Human Capital Productivity: A New Concept for Productivity Analysis

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ABSTRACT

The concept of human capital, defined as the discounted value of future earnings, has a long history in economics. But human capital has never been directly linked to productivity. This article makes an attempt to bring the concepts of human capital and labour productivity together by introducing a new term, human capital productivity, which is defined as the ratio between an index of discounted future output and an index of human capital. While still in its very early stages of conceptual development and without empirical estimates, the concept of human capital productivity may contribute significantly to our understanding of the role human capital plays in potential output growth.

RÉSUMÉ

Le concept de capital humain, défini comme étant la valeur actualisée de la rémunération future, a une longue histoire en économique. Mais le capital humain n'a jamais été directement lié à la productivité. Cet article tente de réconcilier les concepts de capital humain et de productivité du travail en présentant un nouveau terme, la productivité du capital humain, définie comme étant le rapport entre un indice de la production future actualisée et un indice du capital humain. Bien qu'encore aux toutes premières étapes de son développement conceptuel et sans estimations empiriques, le concept de productivité du capital humain pourrait beaucoup contribuer à notre compréhension du rôle que joue le capital humain dans la croissance éventuelle de la productivité.

MUCH HAS BEEN WRITTEN about labour productivity, but little about human capital productivity which is defined as the ratio between an index of discounted future output and an index of human capital. The two concepts are related, but not the same and have until now not been previously brought together. Labour productivity considers only present or current labour productivity; human capital productivity implicitly considers both present and future labour productivity. The productivity of an individual may change in the future; indeed, the productivity of most individuals notably improves due to education and training, physical capital intensity and multifactor productivity growth. Alternatively, the productivity of an individual may decrease in the future, for example if an individual's skills become obsolete, or

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they work less due to ill-health; or becomes zero if they decide to retire. For all of these reasons, when human capital productivity changes, labour productivity may not have changed in the same way or may not have changed at all.

A similar present versus present and future differentiation characterizes productive capital stock compared to wealth capital stock. Productive capital stock depends upon the efficiency of today's stock in the present; wealth capital stock depends upon the efficiency of today's capital stock in the present and in the future.

Background: Human Capital

In his seminal article on investment in human capital, Theodore W. Schultz (1961) emphasized the importance of human capital as a contributor to national wealth. The press release announcing his selection as a Nobel prize laureate in economics illustrated the importance of human capital when it stated "Schultz and his students have shown that, for a long time, there has been a considerably higher yield on "human capital" than on physical capital in the American economy" (Nobel Foundation, 1979). Human capital is broadly defined in an OECD publication (Keeley, 2007) as "the knowledge, skills, competencies and attributes embodied in individuals that facilitate the creation of personal, social and economic well-being." It is clear that human capital is critical to sustainability, productivity, and the current and future health of a country.[2] Accordingly, estimates of human capital and human capital productivity can provide valuable insights to government officials and others involved in policy-making and research.

Human capital varies across countries. The OECD human capital project (Liu, 2011) has generated estimates of human capital for 15 OECD countries using the Jorgenson-Fraumeni methodology (Jorgenson and Fraumeni, 1989, 1992a, and 1992b). A China Center for Labor Force and Human Capital (CHLR) project has done the same for China (Liu *et al.*, forthcoming). Chart 1 shows the ratio of the value of working age human capital, expressed in monetary units, to nominal GDP for these countries and for China for 2006.[3] For most countries, the ratio varies around a fairly narrow band, from 8 to 12. The exceptions are South Korea at 16.3 and China at 18.5.

Chart 2 shows the ratio of the stock of working age human capital to physical capital. Estimates of physical (nonhuman) capital are only available for 10 of the OECD consortium countries and China (Liu, 2011 and Holz, 2006). The rate ranges from a low of around 4 in Italy to a high of around 8 in China.

Discussion

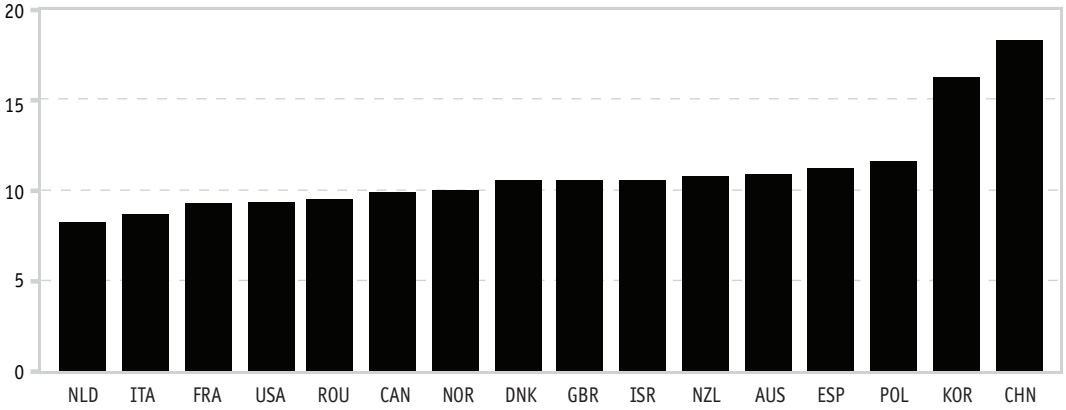
It is considerably more difficult to estimate market human capital productivity than to estimate labour productivity. In any time period, labour productivity can be defined as that period's net output divided by that period's labour input. Labour input can be measured in the current period by the number of workers, hours worked, or an index derived from labour compensation and hours worked. Labour productivity is often the preferred productivity measure as its construction requires much less data than multifactor productivity.

Different decompositions have been developed to identify the sources of labour produc-

2 In recognition of the importance of human capital to sustainability, a recent UNECE/OECD/Eurostat task force draft report includes a section on human capital (Joint UNECE/OECD/Eurostat Task Force for Measuring Sustainable Development, 2012).

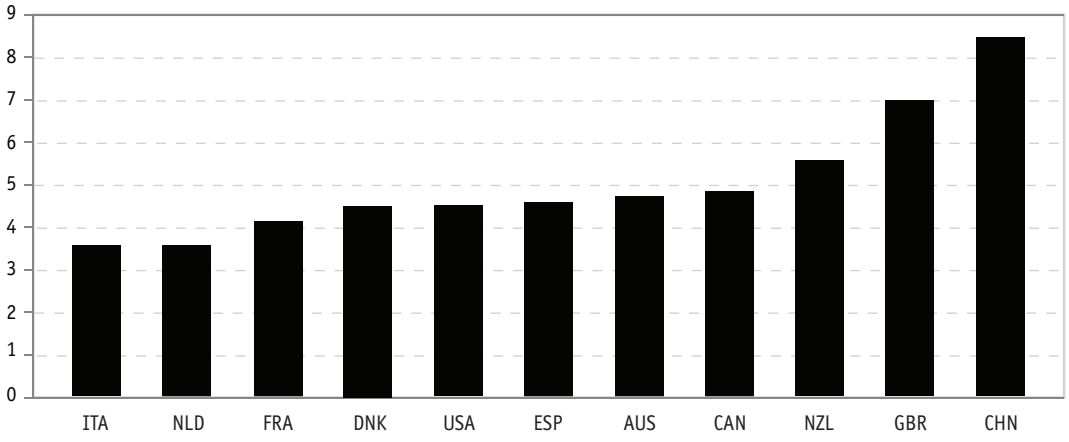
3 The estimates for Australia are for 2001; those for Denmark for 2002 (Liu, 2011). The estimates for China are from Li (2011). The working age is defined as 15-64 in OECD countries and in China as 15-59 for men and 15-54 for women.

Chart 1
Ratio of the Stock of Working Age Human Capital to GDP in Selected OECD Countries and China, 2006



Source: Liu (2011) and Li (2011).

Chart 2
Ratio of Stock of Working Age Human Capital to Physical Capital in Selected OECD Countries and China, 2006



Source: Liu (2011) and Li (2011)

tivity growth. For example, the rate of change in labour productivity can be related to capital intensity and multifactor productivity by the following equation:

$\ln(O(t)/L(t)) = V_K(t)*\ln(K(t)/L(t)) + \ln(MFP(t))$,

where O is net output, L is labour input, V_K is the nominal share of capital input in value added, K is capital input, MFP is multifactor productivity, and t is time.[4] The first term to the right of the equal sign is the contribution of capital deepening. This equation shows that labour productivity depends on other factors besides the quality of labour input.[5]

4 Oliner and Sichel (2000) use this equation in their analysis of the resurgence in post-1995 U.S. economic growth.

The definition of human capital productivity depends on how human capital is defined. One often used definition of human capital is educational attainment, e.g. the average educational attainment of the adult population or the percentage of adults who have completed some level of education. If this approach is taken, the numerator of human capital productivity might be current output. However, this would not consider the future potential of human capital that would increase due to further education as a contributor to a country's wealth.

In this article, human capital is represented by Jorgenson-Fraumeni market human capital (Jorgenson and Fraumeni, 1989, 1992a and 1992b) to include this future potential component. Jorgenson-Fraumeni market human capital is defined as current and future lifetime income, which is estimated under assumptions about future annual income and discounted to the present.[6] Accordingly, to define market human capital productivity, output, the numerator, with an index of Jorgenson-Fraumeni human capital as the denominator, should be estimated with assumptions about the path of future output and discounted to the present in the same way that lifetime income is estimated to be consistent.[7] The need for future period projections of output and labour income increases the effort required to estimate market human capital productivity compared to that required to estimate labour productivity. In addition, in all likelihood estimates of human capital productivity can only be estimated for an aggregate or on an industry basis because of the difficulty of assigning output to individuals grouped by relevant categories.

Illustrative Empirical Estimates from the OECD Human Capital Project for the United States

The easiest way to illustrate the difference between labour productivity and human capital productivity is to give examples of how market human capital can change without labour productivity (however measured) changing or changing in the same way as human capital productivity. The OECD human capital project (Liu, 2011) is the source for estimates of Jorgenson-Fraumeni market human capital for the United States, which are used to illustrate arguments presented in this section.[8] The Jorgenson-Fraumeni market human capital estimates developed by the OECD

5 To show the simplest case, changes in the composition or quality of capital and labour are ignored in this equation.

6 Liu (2011:11) points out that the lifetime income approach is not immune from drawbacks. He notes three criticisms: 1) to calculate lifetime incomes, judgments must be made about discount rates and the real income growth that people currently living may expect in the future; 2) labour markets do not always function in a perfect manner, which means that the wage rates by education used as a proxy for the monetary benefits provided by additional schooling will differ from the marginal productivity of a particular type of worker; and 3) by relying on observed market wages, the monetary stock of human capital may increase when the composition of employment shifts towards higher paid workers (e.g. from women to men, from migrants to natives) independent of the skill levels of those workers. Despite these conceptual drawbacks, many share the view that, compared to other methods, the lifetime income approach provides the most practical way to derive a monetary measure of human capital that is consistent with both economic theory and accounting standards.

7 Jorgenson-Fraumeni estimates of human capital typically assume that future school enrollment, income, age of retirement, and survival rate are best represented by the situation of the contemporaneous, but older, population. For example, in a specific year for which human capital is being estimated, say the year 2000, the probability that an 18 year old male enrolls in school in the future is taken from males who are 19, 20, 21, etc. in the year 2000. There are some exceptions, e.g. estimates of Jorgenson-Fraumeni human capital for China incorporate information about future enrollment from data for later years as educational attainment in China changed very significantly from the mid-1980's to the present (Li *et al.*, forthcoming).

Table 1
International Standard Classification of Education (ISCED) Definitions

Level 2, Lower secondary or second stage of basic education;	Lower secondary education (ISCED 2) generally continues the basic programmes of the primary level, although teaching is typically more subject-focused, often employing more specialised teachers who conduct classes in their field of specialisation.
Level 3, Upper secondary education;	Upper secondary education (ISCED 3) corresponds to the final stage of secondary education in most OECD countries. Instruction is often more organised along subject-matter lines than at ISCED level 2 and teachers typically need to have a higher level, or more subject-specific, qualifications than at ISCED 2. The entrance age to this level is typically 15 or 16 years.
Level 5, First stage of tertiary education.	Tertiary-type A programmes (ISCED 5A) are largely theory-based and are designed to provide sufficient qualifications for entry to advanced research programmes and professions with high skill requirements, such as medicine, dentistry or architecture. They have a minimum cumulative theoretical duration (at tertiary level) of three years' full-time equivalent, although they typically last four or more years. The "I" in ISCED 5AI stands for intermediate.
	Tertiary-type B programmes (ISCED 5B) are typically shorter than those of tertiary-type A and focus on practical, technical or occupational skills for direct entry into the labour market, although some theoretical foundations may be covered in the respective programmes. They have a minimum duration of two years full-time equivalent at the tertiary level.

Sources: OECD (undated and 2006).

depend on the expected market lifetime income of all individuals aged 15 through 64 in a particular year. In this article, it is assumed that groups or categories of individuals of the same gender, age group, and educational attainment have the same labour productivity in the same year. Their market human capital will differ depending upon whether or not they achieve a higher level of education in the future, how many hours they work per year, and for how many years they work in the future. The missing piece is the numerator of the market human capital productivity ratio, namely discounted future output.

The OECD human capital estimates use International Standard Classification of Education (ISCED) categories which are described in Table 1. ISCED categories consistently covered in the OECD human capital estimates for the United States include ISCED 2, 3, 5A, 5AI, 5B and 6.

It is reasonable to assume that in 1997 the labour productivity of all males who are 15 years of age and whose highest level of education is ISCED 2 is identical, as is the case for females.[9] When estimating labour productivity the story goes no further than the present. In the OECD human capital project, the market human capital of all individuals who are age 15 in 1997 depends on the probability that they will obtain future education, their future employment, and survival rate.

OECD estimates of market human capital for the United States are available from 1997 to 2007, with the exception of 2001. Empirical estimates in Table 2 rely on the earlier years to avoid recession bias.

In order to make comparisons between the market lifetime income of an individual who ends his formal education at the ISCED 2 level with someone who continues on, two assump-

8 The most appropriate comparison between labour productivity and human capital productivity is between labour productivity and market human capital productivity. Non-market human capital productivity values non-market time.

9 Age 15 is chosen for the example as age 15 or 16 is the typical age at which someone attending high school in the United States begins the 10th grade (ISCED 3) and is described in the OECD glossary of statistical terms as the typical age at which an individual begins ISCED 3 (OECD, undated).

tions are made. First, it is assumed that individuals who continue their education will do so without a break.[10] Second, it is assumed that individuals begin ISCED 3 at age 15. If individuals take the normal three years to complete ISCED 3, they will be 18 in 2000 when they enter ISCED 5, 20 when they complete ISCED 5B in 2002 and 22 when they complete ISCED 5A in 2004. These assumptions have little impact on the nature of the comparative results.

The ratios of market lifetime income for higher levels of education to market lifetime income by gender for ISCED 2 are shown in Table 2.[11] An ISCED 6 comparison is not made because the number of years it can take to complete a graduate research program (e.g. a masters or a doctorate) can vary tremendously depending upon the degree pursued.

From these ratios, it is clear that market human capital of an individual at age 15 will vary significantly depending upon whether they are expected to continue on with their education and what will be the highest level of education attained. Unless the output numerator of a market human capital productivity estimate varies in the same way as the market lifetime income denominator shown above, human capital productivity will differ from labour productivity among individuals who do, or do not, continue on with their education.

In some countries during certain time periods the probability that individuals will continue on with their education has changed significantly. China experienced a very significant upward shift in the educational attainment distribution of its population over a period of 25 years. In 1985, among the categories: no schooling, primary school, junior middle school, senior middle school, and college and above, the first and second categories were almost equal in size and dominated the distribution. By 2009, the category junior middle school dominated the distribution (Li, 2011:36-7). In many countries, the percentage of younger individuals (those aged 25-34) who have achieved tertiary education is significantly higher than the percentage of older individuals (those aged 55-64) who have achieved tertiary education. For example in 2009, the overall OECD countries' percentage of younger individuals who have achieved tertiary education is just below 40 per cent, but is less than 25 per cent for the older group (OECD, 2011). Current labour productivity levels for those who could still be continuing in school do not reflect these changes; human capital productivity levels will, if and when these changes are anticipated.

Table 2
ISCED Highest Level Attained: Ratio of ISCED Higher Level to ISCED 2 in the United States
Market Lifetime Income

	ISCED 3A	ISCED 5B	ISCED 5A
	Age 18 in 2000	Age 20 in 2002	Age 22 in 2004
Male	1.4	1.2	3.4
Female	1.6	1.5	1.9

Source: Liu (2011).

Conclusion

Labour productivity and human capital productivity are related, but represent different concepts. The former considers only the present while the latter considers both the present and the future. There is no reason to assume that there is a correspondence between the level of labour productivity and the level of human capital productivity at the individual or total population level. Individuals who attain a higher level of education will have higher human capital than

10 Individuals who finish an ISCED category in less than the normal time or whose programs are shorter than the normal length will be included in the OECD estimates of market lifetime income.

11 These are ratios of nominal lifetime income in the specified year.

others who do not obtain this education. There are numerous other scenarios that could demonstrate this same point. For example, individuals in the future could live longer, retire earlier, work more or less, or become more or less productive because of changes in production processes or productivity. As such, labour productivity is far easier to estimate. However, human capital productivity is a valuable measure as it captures the future potential of the population of a country. Indeed, while still in its very early stages of conceptual development and without empirical estimates, the concept of human capital productivity may contribute significantly to our understanding of the role human capital plays in potential output growth.

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