

Discussion

SOCIAL AND NONMARKET BENEFITS FROM EDUCATION IN AN ADVANCED ECONOMY

T. Paul Schultz*

The objective of the paper by Barbara Wolfe and Robert Haveman is to assign a monetary value to the welfare gains associated with schooling that are not captured in the traditional measure of market-wage returns. Extending our perspective beyond the wage differentials of workers with different amounts of education promises to provide a more comprehensive basis on which to evaluate private and social investment priorities within the education sector, as well as the relative returns between education and alternative social investment sectors. This requires that we improve resource-accounting procedures and develop better methods to describe—without bias—the technologies that permit more-educated people to be more productive and thereby enjoy a higher standard of living.

Wolfe and Haveman note that if you can estimate without bias the parameters of the production function for nonmarket goods, which includes at least one market-priced input and one household worker's time input (distinguished by her or his education), then the trade-off between the marginal products of the worker's education and the marginal product of the market-priced input can be inferred. Thus they estimate a monetary value for the educational input, assuming that the ratio of the value of marginal products of all inputs divided by the inputs' market (or nonmarket) prices is equal when the allocation of inputs has been efficiently optimized.

To make this procedure more concrete, consider an example where an extra year of education of a mother increases her child's cognitive achievement by exactly the same amount as sending the child to a more

*Malcolm K. Brachman Professor of Economics, Yale University.

expensive school. In this case, the added market cost of attending that better school is equivalent to a monetary valuation of the mother's production caused by her additional education in this one nonmarket production activity—child cognitive development. As Haveman and Wolfe note in their 1984 paper, several assumptions are required to justify their attractively simple methodology for estimating the social value of the many nonmarket private benefits and public externalities associated with education. Let me review some of the working assumptions that I think have proven unrealistic in subsequent studies, and thus represent limitations to their reported empirical findings.

The production of many goods and services that are consumed in the home by the producers and their families may be influenced by the education of family members in at least two distinct ways. Education may change the allocation of inputs and thereby increase outputs holding total costs constant. Alternatively, education can increase outputs, holding constant the mix of other inputs, presumably because a better-educated worker is intrinsically a more efficient producer with the same inputs in the same production process. Welch (1970) distinguishes between these two roles of education to clarify how a better-educated farmer managed to increase his profit and farm income, by both enhanced *allocative efficiency* and increased overall *labor efficiency*. In their analysis, Wolfe and Haveman allow for only the second pathway for education to impact social output by raising the overall efficiency of the worker's labor (per hour) and, consequently, they must assume "neutrality" of education in production. This implies that the Wolfe-Haveman approach is valid only if "the composition of other inputs does not change with changes in schooling" (Haveman and Wolfe 1984, p. 393). Is this a good approximation, given the limits of our measurement of nonmarket production technology? For farmers it is clearly a poor approximation (Huffman 2001).

I know of only one study of nonmarket production in which the effect of education on output is decomposed into education's production effect achieved via input reallocations, and via education, holding input allocations constant. In this study of a mother's production of birth weight as a proxy for child health, the production technology is hypothesized to be of a Cobb-Douglas form and uses four observed inputs in addition to education. The researchers could fully account for the significant positive partial association of mother's education and the expected birthweight of her child in the United States with the four input reallocations associated with the mother's education (Rosenzweig and Schultz 1982). In other words, the input reallocations associated with maternal education explained adequately the simple association of a mother's education and the improved birthweight outcome, leaving no significant residual to attribute to the "overall labor efficiency" effect of her education.

If this pattern is a typical or even a possible explanation for some of the partial associations between education and nonmarket productivity summarized in this paper, as I would anticipate if the technology is carefully dissected, one must ask, what is the cost of the reallocated input mix that the better-educated mother adopts? The Wolfe-Haveman methodology is likely to attribute all of the improved household production outcome to her education. I conjecture that her education may be associated with the use of a different, and probably a more expensive, mix of inputs in the home, many of which will not be observed in the typical survey or included in the regression analyses listed in the Wolfe-Haveman paper. The omission of such other household inputs as the mother's innate ability could also overstate nonmarket returns attributed to her education, for the same reason that many economists expect that the omission of ability in the analysis of wage determination might lead to an upward bias in the estimation of the private-market returns to education.

Education in such a production function could be viewed as more than a management capacity. Educated labor could also be an exhaustible resource, which must then be withdrawn from other valued activities at an opportunity cost to the family, in order to increase nonmarket production. That cost of the reallocation of family time is not discussed by Wolfe and Haveman, and of course it could be negative or positive. The more-educated mother may manage to produce healthier children while spending less of her time caring for her children. But other inputs are, in this case, likely to be substituted for her time, lowering the *net value* of her education's productive effect on child health, after deducting for the cost of those added inputs. I doubt that most of the studies of nonmarket private production cited by Wolfe and Haveman describe the determinants of the input used in household production and how education affects the use of all productive inputs, including the time of family members.

Heterogeneity bias is another general limitation for the study of household production functions (Rosenzweig and Schultz 1983), and is not discussed in the Wolfe-Haveman papers. The inputs to a household production function are allocated in response to *unobserved characteristics* of the individual producer. For example, the child's ability may affect which child goes to school; the initial health status of the child may determine whether the child receives medical care; the doctor's diagnostic ability may affect the health inputs the child is prescribed. The household's use of productive inputs is thus impacted by these variables that are unobserved by the researcher and that are likely to be associated with the residual variation in outputs—the child's productive capacity or the child's final health status, respectively. The estimates of the effects of the parents' education on household production will, in this case of heterogeneity of observations, tend to be biased and inconsistent, if

estimated by single-equation methods, such as standard regression analysis employed in many of the studies cited by Wolfe and Haveman. One approach used increasingly to deal with this problem of heterogeneity is two-stage (least squares) or instrumental variable estimation methods. This involves predicting variation in input use related to variation in the exogenous instrumental variable, and this predicted variation in the inputs is then purged of the correlation with the residual variation in output from the household production function. Unbiased second-stage estimates of the household production function can thus be obtained, from which the marginal product of education can be inferred. A natural candidate for the instrumental variables in this context is the market-determined price of, or access to, the input that is observed to enter into the household production process.

Finally, the critical input that one wants to understand in the accounting exercise advanced by this paper is the reallocation of the time of the more-educated individual toward or away from the nonmarket production activity. Even if a mother today does not substantially reduce her time in market production to achieve an improvement in her child's health outcomes, she may sacrifice her leisure as well as use other market goods and services to substitute for her own home childcare time. The exercise reported in the Wolfe-Haveman paper is, therefore, only the starting point for a more comprehensive evaluation of the *net* benefits arising from education contributing to enhanced nonmarket production. In other words, from the gross output association reported in their paper, one must subtract the opportunity cost of lost leisure and market work time, if any, and the market cost of other inputs substituted for the time of the more-educated mother in the nonmarket production process. Therefore, I would conjecture that the nonmarket private productive values of education reported in this paper are substantially upward biased. Improved research is now needed to confirm this intuition.

As the authors note at the start of their paper, the economics literature on the market-wage returns to schooling as approximated in a Mincerian wage function has evolved through a variety of conceptual and statistical interpretations in the last 40 years. Literally hundreds of empirical and statistical papers were produced before there emerged a consensus that the widely anticipated "ability bias" that is expected to overstate the wage returns to schooling is not in fact all that substantial. The first generation of studies summarized by Griliches (1977) concluded that the errors in measuring education were an offsetting source of downward bias, which apparently canceled out the upward ability bias. In the second generation of work, summarized by Card (2001), the application of instrumental variable estimation methods, which exploit the variation in school-system supply factors for identification—in other words, building schools in the neighborhood of the respondent—has yielded somewhat higher estimated wage returns than implied by the

simple regression approach pioneered by Jacob Mincer. Card concludes that this upward adjustment in schooling returns associated with supply-based instruments may be due to the heterogeneity of the labor productivity gains realized from schooling. He hypothesizes that the expansions in public supplies of school service disproportionately benefit disadvantaged children from credit-constrained families and that these children may earn higher-than-average returns on their education.

This estimation methodology must now be extended to grapple with the task of estimating nonmarket production functions without bias, in order to proceed to answer the question addressed in the Wolfe-Haveman paper. A similar problem arises from the heterogeneity of students and schools, which affects the endogenous allocation of inputs among and within schools and contributes to bias in the estimation of educational production functions by ordinary single-equation methods. Interpreting with caution the existing empirical evidence derived from educational production-function studies of schools is imperative, except when input or process variation is implemented randomly across treatment and control populations. (This important issue is relevant to the Hanushek and Raymond paper included in this volume.)

This history of statistical and empirical studies of the market-wage returns to education is well known, but I have restated it here to underscore the point that to improve our empirical knowledge of the private market-wage returns to education, many increasingly sophisticated studies were undertaken that explicitly allowed for the heterogeneity of people and their environments, and in many cases natural and social experimental settings were exploited with and without instrumental variable methods. There is now a need to improve the first-generation studies of nonmarket household production, which are reviewed in the Wolfe-Haveman paper, because most of these studies ignore these problems. A more satisfactory statistical and conceptual approach to household production (one that recognizes that the education of family members influences the mix of inputs used in the household, and changes the allocation of the time of household members) will be needed. Because of the heterogeneity of households and their endogenous choice of inputs, including their own time allocations, the reported empirical evidence of private nonmarket returns to education as reported by Wolfe and Haveman is not satisfactory as even a first approximation, although I have no doubt that nonmarket privately realized returns in the formation of children's human capital are probably substantial. But these are privately captured returns, if altruistic parents benefit from these returns, and thus not commonly viewed as a rationale for public sector subsidies for education.

I look forward to a new generation of empirical research into the role of education in household production, from which more adequate and less biased evaluations of the nonmarket returns to education can be

derived using the conceptual logic outlined in the Wolfe-Haveman paper. I anticipate that these new studies will show substantial returns in welfare improvements beyond market-wage returns to schooling, which arise from the enhanced production of nonmarket outputs, such as the health and schooling of children. But we do not yet have these studies in hand, and the remaining task is not a trivial one, in terms of collecting suitable data and their correct analysis.

In conclusion, I should indicate that I have commented only on the private nonmarket returns to education. I have not elaborated on the equally daunting analytical challenges that face Wolfe and Haveman if they want to develop more satisfactory estimates of the social externalities from education that spill over beyond the family. In his comments on this paper, Daron Acemoglu reviews these issues involving the definition and measurement of social externalities of education. (See also Acemoglu and Angrist 1999; Moretti 1998.)

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