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Comments: “Human Capital Accounting in the US: 1994-2006”

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*This discussion of Michael Christian’s paper was prepared for the Bureau of Economic Analysis Advisory Committee meeting in May 2010. The views expressed herein are those of the author and not necessarily those of the Federal Reserve Bank of Minneapolis or the Federal Reserve System.

1. Summary of the Paper

Michael Christian’s paper presents measures of the stock of human capital for the United States over the period 1994 and 2006. The main findings are twofold. First, the total stock—including the value of market production and non-market production—is about three-quarters of a quadrillion dollars in 2006. This estimate is roughly 55 times GDP and 16 times the net stock of fixed assets plus consumer durables. His second finding is that the measures of gross investment in human capital are sensitive to alternative assumptions about enrollment patterns.

Christian applies the methodology of Jorgenson and Fraumeni (1989,1992) who estimate the present discounted value of the future stream of earnings to investment in human capital.¹ To keep things simple, assume that death is certain after age 80. Then, starting with the oldest age group considered (which is 80), the human capital for someone is the average yearly earnings of people with the same sex and education level. Working backwards, the human capital of the second oldest age group (which is 79) is calculated as the average yearly earnings of people with the same sex and education level plus the present value of future earnings. Continuing recursively, the stock is constructed as follows

$$H_{y,s,a,e} = E_{y,s,a,e} + \frac{(1+g)}{(1+\rho)}\pi_{y,s,a+1}H_{y,s,a+1,e} \quad (1.1)$$

where y denotes year, s denotes sex, a denotes age e denotes education level, E is average yearly earnings, H is the stock of human capital, π is the survival probability, g is the growth rate of labor income, and ρ is the rate of discount. The same calculation can be done for nonmarket earnings, which is assumed to earn the same after tax income.

¹ One innovation of Christian’s paper is the handling of a change in the Current Population Survey (CPS) which now asks individuals what degree they earned rather than number of school years they completed.

The calculations are slightly more complicated for younger age groups since some people may have not completed all of their schooling. In this case, the term $H_{y,s,a+1,e}$ on the right hand side of (1.1) is replaced by a weighted sum of $H_{y,s,a+1,e}$ and $H_{y,s,a+1,e+1}$ where the weight depends on the probability of someone with characteristics (s, a, e) enrolling for another year.

The results of Christian's calculations are shown in Figure 1. Here, I have divided the stocks by GDP in order to see how they have varied across time. The top line is the total stock which is about 59 times GDP in 1994 and 55 times GDP by 2006. The market and nonmarket components are also shown. The market component is slightly under 30 percent of the total human capital stock; this estimate is consistent with discretionary time allocation to market activities reported in time use studies. The bottom line in the figure is the ratio of fixed assets and durables to GDP, which is a typical reference point for human wealth accountants. The ratio of fixed assets plus durables to GDP is slightly over 3, which is *much* smaller than either of the human capital to GDP ratios shown in Figure 1.

Figure 2 compares the total human capital estimates of Christian with the earlier work of Jorgenson and Fraumeni (1989,1992) and Kendrick (1976). In their 1989 study, Jorgenson and Fraumeni compute estimates of human capital that are on average 55 times GDP. This is what Christian finds. The later 1992 study of Jorgenson and Fraumeni finds estimates that are 64 times GDP on average. The lower line on Figure 2 is the cost-based measure of Kendrick (1976), which is computed from costs of inputs to formal education like teacher time and books. Kendrick's estimates are 3.5 times GDP on average. Interestingly, the difference between the two Jorgenson and Fraumeni series of 1989 and

1992 is larger than either Kendrick's measure or the ratio of fixed assets plus durables to GDP shown in Figure 1.

The second main finding of Christian's study is that gross investment estimates are very sensitive to assumptions about future enrollment decisions of individuals. The gross investment in education for a particular year is the difference between the actual human capital stock and the stock if no one enrolled in the year. Thus, it matters a great deal what one assumes about future years for someone that missed a year of education. For two extreme scenarios, Christian finds that the gross investment estimates are different by slightly more than a factor of five. (See his Figure 5.)

2. Comments

I enjoyed reading Christian's paper and the papers of Jorgenson and Fraumeni upon which it builds. It was interesting to contrast this work with Kendrick's (1976) earlier work and to see how the different approaches lead to such different estimates for human wealth. What I find most surprising, however, is the disconnect between the work on the human capital accounts and almost all applied work in labor, development, finance, and macroeconomics. A priori, I would have thought that users of the accounts would extend well beyond the national accountants themselves. In this section, I hypothesize that the source of the disconnect in the two literatures is fact that the accountants focus almost exclusively on the size of the capital stock estimates and hardly at all on the ultimate questions they hope to address with the accounts.

2.1. Less Focus on Size of Stock

Abraham (2010) and others before her² present a long list of reasons why the estimates of human capital based on the Jorgenson-Fraumeni methodology—which Christian uses—are so large and why there is “underlying discomfort with the magnitude” of the estimates. Just about every commentator of the Jorgenson-Fraumeni methodology points out that human capital estimates are large because the imputed value of nonmarket time is the after-tax wage rate, which may be implausibly high. Rosen (1989) also highlights the fact that costs of raising children and maintaining the stock during the working life is not netted out, implying an asymmetric treatment of human and nonhuman capital. Choices of discount rates, which may be too low, and growth rates, which may be too high, can also bias the results.

What these commentators do not really discuss is why any of this matters. What are the economic questions these estimates could help us answer? What if Christian’s estimates were 10 times bigger or, alternatively, 10 times smaller? What results will be overturned if we use the Christian-Jorgenson-Fraumeni estimates versus the Kendrick estimates?

At this point, I suspect that few, if any, have an answer to these questions. Most citations of the human capital accounts simply point out the estimates of human wealth are large (regardless of how they are constructed) and, therefore, neglecting them has a big impact on wealth and income accounts.³ But, for the most part, researchers citing the human capital accounts *are not actually using the estimates* as an intermediate input in their own work.

² See, for example, Rosen (1989) and Rothchild (1992).

³ In his presidential address for the AEA, Gary Becker (1988) surmises that “the true ratio of human capital to the total capital stock may be as high as 90 percent or as low as 50 percent. Of course, even this lower percentage signifies a large contribution.”

2.2. More Focus on Economic Importance

Perhaps what is needed is more focus on the economic importance of the human capital estimates and less focus on the plausibility of their magnitudes. Here, I will discuss several research areas that could take advantage of the human capital accounts but have not yet. Given more time, I'm sure that many more will come to mind.

A priori, I expected to see a much stronger connection between the research on the human capital accounts and research on the economic impact of education. For example, in a survey of studies of the return to education, Card (2001) summarizes econometric estimates from regressions of earnings on schooling (which is a slightly more general version of the regression proposed by Mincer (1974)). I found no discussion of how the surveyed results compare to returns to education implied by the human capital accounts. Similarly, I found no discussions by the human capital accountants relating their estimates—either of total investment or even just market investment—to the regression results surveyed by Card.

In comparing the impact of schooling on growth performance across countries, Hanushek and Kimko (2000) use international math and science test scores as a measure of labor quality. They note that an alternative measure of labor quality is the human capital stock based on lifetime earnings, but I found no studies comparing human capital accounts across countries. Obviously, the wealth of nations will change dramatically if we include values of human capital on the order of 55 times GDP. However, given all time has an implicit value equal to the observed after tax wage, relative comparisons of wealth, incomes, and productivity across nations may not change.

I also expected a stronger connection between research on the human capital accounts and the finance literature. There is a growing body of work within finance that explicitly

introduces human wealth in portfolios of asset pricing models. Shiller (1995) assumes the expected return on human wealth is constant. Campbell (1996) assumes the expected returns on human wealth and financial wealth are perfectly correlated. Jagannathan and Wang (1996) assume that the expected return on human wealth is perfectly correlated with the expected labor income growth.

Lustig and Van Nieuwerburgh (2008) show that none of these assumptions about returns to human wealth are consistent with observed moments for consumption. They, therefore, back out the returns to human wealth using aggregate consumption data and find that they need to be negatively correlated with returns to financial assets in order to rationalize consumption patterns. This result puts Christian's assumption of a constant discount rate into question. However, besides generating the observed patterns in consumption, it is not obvious what the full quantitative impact would be of relaxing this assumption.

Palacios-Huerta (2003) also considers the role of risk in human capital investment, but uses data on individual earnings to construct returns to human capital. His methodology is conceptually the same as Jorgenson and Fraumeni (1992), but as is true of much of the literature, no connection is made between the two sets of estimates of the human capital stocks or returns.

Finally, because I am a little more familiar with business cycle research, I am sorry to report that the connections with the human capital accounts are weak there too unless we focus narrowly on firm-specific human capital. Prescott and I (2010) found that incorporating firm-specific intangible investment—human and nonhuman—into an otherwise standard business cycle model resolved a puzzle that we struggled with for several years. In the 1990s, corporate profits were falling as output was rising, and compensation per

hour was falling when hours were booming. The low factor incomes during a period of increased economic activity were suggestive that investments in R&D and advertising—that are expensed from corporate profits—and investments of time by business owners—that are expensed from compensation—were abnormally high.⁴

In our business cycle model, we allowed for rates of technological change to differ across production of final goods and services and production of intangible investment goods. More specifically, we allowed for a high-tech boom in production of intangible investment. Assuming that households equate wages and rental rates across production activities, we had a way to identify the TFP paths in our model's two sectors and to estimate the magnitude of intangible investment. We fed those TFP paths into our model to see whether or not the model time series for GDP, hours, and tangible investment were close to the U.S. time series. We found that they were.

I know of no studies that try to explore the impact on business cycles of human capital investments that are not rents to the corporation or the proprietor. But it's possible that unmeasured human capital investment may be the source of what many of us call the "labor wedge." The labor wedge is the unexplained gap in the intratemporal condition of the standard growth model (which equates the marginal rate of substitution between consumption and leisure and the marginal product of labor). Is it a preference shock? Is it countercyclical wage markups? Or, is it due to variations in human capital investment that somehow are not being captured in the BEA accounts that we work with?

⁴ Direct measures of some of these expenditures made by Corroda, Hulten, and Sichel (2005,2006) also showed an increase over the 1990s.

3. Recommendations for Future Research

In addition to focusing more on key economic questions, I recommend specifying the economic environment more fully. Obviously, estimates of the stock of human capital depend on many assumptions. I would recommend more transparency by making the choices very explicit in the context of a theoretical model. Specifically, it would help consumers of the estimates if we knew details about preferences, technologies, and transactions. A clear distinction should also be made between variables in the model and statistics that the BEA reports. The same methodology used by the BEA to construct the U.S. accounts can and should be used to construct the accounts in the model.

With a fully-specified model in hand, we can begin to address the many issues raised above.

4. Conclusions

In a workshop at the Brookings Institution, Fraumeni (2000) acknowledged that “the profession has been largely silent” about the conceptual and methodological features of the Jorgenson-Fraumeni approach. She discussed some of the controversial choices that they had made in laying out the human capital accounts in an attempt to spur debate. In my opinion, more interaction between quantitative theorists and national and satellite accountants may better stimulate the debate she is seeking.

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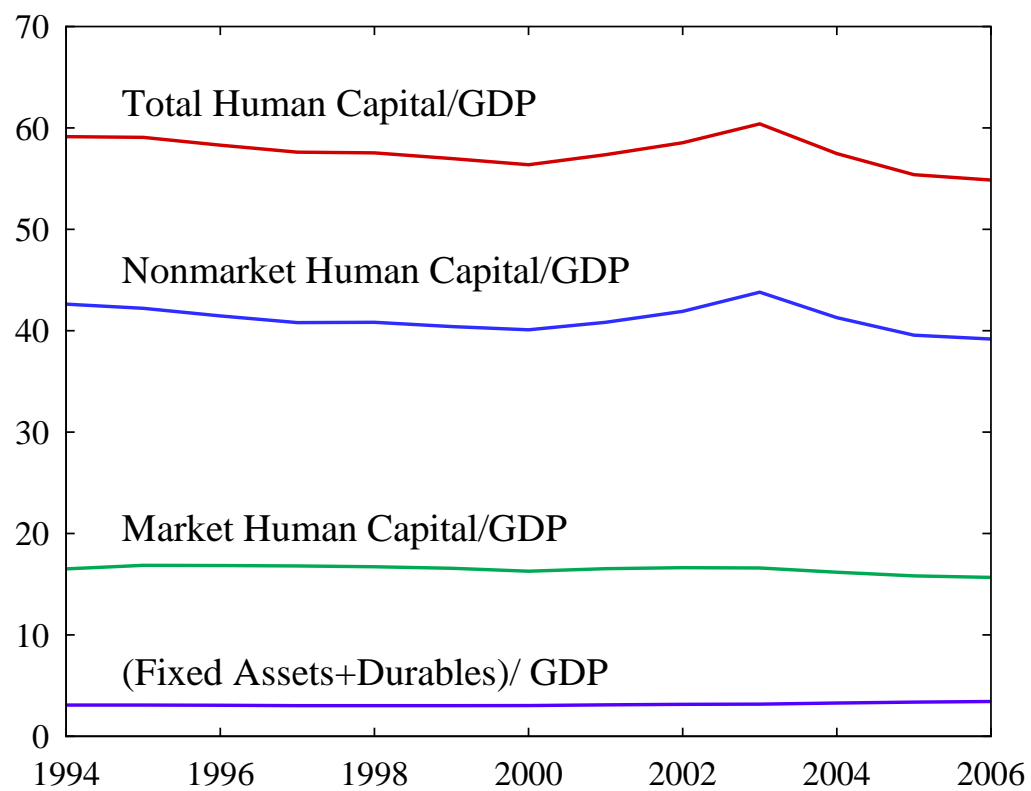


FIGURE 1. HUMAN CAPITAL STOCKS RELATIVE TO GDP

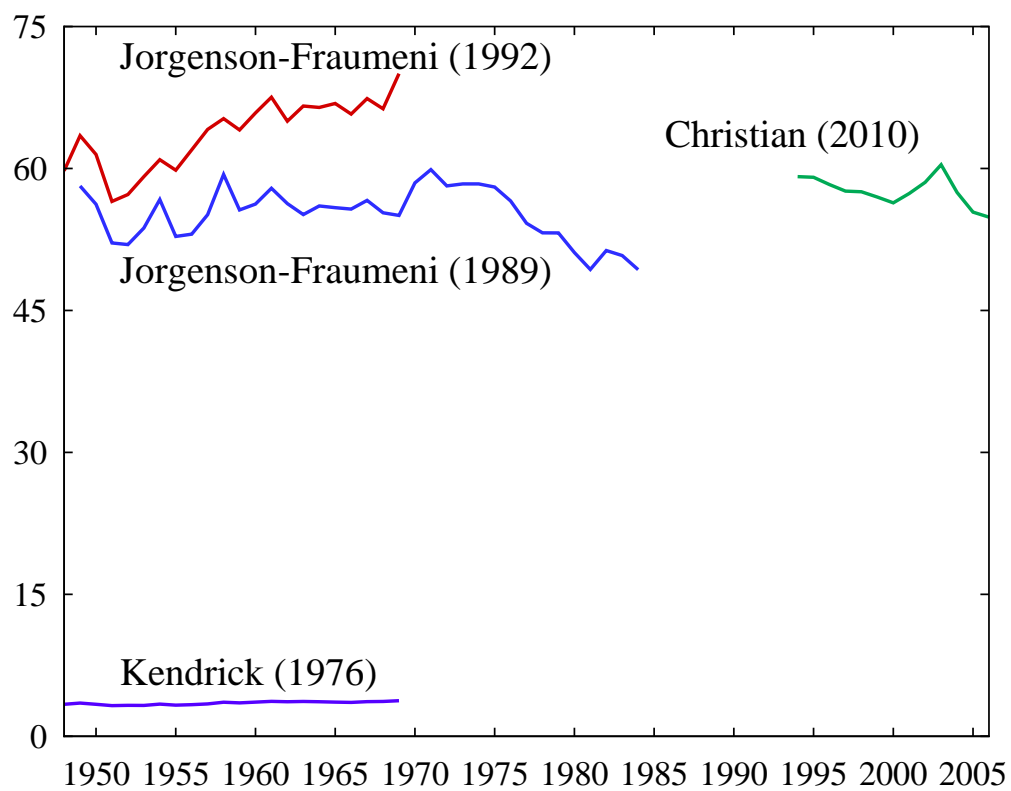


FIGURE 2. HUMAN CAPITAL STOCKS RELATIVE TO GDP:
COMPARISON ACROSS STUDIES