

**Economic and Social Council**Distr.: General  
4 April 2011

Original: English

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**Economic Commission for Europe**

## Conference of European Statisticians

**Fifty-ninth plenary session**

Geneva, 14-16 June 2011

Item 5 of the provisional agenda

**Measuring human capital****Human capital and economic growth - about feasibility to  
treat human capital as an asset****Note by Statistics Finland and European University Institute***Summary*

In the latest revision process of the System of National Accounts the issue of measuring human capital in the context of the System of National Accounts was widely discussed with the conclusion that this was not feasible for the time being. At the same time, an overwhelming majority of empirical examinations on human capital and economic growth have used school attainment variables without receiving unambiguous results on the role of human capital in standard Gross Domestic Product growth. This paper shows that the role of human capital by education will likely prove to be unquestionable for standard Gross Domestic Product growth and its impact on growth turns out to be essential when human capital is taken into account inside the National Accounts framework. Measuring human capital in the context of National Accounts would increase the policy relevance of our work and offer a useful tool for economic analysis and growth research.

## I. Introduction

1. The role of human capital in economic growth has been thoroughly discussed and emphasised in a variety of modern growth theories since the 1960s. To put it briefly, human capital has been accepted as one of the most important sources for growth in the modern growth theory models. Human capital is seen either as an input in production together with fixed capital enhancing labour input or as an enabling factor for technical change.

2. In line with the above, the new growth theories since the 1980s have questioned whether the unexplained residual, multifactor productivity (MFP) observed in the growth accounting exercises, could vanish or be substantially diminished when including human capital in the analysis. This unexplained residual began to explain a bigger and bigger proportion of economic growth in advanced economies after World War II.

3. In numerous empirical studies on human capital and economic growth, school enrolment ratio and average years of schooling in the working age population have been used as typical proxies for human capital. However, no unambiguous agreement has been achieved as regards the role of increased educational attainment in explaining differences in economic growth across countries and time. Some of the cross-country empirical comparisons show a positive and significant impact of schooling on real Gross Domestic Product (GDP) growth, while other studies show a non-significant or even negative effect. In this paper, the educational attainment measures are referred to as 'proxy' or 'conventional' measures.

4. In these empirical studies, human capital is measured by educational attainment while at the same time, the empirical counterparts for the other key variables in these calculations – like GDP, fixed capital and labour input – are derived from the National Accounts. This obviously leads to the question whether assessment of human capital by schooling in the same National Accounts framework as the other core variables would be viable and would lead to different results.

5. In the latest revision process of the System of National Accounts (SNA) the issue of measuring human capital in the context of the SNA was widely discussed with the conclusion that this was not feasible for the time being. However, this does not say that we should totally reject this kind of research. Measuring human capital in the context of National Accounts would increase the policy relevance of our work and offer a useful tool for economic analysis and growth research.

6. Measuring human capital in the National Accounts framework could reveal better the impact of human capital on growth and possibly result in a more straightforward long-run relation of human capital and GDP than with the proxy measures. A more straightforward long-run relation between measured human capital and GDP would implicate human capital as one of the determinants of the long-run growth. This econometric analysis on long-run relation demands, however, long numerical time series.

7. The two best known measurement methods relating to the treatment of human capital in the National Accounts are estimation of human capital through accumulated inputs by John Kendrick and calculation of human capital through estimated lifetime labour incomes by Dale Jorgenson and Barbara Fraumeni (Jorgenson & Fraumeni). Both of these methods have broadened the scope of National Accounts far beyond the standard GDP<sup>1</sup>. In both cases, the imputed values for non-market activities have been included both in

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<sup>1</sup> Standard GDP refers here to the GDP calculated in the current SNA.

investments in human capital and in the new GDP. Since the imputed non-market values have been estimated by e.g. exponentially growing market wages, the imputations might make the long-run relation more easily achieved with the new GDP in these systems. The methods of Kendrick and Jorgenson & Fraumeni are referred to in this paper as the two best known measurement methods for human capital in the National Accounts.

8. The current paper is a summary of the empirical study which was presented in the International Association for Research in Income and Wealth (IARIW) 2010 Conference.<sup>2</sup> This study demonstrates empirically that the role of human capital measured by education will likely prove to be unquestionable for standard GDP growth and its impact on growth turns out to be essential when human capital is taken into account inside the National Accounts framework. Treating human capital as an asset was studied empirically by accumulating the paid monetary flows on education, education expenditures by number of students in cohorts, into a stock of human capital in Finland in 1877–2000. The connection between human and fixed capital and economic growth was studied in 1910–2000.

9. The next section of this paper will briefly describe the differences between various methods in the measurement of human capital. Section III reviews the modifications made in the current SNA for treating human capital as an asset while Section IV summarises the empirical econometric analysis. Concluding remarks are presented in Section V.

## II. Differences in the measures for human capital

10. In the IARIW 2010 paper, the author of this paper demonstrates the differences in the evolution of school enrolment ratio and average years of schooling in the working ages with the two best known proposed National Accounts measures and economic growth in the US. The time frame in the comparison with the measures and GDP was 1930–1969 in the case of Kendrick’s accumulated inputs method and for Jorgenson & Fraumeni’s lifetime labour income method 1950–1986. The evaluation inevitably shows that the school attainment proxy measures for human capital grow linearly while standard GDP, the adjusted GDP and the estimates for human capital by Kendrick and Jorgenson & Fraumeni grow exponentially in the long-run.

11. Nevertheless, by far most of the studies exploring empirically human capital and economic growth have used proxy-variables on educational attainment as the empirical counterpart for human capital. In these studies the connection of schooling has been investigated with the standard GDP. As noticed before, both the methods of Kendrick and Jorgenson & Fraumeni have broadened the National Accounts beyond the standard GDP and hence their estimates of human capital have to be compared with the adjusted GDP in their systems.

12. In Kendrick’s study the imputed value for the foregone earnings of students formed a major part of investments in education and training and changed the level of GDP dramatically. It could be argued that the imputed foregone earnings have affected the evolution of Kendrick’s estimate for human capital, as the market wages themselves used as a reference for valuation have grown exponentially.

13. In a similar way, in the Jorgenson & Fraumeni system the imputed compensation for the time in the non-market activities – valued again on the basis of market wages – and the projections for the rest of the lifetime incomes based on expected wages – have

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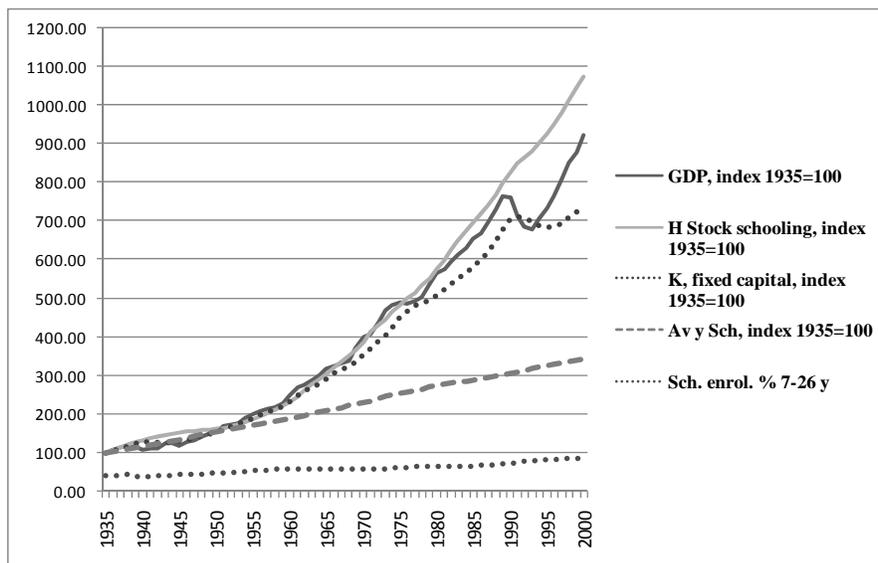
<sup>2</sup> See Kokkinen, Arto (2010). Assessing Human Capital in the National Accounts – Is there a Feedback to Theory. The 31st General Conference of the International Association for Research in Income and Wealth (IARIW), Session 8C, August 22–28, 2010, St. Gallen, Switzerland.

substantially affected both the evolution of ‘new’ output and investment in education. The question whether more weight can be given to the contribution of human capital by education assessed in the National Accounts frame in explaining the standard GDP based on market activities has remained open.

14. In my study, the object was to explore whether the connection between human capital measured by accumulated education expenditure used by the students and standard GDP was more evident and whether the human and fixed capital explained more of the long-run continuous growth than suggested in studies with proxies based on school attainment. As mentioned earlier, in this exercise human capital measured by education expenditures attached with the number of students, is assessed in the core of the National Accounts concentrating on paid monetary flows on education. The terms ‘human capital by schooling’ and ‘human capital by formal education’ used in the following refer to this measurement.

Figure A.

**Real GDP (2000 reference year), intangible human capital stock by schooling, fixed capital, average years of schooling in the working age population (16–64), school enrolment % at the ages 7–26, in Finland in 1935–2000. NB: all variables except school enrolment ratio are expressed in index form, 1935=100.**



15. For reaching a fair comparison with the conventional proxy measures, Figure A depicts the evolution of the National Accounts estimate on intangible human capital by schooling based on paid monetary transactions on education for Finland in 1935–2000, together with real GDP, fixed capital and the conventional schooling measures (the average years of schooling in 16–64 year-old population, school enrolment ratio at the ages 7–26 for Finland).<sup>3</sup> Here, the estimate for human capital by schooling is formed through accumulated volume of monetary inputs in education in accordance with a modified<sup>4</sup> SNA

<sup>3</sup> The time frame in the figure comes from the feasibility to calculate average years of schooling in the working age population in Finland, as the number of students were available from 1877 onwards.

<sup>4</sup> Human capital is not treated as an asset according to the asset boundary of the international Standard of National Accounts (SNA) in the 1993 version, also applied in the European Union. The revised SNA2008 to be implemented in coming years excludes it from the core accounts as well, but proposes

including human capital by schooling in a way that the level of GDP remains unchanged. The long graduation times in education have been taken into account and the stock of human capital by schooling is accumulated by the volume of expenditures up to the time when a person has graduated from his/her highest education (see Section III). In this case the conventional proxy measures and the National Accounts estimate can be compared with the same standard GDP, which makes the examination exact. Intangible human capital by schooling through the volume of accumulated costs based on paid transactions on education is growing exponentially and very similarly to GDP and fixed capital, while average years of schooling and school enrolment ratio are not.

16. To summarise, the National Accounts estimate of human capital, measured by accumulated education expenditures grows exponentially in the long-run with indicating an evolution much more similar to GDP than the conventional proxy measures. Therefore, treating human capital as an asset in the National Accounts might suggest:

(a) Human capital could have a more straightforward relationship with standard GDP than reported in the studies with the proxy measures;

(b) There seems to be a long-run equilibrium type of relationship between the evolution of human capital and GDP, and possibly also with exponentially growing fixed capital;

(c) Human capital might have a higher weight in explaining the evolution of GDP than what the conventional measures have suggested. Together with fixed capital, the unexplained residual, multifactor productivity or the Solow residual might diminish significantly in the production function.

17. In the IARIW 2010 paper of the author, these suggestions were tested for Finland in 1910–2000. The testing was done by objective numerical time series methods beginning without any assumptions of the relations between the variables. The Finnish data allowed for constructing long enough time series for such an econometric analysis.

### **III. The modified system of production of National Accounts with intangible human capital by schooling**

18. Human capital is not treated as an asset according to the asset boundary of the international standard of National Accounts in the current 1993 version (SNA1993). The revised SNA2008 to be implemented in coming years excludes it from assets in the core accounts as well, but proposes to handle it in an additional voluntary satellite account outside the core system.

19. It is worth clarifying that excluding human capital from the SNA is not an accident. It is a logical consequence of the definition of production in the system. However, economists have often requested to include human capital inside the system. The National Accounts are also constantly criticised for not incorporating the most important factors for modern economic growth.

20. In the SNA non-financial assets are either produced assets or non-produced assets. Following Aulin-Ahmavaara's (2002, 2004) comprehensive work, learning new skills and knowledge requires inputs. Therefore, if human capital is wanted to be seen as an asset, it

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it as an additional satellite account to the core system. It is argued in the SNA2008 (par 3.48) that "Human capital is not treated by the SNA as an asset. It is difficult to envisage "ownership rights" in connection with people, and even if this were sidestepped, the question of valuation is not very tractable."

has to be produced (Aulin-Ahmavaara, 2002, p. 3). But production of human capital falls outside the production boundary of the SNA. Hence, including human capital inside the National Accounts necessitates moving its production inside the production system where output (including produced assets, e.g. fixed capital) is produced.

21. Changing the system of production, however, may lead to difficult changes in other parts of the sequence of accounts in the SNA. In the proposed systems of Kendrick and Jorgenson-Fraumeni, human capital related flow variables without paid monetary transactions are suggested to be accounted either as investments (see Kendrick 1976) or as services of human capital (see Jorgenson & Fraumeni 1989, 1992a, 1992b). For instance, in the Kendrick's system treating foregone earnings of students as investments would make GDP to include this same amount, for which no transactions occurred. Consequently, it should be added to the balance sheet of households as well.

22. While e.g. foregone earnings can be justified from the input-output point of view, it may be unjustified from the point of view of institutional sector accounts, which aim at giving the financial position (the net lending/borrowing to/from other institutional sectors) of the institutional sectors and how they have financed their production and investments. If foregone earnings were added to the output (/or as an input) of the household sector (/of the sector to which educational institutions belong in each country), this would have to change the financial position of the household sector (/the respective sector) even without any transactions having occurred.

23. In order to eliminate the changes to GDP and to the financial position of the institutional sectors by imputed monetary flows which have not actually been paid, a method concentrating on paid monetary flows as investments in formal education was used here. In order to produce estimates according to this method, some modifications to the system of production in the SNA were made and they are briefly described in the following. The system of production and the revisions to it are discussed in more detail in the IARIW 2010 paper of this author. In that paper the description of the production system is described with six basic equations based on the presentation of Aulin-Ahmavaara (2002).<sup>5</sup> Here the main idea is given by concentrating on the first two of the equations.<sup>6</sup>

$$1. \quad [O+O_H] + M = [U + \text{education expenditure}] + C + [I_K + I_H] + [G - \text{education expenditure}] + E + \Delta \text{ inventories}$$

$$2. \quad \text{GDP} =$$

$$[O+O_H] - [U + \text{education expenditure}] = C + [I_K + I_H] + [G - \text{education expenditure}] + E - M + \Delta \text{ inventories}$$

Where

O = gross output, U = intermediate uses / intermediate inputs, C = private final consumption

G = general government final consumption expenditure

I<sub>K</sub> = gross fixed capital formation, I<sub>H</sub> = gross human capital by schooling formation

E = exports, M = imports

Δ inventories = change in inventories

<sup>5</sup> Aulin-Ahmavaara was originally referring to the system of production of the SNA93. However, the modifications would be the same in case the SNA2008 was used.

<sup>6</sup> The system is simplified in a way that taxes and subsidies are ignored and a simple geometric rate of depreciation is assumed. The components in the equations are expressed at constant prices.

24. In the original system of production of SNA the first equation (1) defines the supply and demand in the economy in a time unit: Output ( $O$ ) is the sales revenues producers get when selling the products they have produced. Imports ( $M$ ) include the value of goods and services imported to the country. The use or demand of these products is on the right hand side of the first equation (1): Part of these products has been reused as intermediate inputs ( $U$ ) or as investments in fixed capital,  $I_K$ . A good part of them is used as private final consumption ( $C$ ) and general government final consumption ( $G$ ) or exported ( $E$ ). The products not yet sold, either at final or at an intermediate stage of production, are recorded in the output and in the change in inventories. The second equation (2) shows how GDP (or value added) can be calculated through output minus intermediate inputs or through net-demand, i.e.  $C + I + G + (E-M) + \Delta$  inventories.

25. In order to include intangible human capital by schooling in produced assets the production system is revised in this paper (the bolded variables). In equation 1, the education expenditures are deducted from final consumption (in the Finnish case from general government) expenditures and reclassified as intermediate inputs (education services are used in the learning process of students). The new skills the students have acquired within a year are treated as produced human capital by schooling ( $O_H$ ), which is valued through expenses in education. Each year when students continue at schooling, the amount of produced human capital is recorded into the change in inventories in the demand side. Since the intermediate inputs, the new produced human capital and the change in inventories all equal the value of education expenditures, the accounts are balanced and GDP does not change. Along the same line of thoughts, the analysis could be broadened to include, e.g. social and health expenditures as investments in human capital.

26. When a student has finally graduated from his/her highest education, all the produced human capital up to that date will be moved from the inventories into investments in human capital ( $I_H$ ). At that time, the stock of human capital is accumulated by the amount of investments in human capital. Therefore the long graduation times in education are taken into account in accumulating the stock of human capital by schooling. The entire stock reflects people in the working ages with different education along time, taking into account the volume of the resources put to education each cohort with different educational path has used. The productive stock of human capital is decreased by the rate of depreciation of human capital by schooling with the assumption of geometric age-efficiency profiles, calculated separately in basic, upper secondary, professional and university education in accordance with the average service lives, assuming that the average retirement age is 65. The stock of human capital was adjusted by those deceased in wars and by net migration.<sup>7</sup>

27. It is worth mentioning that the educational system in Finland up to the present day is almost totally financed by general government. Therefore, the minute part of privately financed education has been neglected in these calculations for Finland. In the countries with private educational system the education expenditures in the private final consumption would be, of course, used as investments.

#### IV. The econometric analysis between human capital and growth

28. As discussed in the Introduction, the new growth theories since the 1980s have questioned whether the unexplained residual, multifactor productivity (MFP) observed in the growth accounting exercises, could vanish or be substantially diminished when

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<sup>7</sup> The services of human capital are the hours worked adjusted with the human capital by schooling in the labour force.

including human capital in the analysis. This unexplained residual began to explain a bigger and bigger proportion of economic growth in advanced economies after WWII. In the empirical studies with long time series on economic growth this residual shows up as a deterministic time trend that needs to be added to the production function when economic growth is explained solely by fixed capital and labour input. This deterministic time trend is often named exogenous technological progress.

29. Along with the early rise of endogenous growth theories, Mankiw, Romer and Weil (1992) used enrolment in secondary schooling as a proxy for human capital and conducted a cross-country study on economic growth with fixed capital, human capital by schooling and labour input. They reported strong empirical evidence on improved results when including the proxy for human capital in the analysis. However, the unexplained residual was still explaining a substantial part of the long-run growth with reference to the traditional neo-classical model. Other studies have confirmed the results when using the conventional proxy variables for human capital by schooling. The conventional proxy measures based on school attainment are not able to diminish considerably the unexplained residual.

30. The interesting question related to the National Accounts estimate based on human capital measured by education expenditures attached with the number of students by cohort is whether the results were different from those with the proxies for human capital. This is the key question presented in the IARIW 2010 paper mentioned above. The analysis and the results of the long-run econometric analysis will be summarised here.

31. Essentially, the long-run economic growth is due to continuous improvements in labour productivity. Therefore, labour productivity measured as GDP per labour input was studied together with both fixed capital and human capital in proportion to labour input in Finland in 1910–2000. The analysis was conducted by cointegration analysis of time series (originally developed by the Nobel Prize winners Engle and Granger (1987), further developed by Johansen (e.g. in 1996)). This method allows for beginning the examination without any assumptions of the relations between the variables.

32. The empirical examination demonstrated that once human capital by education is measured by the paid monetary flows in education in the National Accounts, it can be straightforwardly taken into the analysis of the standard long-run labour productivity growth together with fixed capital and labour input. The contribution of human capital by education to labour productivity growth turns out to be essentially higher than in the studies with conventional proxy variables. As a matter of fact, the direct contribution of human capital proves to be as big as that of fixed capital and the continuous improvements in labour productivity are almost equally due to the growth in fixed and human capital in the labour input. The capitals have been complements and enhanced the contribution of each other to labour productivity.

33. However, the results show as well that human capital and fixed capital are nourishing the growth of each other: without the growth in human capital, fixed capital could not have grown as recorded, and vice versa. According to this long-run relation between the capitals, the results suggest that later produced varieties of fixed capital have been more productive in accordance with human capital of that time. This implies that technological progress could be interpreted to be included in the advancement of the machines, equipment and other types of fixed capital.

34. The part of the unexplained residual (or multifactor productivity (MFP)) needed in explaining the long-run labour productivity growth diminished significantly. It could even vanish in the long-run analysis from the production function in the form where GDP, fixed capital and human capital are all expressed in proportion to labour input. This suggests the accumulated capitals to have been the most important factors for growth. This contradicts

obviously with the results obtained in the studies where school attainment proxies are used as empirical counterparts for human capital. The results with the National Accounts measure for human capital give support to the modern growth theories.

## V. Concluding remarks

35. Treating human capital as an asset in the National Accounts frame can change both the idea of what factors are valued as the most important determinants for long-run growth and how economic growth is analysed. The increased share of the unexplained residual of the productivity accounts - multifactor productivity - in explaining the standard GDP growth in advanced economies after WWII may be due to lack of a proper empirical variable for human capital.

36. The results summarised above show that assessing human capital in the National Accounts can change the whole view on standard economic growth. Human capital has been one of the most important factors for growth. Fixed capital and labour input adjusted by human capital in the working age population may explain the long-run economic growth without the unexplained residual or multifactor productivity needed in the long-run analysis. The capitals have been complements and enhanced the contribution of each other to labour productivity. In addition, the results show as well that human capital and fixed capital are nourishing the growth of each other: without the growth in human capital, fixed capital could not have grown as recorded, and vice versa.

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