heaping when applied to measure differences in literacy and human capital endowment. While in Europe and Africa, one may find a tendency to round the respondents' age to a number ending on 5 or 0, in China the age-heaping follows a 12 year cycle, in conformity with the traditional Chinese calendar (Jowett and Li, 1992).

in Western Europe just 120. By the turn of the 19th and 20th century in both region the index reaches its minimum at circa 100 marking the point when the Whipple index will not supply us with any useful information about human capital these regions any more. Nevertheless, the difference in human capital endowment between Western and Eastern Europe suggested by the age heaping data seems to be much more believable than what we found with the book production data.

Literacy and educational variables

One very popular approach to approximate human capital stock is to equate human capital with the attained formal education. Since statistics on formal education are relatively easy to access, it is not surprising that the majority of empirical studies use either literacy or formal schooling data to proxy for human capital Famous examples are Barro (1991) and Mankiw, Romer and Weil (1992) using secondary enrolment data, and Azariadis and Drazen (1990) and Romer (1990) who rely on adult literacy rates.

These measures, however, have their own shortcomings. Literacy, although it may capture human capital accumulation in a certain phase of development, cannot measure the growth of human capital in secondary and higher education (Wössmann, 2003) and is in this respect similar to age heaping. The same applies to (secondary) enrolment ratios. In addition, high secondary enrolments may also be accompanied by relatively low primary enrolments, depending on the educational structure. Also, one should bear in mind that enrolment rates can at best approximate the yearly addition to the stock of human capital, and therefore can proxy the growth but not the stock of human capital.

The ‘average years of education’ or ‘average years of schooling’ has been proposed as a relatively easy way to construct a variable that captures the population’s average

educational attainment. This measure has been used in countless empirical studies such as Benhabib and Spiegel (1994), Islam (1995), Barro (1997, 2001), Temple (1999), Krueger and Lindahl (2001), and Barro and Sala-i-Martin (2004). The average years of education can be estimated in three different ways (Wössmann, 2003). The first one (Lau *et al.*, 1991; and Nehru *et al.*, 1995) is based on a Perpetual Inventory Method (PIM): with sufficiently long series of enrolment data one can calculate the total years spent with formal education. This crude estimate is corrected for mortality, repeaters, and drop-outs, and finally divided by the number of working age population yielding the average years of education. This method is sensitive to the availability of data for the correction factors, though, which are in most cases available for a few years only and are usually interpolated by a regression. This raises doubts about the accuracy of these estimates. The second method is the projection applied by Kyriacou (1991): he calculates the 'average years of schooling' from mid-1970s censuses for a few benchmark years and then uses lagged enrolment ratios to interpolate average years of schooling in the labor force for the missing years. Obviously, this method is based on quite bold assumptions regarding the relationship between enrolment and educational attainment. The third method relies on attainment figures taken directly from censuses (Psacharopoulos and Arriagada 1986). A drawback is that the number of censuses is limited, being generally available only once in every 10 years. Barro and Lee (1993; 2001) suggested solving this problem by interpolating the census data to obtain estimates of 'average years of education' for every fifth year. Their method is however subject to a possible bias as pointed out by Portela *et al* (2004). They argue that since Barro and Lee implicitly assume that the mortality rate is independent of the education level, their estimates exhibit a serious downward bias which accumulates over time until the next census data is available. Also, Barro and Lee's work is often criticized for the quality of data sources, which led to revisions and upgrades by

De la Fuente and Doménech (2000) for the OECD and Cohen and Soto (2007) for a larger set of countries.

As a general critique on the use of literacy and schooling related variables as human capital measures, we can conclude that these cannot capture the qualitative aspects of human capital (Judson, 2002). It is reasonable to assume that an extra year of education in 1900 added less to the stock of human capital than it did in 2000. This difference will not be reflected by either average years of education or enrolment data. Similarly, the available data on the returns to different levels of education suggest higher education contributing more to the stock of human capital than primary education. This also is not captured by the average years of education, because it either does not reflects structural changes at all, or it does just in a very indirect way. Since the structure and technology of education changed a lot in the last century, one may assume that the accumulation of human capital accelerated more than it is suggested by these traditional proxies.

In Table 2 we report estimates of the average years of education by Barro and Lee and Cohen and Soto for four benchmark years in three regions.[2]

Table 2

The table suggests the revision by Cohen and Soto leads to significant changes in the estimated educational attainment: in the OECD it has been adjusted upwards by roughly one year, leading to very different conclusion regarding the relative position of Eastern European countries. According to Barro and Lee, the average educational attainment in Eastern Europe

[2] Since Cohen and Soto reports the average years of education in Bulgaria, Romania and Hungary only, for comparison, we take only these three countries from the Barro and Lee data even though these covers the whole of Eastern and Central Europe.

was about 90% of the OECD in 1960, which grew to 102% by 1990. In other words: Eastern Europe not only managed to converge to the OECD but even surpassed it in terms of educational attainment. In de Cohen and Soto data, on the other hand, we find that Eastern Europe has 94% of the OECD average in 1960 that reduces to 87% in 1990, which indicates a divergence. This casts some doubts on the usefulness of the average years of education for a cross-country comparison: two similar methods, with only some difference in the data sources, lead to contradictory conclusions regarding the position of Eastern Europe in terms of human capital endowment.

A quite popular way to improve the ability of educational attainment variable to capture the real differences in human capital endowment and the market value of human capital is based on a Mincerian approach. Mincer (1974) applied an earnings regression to estimate the return to schooling:

$$\ln w_i = \beta + r \cdot S_i + ... + u_i \quad (1.)$$

Where w_i and S_i denote the earnings and the educational attainment of individual i in a sample. The regression needs to be augmented to capture other, non-educational sources of wage differences like ability, age and experience. If these factors are taken care of, the coefficient r can be identified as the rate of returns to an additional year (or additional completed level) of education. Equation (1) has been used by several authors (Pritchett, 2001) to identify the stock of human capital as follows:

$$h_{i,t} = e^{r_{i,t} S_{i,t}} \quad (2.)$$

Where $h_{i,t}$ denotes the per capital human capital stock in country i in year t. In this specification, a country with either no educational attainment, or no returns to education, has a per capita human capital stock 1.[3]

Obviously, if one regresses the log of per capita income simply on the log of educational attainment, it is equivalent with (2.) under the assumption that the returns to education are uniform in all countries and all periods. This assumption is not valid, however. Psacharopoulos and Patrinos (2004) report the rate of returns to education for a large set of countries and find a significant amount of variation in the returns to education. In Table 3 we report the average years of education, the rate of returns to education, a Whipple index, and the Mincerian human capital stock estimate for 25 countries in 1990.

Table 3

We find again that purely looking at the average years of education results in an insignificant difference in educational attainment between the transformation economies of Eastern Europe and the OECD countries. As expected, at this advanced stage of literacy, age-heaping will also suggest no difference. We find, however, that the rates of return to education show a larger variation: generally it is true that where human capital endowment is lower (developing countries) the rate of returns is higher (because of decreasing marginal product of human capital/formal education) and this corrects for the lower educational attainment. This leads to some quite surprising results: while purely looking at the educational attainment suggests Brazil has less than half of the human capital of Austria, when we calculate the human capital stock by the Mincerian approach, we find that the per capita human capital endowment is actually higher in Brazil than in Austria or the Netherlands, and comparable to that of Finland. This finding is so controversial that we must

[3] Pritchett takes the rate of returns to education 10% for all countries, which means that he neglects cross-country differences completely and just rescales the average years of education.

dismiss it, and conclude that neither educational attainment nor its augmented Mincerian version can be trusted as a proxy or measure of the value of human capital. Educational attainment may adequately proxy the time that is spent with education on average, but neglects the effect of all other factors, while the Mincerian approach is obviously incorrectly specified, since the decreasing marginal product of human capital causes the rate of returns to education being higher in less developed country, finally leading to erroneous results and conclusions. For a serious comparison, we need to choose alternative and, unfortunately, more data demanding methods.

Pro-and retrospective methods

Aware of the limitations of 'average years of education' and other proxies, alternative methods have gained popularity to measure human capital stock. These variables are either calculated by summing the costs of human capital (retrospective method), or by summing the gains from it (prospective method).

The prospective method

The prospective method is also referred to as income-based approach, since it estimates the value of human capital from the future (expected) earnings. This method originates with Petty (1690) who calculated the human capital of England as the difference between his estimates of the national income and property income, capitalized in perpetuity at a 5% interest rate. The modern versions of income based estimations define the (expected) value of human capital as the total income that could be generated in the labor market over a lifetime (Le, Gibson, and Oxley, 2003: p. 273). In other words, human capital is treated as an investment. A typical example of income-based approach has been applied by Dagum and Slottje (2001) to arrive at an estimate of the average human capital stock of the USA in 1982.

They define human capital as the discounted sum of future earnings, corrected for the probability of survival. Algebraically:

$$h(x) = \sum_{t=0}^{70-x} y(x+t)p(x,x+t)(1-i)^{-t} \quad (3.)$$

Where *h(x)* is the human capital of a household aged *x* (they equal the household head's human capital stock with that of the household), *p(x,x+t)* denotes the survival probability of a household aged *x* in the following *t* years, and finally i is the discount rate normally taken as 6% per annum. In their original article, the authors apply this method as a first step to determine the average human capital stock from a household survey and this was followed by a latent variable estimation (Partial Least Squares or Structural Equation Modeling) to estimate the distribution of human capital within the population. Since this last step requires good quality data that is rarely available, it is only the first step that has been used by other authors, such as Wei (2001) for Australia, Oxley and Zhu (2002) for New Zeeland, and Földvári and Van Leeuwen (2005) for a set of Eastern European countries. Földvári and Van Leeuwen find that in the mid-1990s Eastern Europe had circa 20-30% of the per capita human capital stock of the USA in 1982.

The idea that wages reflect differences in efficiency and ultimately human capital endowment has been used by other authors as well to develop their methods. Jeong (2002), following Mulligan and Sala-i-Martin (1997), estimated a human capital index for 39 countries. He assumes that all countries have the same Cobb-Douglas type production function, and therefore the difference in the observed real wages must be attributed only to differences in human capital endowment and aggregate output. This leads to the following equation:

$$\frac{H_i}{H_j} = \frac{Y_i}{Y_j}\frac{w_j}{w_i} \quad (4.)$$

Where H_i and H_j denote the human capital stock in countries *i* and *j* respectively, *w* denotes real wages, and *Y* is aggregate income. He uses wage data from the ILO October Inquiry to arrive at estimates of the human capital stock in 39 countries in 1995 relative to the USA.[4] His results suggest that the human capital stock in Africa was roughly 52.3% (average of 11 countries), in Asia 66.2% (average of 10 countries), and in Europe 90.2% (average of 9 countries) of the human capital stock in the USA.

The retrospective method

Since earning data are rarely available for a larger period, the retrospective method is still very popular. This method measures human capital as the sum of all costs incurred during the formation of human capital. Engel (1883) was the first to apply this method when he estimated human capital from the costs of rearing a child. His approach was adopted any extended by Schultz (1961) and Machlup (1962). A more popular application (see for example Pyo and Jin, 2000) of the cost-based approach has been developed by Kendrick (1976) who estimated the human capital stock for the United States in the period 1929-1969 by summing the tangible costs (rearing a child until age 14) and the intangible costs (health, safety, education, and the opportunity costs of students attending school).

Even though this method has its drawbacks (requires a lot of assumptions regarding the importance of cost factors, or the depreciation of human capital) it partly solves the problems associated with 'average years of education' as it at least partly incorporates the qualitative aspects of human capital. Also, as suggested by Judson (2002), this approach is

[4] The only Eastern European country for which he reports a human capital estimate is Romania. In an earlier draft of his paper he included Poland and Hungary as well, but these were omitted from the final version so we do not report these.

similar to the measurement of physical capital stock. She suggests a method to calculate the per capita stock of human capital at its replacement costs:

$$h_{it} = \sum_{j} d_{ijt} a_{ijt} \qquad (5.)$$

, where d_{ijt} is the public expenditure on education per education level *j* in country *i* in year *t*, a_{ijt} denotes the share of the labor force in year *t* with a certain level of education, and h_{it} denotes the average per worker human capital stock. Because of the lack of data, Judson does not add private expenditure on education and foregone wages to her human capital stock, even though on theoretical basis these should be included as well. Another problem is that Judson's method uses the expenditure per level of education for a single year and weighs this with the shares of primary, secondary, and higher educated in the working population. Hence, even after multiplying with the total working population she arrives at the replacement value of *a single year of education* instead of the total accumulated stock of human capital. As such, the human capital stock by the original method of Judson is very likely to underestimate the value of the stock of human capital. This, however, can simply be corrected by multiplying her per capita human capital stock by 'average years of education'.

In Table 4, we report the estimated per capital human capital stock for a set of countries by the Judson (2002) method, the method of Dagum and Slottje (from Földvári and van Leeuwen, 2005), and finally by Jeong (2002).

Table 4

Since Judson's dataset is not available, we arrived at the reported estimates by reproducing her method. While both the Judson and the Dagum and Slottje method suggest quite large differences between de human capital endowment in OECD countries and Easter Europe, the

possible conclusion from the Jeong method is more similar to that of the average years of education.

How much human capital does Eastern Europe have?

After reviewing some of the best-known human capital measurement methods and the results for Eastern Europe, we can answer the main question of this article: how much human capital Eastern Europe has, or had in the 1990s.[5] Table 5 has the summary results, where we compare the human capital endowment in some Eastern European countries as suggested by the reviewed estimation methods.

Table 5

The educational attainment data suggests the time devoted to formal education in Eastern Europe be quite similar in all countries and equals roughly 70-80% of the USA. As we argued earlier in this text, the amount of resources devoted to education does not equal human capital. If we include the rate of returns to education (the Mincerian method), that should reflect the cross-country differences in the efficiency and value of human capital (even though incorrectly as we claimed in the section on educational variables), the estimated human capital stock reduces to about 50-60% of the USA.

The direct estimates of human capital by cost or income based methods lead to even larger differences: now we find that the per capita stock of human capital in Eastern Europe is 17-35% of the USA calculated at replacement costs (similarly to how physical capital stock is estimated). If we estimate human capital stock from the expected future earnings (as if it was

[5] Since most work in this field has estimates for the 1990s, unfortunately we cannot be more up to date.

an investment), the difference is even greater: Eastern Europe has about one-fifth to one-sixth of the human capital of the USA.

Which result should be trusted? All the reported measures tell us something important about human capital endowment in Eastern Europe, but each requires a different interpretation. The educational attainment can be seen as a proxy of the share of educated people in the society, which does not equal human capital, however. These estimates suggest rather an upper bound, a possible maximum value of human capital stock: if the institutions and the economy were as efficient in Eastern Europe as in the USA, the human capital endowment could reach 70-80% of the USA. Inefficiencies and structural differences, however, strongly affect how human capital is valued by the market. If we measure this by either replacement costs (Judson method) or by the expected lifetime earnings (Dagum and Slottje method) where these inefficiencies are already implicitly taken account of, the estimated human capital stock becomes much lower.

Conclusion

In this paper we reviewed some well-known human capital measurement methods, and compared the estimated human capital stock for Eastern Europe. We find that different measures lead to very different estimates. Even though educational attainment (average years of education) is still the most popular proxy used in the literature, we argue that it cannot be trusted because it neglects how human capital is valued by the market. Since this value depends directly on how efficiently human capital is allocated and employed in the economy and therefore depends ultimately on the efficiency of institutions, we should find that measures that take these differences into account should lead to very different estimates. Using both cost-and income-based methods to estimate the human capital stock in Eastern Europe, this is exactly what we find. While looking at the attainment figures only, one would

expect that Eastern Europe has about 70-80% of the USA's human capital in per capita terms, when we measure the value of human capital this estimate reduces to 10-20% in the 1990s.

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Table 1

Printed books per 1000 inhabitants

Period	*Europe without Russia*	*Periphery*[a]
1454-1500	3.1	0.0
1501-1550	17.5	1.1
1551-1600	29.1	1.5
1601-1650	40.6	2.0
1651-1700	66.7	4.5
1701-1750	66.7	4.8
1751-1800	122.4	17.5

Source: Buringh and Van Zanden, Table 4.

[a]Austria, Hungary, Portugal, Czech Republic (today), Norway, Denmark.

Table 2
Average years of education in three worlds
(Coefficient of variance is reported in parentheses)

	Barro and Lee			*Cohen and Soto*		
Year	OECD countries[a]	Eastern Europe[b]	Rest	OECD countries	Eastern Europe	Rest
1960	6.70 (6.4%)[c]	6.02 (6.3%)	2.19 (8.8%)	7.32 (5.1%)	6.85 (1.9%)	2.06 (8.8%)
1970	7.25 (5.6%)	6.74 (9.6%)	2.50 (8.4%)	8.23 (5.0%)	7.34 (1.4%)	2.51 (8.4%)
1980	8.22 (5.5%)	7.83 (6.3%)	3.30 (7.2%)	9.29 (4.4%)	8.00 (4.1%)	3.17 (7.6%)
1990	8.87 (4.5%)	9.07 (1.9%)	4.17 (6.3%)	10.19 (4.0%)	8.89 (3.5%)	4.15 (6.7%)

Source: own calculations from the data of Cohen and Soto (2007), http://www.iae-csic.uab.es/soto/Data.htm

[a] pre-1994 membership, 21 countries, [b] Bulgaria, Hungary and Romania, [c](standard error/mean)x100%

Table 3
Education related human capital measures in 25 countries in 1990

	country	Av. years of schooling Barro and Lee	Av. years of schooling Cohen and Soto	Age heaping	returns to education	Mincerian human capital index[b]
Developed countries	Australia	10.12	12.22	101.7	8.0%	2.66
	Austria	9.22	10.16	97.9	7.4%	2.12
	Canada	10.50	12.74	99.6	8.9%	2.83
	Finland	9.48	10.14	99.5	8.2%	2.29
	Greece	7.66	7.88	108.8	7.6%	1.82
	Italy	6.16	7.97	101.1[a]	2.7%	1.24
	Japan	9.22	11.18	98.9	13.2%	4.37
	The Netherlands	8.61	10.33	101.2[a]	7.3%	2.13
	United Kingdom	8.74	11.27	98.0	6.8%	2.15
	USA	12.00	12.23	104.5	9.8%	3.31
Transformation economies	Bulgaria	9.26	9.03	n.a.	n.a.	n.a.
	Czech Republic	9.39	n.a.	99.0	8.1%	2.14
	Hungary	8.70	9.34	102.1	n.a.	n.a.
	Poland	9.60	n.a.	100.5	7.0%	1.96
	Romania	9.24	8.30	95.8	n.a.	n.a.
Developing countries	Bolivia	4.74	6.34	125.4	10.1%	1.90
	Brazil	3.76	5.62	103.3	14.7%	2.28
	Chile	7.14	8.42	100.3	8.2%	2.00
	Honduras	3.69	4.33	104.1	10.4%	1.57
	Kenya	2.98	3.98	147.8	16.0%	1.89
	South Korea	9.25	9.56	99.5	13.5%	3.64
	Mexico	5.87	6.41	125.2	7.5%	1.62
	Philippines	7.07	6.59	112.3	8.0%	1.69
	Singapore	5.52	6.15	98.2[a]	13.1%[a]	2.24
	Thailand	5.35	5.78	n.a.	11.5%	1.94

[a] 2000

[b] as explained in the text, this stock takes the value one for a country with zero educational attainment and/or zero returns to schooling

Table 4
Per capita human capital stock by income and cost based measures 1995 expressed in 2002 USD

	country	*HC by the Judson method (cost based)**	*HC by Judson times av. years of education*	*Dagum-Slottje method (income based)***	*Jeong-index (income based) USA=1.00*
Developed countries	Australia	4604	47465	n.a.	0.58
	Austria	7270	61362	n.a.	1.31
	Canada	7244	80991	n.a.	n.a.
	Finland	5707	55075	n.a.	n.a.
	Greece	1875	15092	n.a.	n.a.
	Italy	5006	33042	n.a.	0.88
	Japan	4591	43336	n.a.	n.a.
	The Netherlands	5854	52448	n.a.	n.a.
	USA	7269	88538	756754[a]	1.00
Transformation economies	Bulgaria	1572	14952	107324	n.a.
	Czech Republic	3548	32957	n.a.	n.a.
	Estonia	3470	31819	101761	n.a.
	Hungary	3380	28795	141403	n.a.
	Poland	1615	15711	122120[b]	n.a.
	Slovakia	n.a.	n.a.	160952[b]	n.a.
	Romania	808	7469	n.a.	0.77
	Russia	n.a.	n.a.	141235[b]	n.a.
Developing countries	Bolivia	667	3457	n.a.	0.55
	Brazil	1418	5914	n.a.	n.a.
	Chile	1350	10163	n.a.	0.42
	Egypt	667	2830	n.a.	0.63
	Ghana	241	902	n.a.	n.a.
	India	216	899	n.a.	n.a.
	Indonesia	153	615	n.a.	0.50

* own calculations, ** Földvári-van Leeuwen (2005) Table 5, converted from 2002 USD to 2000 USD

[a] 2000, [b] 1993

Table 5

Summary table, various human capital proxies and estimates for Eastern Europe as percentage of the USA

	av years of education in 1990	*Mincerian hc in 1990*	*cost based method by Judson in 1995 (original)*	*cost based method by Judson in 1995 (multiplied by av. years of education)*	*income based on Dagum and Slottje, percentage of the USA in 2000*	*income based 1995 Jeong*
Bulgaria	77.1%[a]	n.a.	21.6%	16.5%	14.2%	n.a.
Czech Republic	78.3%[a]	64.6%	48.8%	37.2%	n.a.	n.a.
Estonia	76.4%[b]	n.a.	22.2%	35.9%	13.4%	n.a.
Hungary	72.5%[a]	n.a.	46.5%	32.5%	18.7%	n.a.
Poland	80.0%[a]	59.2%	22.2%	17.8%	16.1%[c]	n.a.
Slovakia	75.6%[b]	n.a.	n.a.	n.a.	21.3%[c]	n.a.
Romania	77.0%[a]	n.a.	11.1%	8.4%	n.a.	77%
Russia	87.7%[b]	n.a.	n.a.	n.a.	18.7%[c]	n.a.

[a] Cohen and Sotos, [b] Barro and Lee (2001), [c]1993