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Measuring human capital

Measurements in formal education: estimates from the United States

Note by the United States Bureau of Economic Analysis*

Summary

The paper gives a short overview of the cost-based and income-based measures of human capital, lists some concerns about the implementation of the Jörgenson-Fraumeni approach, and presents recent work on human capital measures in the United States and the United States Bureau of Economic Analysis' plans for human capital accounting.

* This document has been submitted late for technical reasons.

I. Why measure human capital?

1. Interest in measuring human capital has risen in recent years, particularly as it pertains to national accounting. There has been increased focus on using a national accounting framework to include nonmarket time as well as nonhuman capital. Traditionally, the output of education is only measured using nonhuman capital stock and does not include the return to past investments in schooling and work experience. Further study on human capital would provide insight into how investment and human and nonhuman capital stock affect economic growth. In a broader sense, enhanced human capital measures would enable a better understanding of the output and productivity trends in the growing education sector (Abraham and Mackie 2005).

2. While measurement difficulties exist, exploring human capital measures can provide the foundation for creating an education satellite account within a national accounting framework, providing a more comprehensive view of the education sector. The research conducted regarding human capital measures by an increasing number of countries will facilitate international comparisons of growth, sustainable development, and productivity. Others (Haverman et al. 2003) have noted the usefulness of human capital studies for providing insight to potential earnings by race, age group, and education level (Christian 2011).

II. Cost-based vs. income-based methods

3. Shaping human capital estimates into a national accounting framework requires following a double-entry bookkeeping system. The two commonly proposed measures of human capital investment mirror this system used by the National Income and Product Accounts (NIPAs): the cost-based method (Kendrick 1976) and the income-based method (Jörgenson and Fraumeni 1989, 1992a, 1992b); in contrast to the national accounts the two sides of the accounting ledger in the human capital case will not necessarily lead to equivalent results.

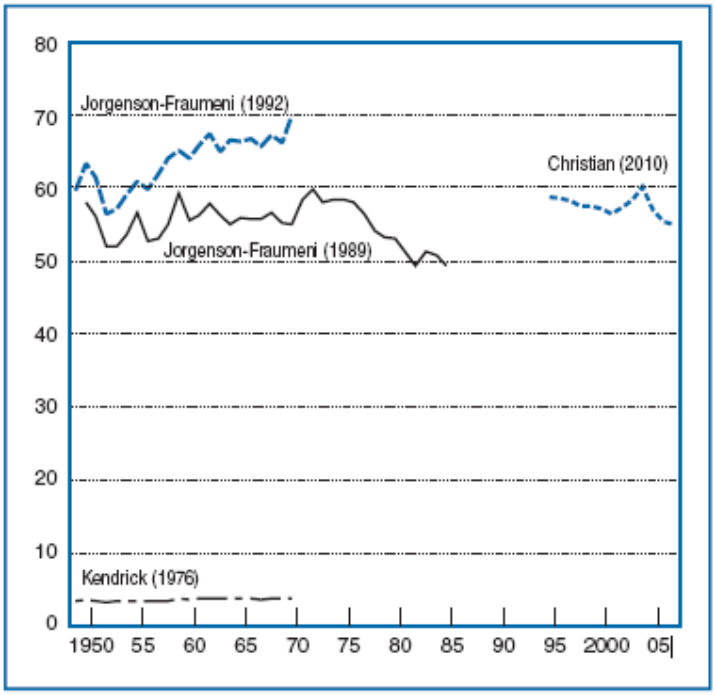
4. Kendrick's cost-based method parallels the income side of the NIPAs and is based on the costs, or inputs, required to produce formal education. This method relies on a more inclusive set of historic data for various market and nonmarket spending categories, including costs for food, clothing, and shelter, as well as time parents spend caring for their children. These costs are then combined with costs of past investments in health, education, and training. The cost-based method of measuring investment in education includes direct costs for schooling (e.g. books and supplies and fixed education capital) and the opportunity cost of students' time (Abraham 2010).

5. The Jörgenson and Fraumeni (henceforth J-F) income-based method corresponds to the production side of the national accounts and the output the education sector produces; the J-F method requires measuring the present value of the return to education and the assets it yields. In this method, human capital is equal to the expected present value of future market and nonmarket labor income. The market component of human capital in the J-F approach is the portion of human capital that corresponds to the value of the population's market work. The income-based approach typically limits its dataset to the working-age population, persons in the labor force, or employed persons. J-F estimate the returns to additional years of education, valuing the future flow of income to the current population.

6. Despite employing a more narrow definition, the income-based approach results in significantly higher estimates of human capital; J-F estimate the human capital stock to be

about 16 to 18 times larger than the GDP estimate and the Kendrick estimate is about 3.5 times GDP. Figure 1 highlights the extreme differences among the results each method produces.

Figure 1
Human capital stocks relative to Gross Domestic Product: comparison across studies



Source: Survey of Current Business June 2010

III. Critiques of Jörgensen-Fraumeni

7. There is little argument regarding the J-F concept of valuing investment in formal education using future returns attributable to the investment; however, many concerns surrounding various aspects of the J-F implementation have arisen as a result of the magnitude of their human capital estimates (Abraham 2010). While there do not appear to be any immediate solutions to the questions raised, they are important to consider.

(a) **Using wages as a proxy for productivity.** The J-F methodology assumes that differences in wages result from differences in workers' productivity. One question raised about the J-F framework is whether or not higher wages really do reflect higher productivity. Abraham (2010) notes that including sex as a factor in potential earnings estimates would be useful because the data J-F use do not provide a direct indication of experience. Currently, they use age and years in school; neither reflect differences in life expectancy and the fact that women tend to have fewer years of work experience.

(b) **Using synthetic cohort data to proxy for future earnings expectations.** The J-F data rely on synthetic earnings profiles in cross-sectional data and this may not lead to an accurate estimate of individuals' lifetime earnings. This issue arises in part from the fact that expected earnings change over time due to cyclical or other factors. The expected future earnings for someone who obtains an additional year of schooling is likely to vary

over time as demand for less educated workers changes. In addition, the content of the degree one receives (e.g. engineering versus a "softer" discipline) will affect one's returns to education in conjunction with the number of years of education.

(c) **Choice of discount rate.** The J-F framework is significantly impacted by the choice of discount rate for valuing future returns to education. The J-F methodology uses a risk-free rate of return, which is likely too low considering education is a risky investment for individuals because they cannot diversify this particular investment. Abraham (2010) suggests a discount rate of 4 percent is a more accurate representation of an individual's rate of return to education.

(d) **Treatment of aggregate productivity growth.** In the J-F calculations, annual labor income grows at a given rate at each level of education obtained. Because the income growth rate is applied to higher base-level earnings for higher levels of education, the value of investing in education becomes higher. Earnings growth corresponds to improvements in productivity resulting from investments in physical and knowledge capital; there are questions about whether these returns are being double counted and should not simply be attributed to the initial investment in education.

(e) **Counterfactual earnings for those who pursue additional education.** There are two issues that can arise from assumptions regarding what would have happened to individuals receiving additional education had they not done so. First, it is possible that those with more education would have had higher earnings without additional schooling; second, even if a highly educated person had not acquired additional schooling in a given year, the odds of their obtaining more education in another year could be higher than the odds for the average person of the same age. Christian (2010) suggests a more reasonable counterfactual for the second issue is to assume the same probability of additional schooling as a person who is "on track" for the given years of education. For example, an 18 year old with 11 years of education (instead of 12) would be assumed to have the same probability of a twelfth year of school as a 17 year old with 11 years of education.

(f) **Confounding returns to other human capital investments.** J-F estimates may also be overstated because some of the returns should not be attributed to formal education, but other types of human capital. When parents with more education invest time in their children, their returns would be reflected in higher average earnings and therefore wrongly attributed to the education the parents received. With regards to on-the-job training, if individuals (especially those with more education) view this is a risky investment their discount rate would be higher than the risk-free rate, which causes returns to exceed costs in the J-F framework.

(g) **Valuation of nonmarket time.** Valuing nonmarket time as well as market time also causes the J-F estimates to be overstated. They assume that individuals' returns to nonmarket time are equal to their market wage. It has been argued that because many workers have a fixed number of hours and cannot choose their nonwork time, the value of the marginal nonmarket hour is less than that of the marginal market hour. Furthermore, J-F use market wages to value the nonmarket time of those not in the labor force.

IV. Recent work: Michael Christian (2011)

8. Christian (2011) recently provided updated human capital measures for the United States; these estimates followed the methodology provided in Christian (2010). He uses a method similar to J-F and produces a human capital account based on the Current Population Survey (CPS) for population and school enrollment; the March demographic supplement to the CPS for wages and hours worked; and life tables of the Centers for Disease Control for survival rates. He found the total human capital stock to be about

three-quarters of a quadrillion dollars in 2006, or 55 times the value of GDP; this finding includes the nonmarket component, and the market component is about 30 percent of the total human capital stock.

9. Christian (2010) measured investment in education net of aging, therefore measuring the value of moving along the age-education progression, rather than the value of not falling off-track, making the estimates more reasonable. The market component of Christian's methodology is not sensitive to the choice of tax rate. He applies a discount rate of 4 percent and an income growth rate of 2 percent. Table 1 indicates the sensitivity of the human capital stock to the choice discount and income growth rates.

Table 1
Market human capital stock and investment under alternative income growth rates and discount rates, 2009

	IG:2% D:4%	*IG:1% D:6%*	*IG:1% D:12%*
Stock of human capital (tril.)	$231.6	$135.4	$69.6
Net investment in human capital (tril.)	$2.6	$1.5	$0.8
Investment from births (tril.)	$4.0	$1.2	$0.2
Depreciation from deaths (tril.)	$0.4	$0.3	$0.2
Investment from education, net of aging of enrolled (tril.)	$3.7	$2.9	$1.7
Depreciation from aging of non-enrolled (tril.)	$5.3	$2.7	$1.2
Residual net investment (tril.)	$0.7	$0.4	$0.2
Real growth in stock (ann. 1998-2009)	0.8%	0.9%	1.0%
Real growth in net investment (ann. 1998-2009)	-0.8%	-1.8%	-3.3%
Real growth in investment from births (ann. 1998-2009)	0.4%	0.4%	0.4%
Real growth in depreciation from deaths (ann. 1998-2009)	0.2%	0.4%	0.6%
Real growth in net education investment (ann. 1998-2009)	1.7%	1.6%	1.7%
Real growth in aging of non-enrolled (ann. 1998-2009)	0.3%	1.2%	3.1%

10. Christian also finds that measures of investment in human capital are sensitive to assumptions regarding enrollment. When computed directly, he assumes that students who miss a year of school pursue an additional year with the same probability as if they had not missed a year; the imputed method assumes those that miss a year behave like people who actually missed a year. The imputed case produces a market component of human capital that is 120 percent of GDP, while the direct case produces investment in human capital that is 20 percent of GDP. Christian also experiments with imputing multiple variables. Table 2 indicates the difference in the overall human capital stock, comparing the baseline model to a model with imputed variables; as Table 2 demonstrates, the imputations result in a smaller stock of human capital.

Table 2
Market human capital stock and investment from baseline model and model with substantial imputations, 2009

	Baseline	*Imputed*
Stock of human capital (tril.)	$231.6	$177.1
Net investment in human capital (tril.)	$2.6	$1.9
Investment from births (tril.)	$4.0	$3.0
Depreciation from deaths (tril.)	$0.4	$0.3
Investment from education, net of aging of enrolled (tril.)	$3.7	$3.2
Investment from education, gross, trad. assumptions (tril.)	$21.0	$14.0
Depreciation from aging of non-enrolled (tril.)	$5.3	$4.6
Residual net investment (tril.)	$0.7	$0.5
Real growth in stock (ann. 1998-2009)	0.8%	0.8%
Real growth in net investment (ann. 1998-2009)	-0.8%	-1.0%
Real growth in investment from births (ann. 1998-2009)	0.4%	0.4%
Real growth in depreciation from deaths (ann. 1998-2009)	0.2%	0.1%
Real growth in net education investment (ann. 1998-2009)	1.7%	1.5%
Real growth in aging of non-enrolled (ann. 1998-2009)	0.3%	0.5%

11. Overall, real growth in net investment in education is robust to changes in the income growth rate, discount rate, tax rate, and approach to smooth and imputation, and valuation of nonmarket time. The robustness of the findings suggests that smaller datasets could be used to construct a human capital account; this could be particularly useful when constructing estimates further back in time.

V. The Bureau of Economic Analysis' plans for human capital accounting

12. BEA plans to continue experimenting with the J-F methodology and assumptions. The primary difference will be in the exclusion of a nonmarket component; nonmarket time does not easily fit into the national accounting framework within which BEA's estimates are constructed. Additionally, there is not yet a consensus on data sources and methodology for valuing nonmarket time. In focusing on the market component, BEA will follow the methodology used to construct the NIPAs and appeal to existing literature to establish reasonable assumptions and models (Card 2001). Following McGrattan's (2010) guidance, BEA will focus less on the level of the stock of human capital and more on the investment in education and how it can inform future economic research and the economic impact of the education sector. As BEA continues researching improvements to methodology, estimates will be updated and published annually in the *Survey of Current Business.*

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