# Social and Nonmarket Benefits from Education in an Advanced Economy

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The extent to which human capital, especially schooling, contributes to social well-being and economic growth is an important question, and has been addressed in numerous research studies. The results of these studies are diverse, and hence controversial and widely debated. Evidence on this issue has important implications for public policies toward education and the optimal public/private balance in the financing of educational services.

One important line of research builds on the "human capital model" developed by Becker (1964) and Mincer (1962). Here the strategy has been to empirically estimate the returns to incremental schooling largely in the form of market-valued increases in productivity associated with more schooling. The value of this increase in skills and productivity is reflected in earnings differences between identical individuals with different levels of schooling. The 40 years of research on this question has been voluminous, and only recently has a consensus emerged regarding the wage returns to schooling.[1]

A second important approach is often referred to as "endogenous growth" analysis (Barro 1997, 2001 reviews this literature). The theoretical

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[1] An important issue in this literature concerns the potential upward bias in estimates of the return to schooling caused by an "ability bias." This was an important topic in an early review of this literature, by Griliches (1977). The current consensus is discussed by Card (2001), who concludes that estimates based on instrumental variables seem to be higher than the earlier studies based on Mincerian wage functions.

growth models of this genre view economic growth as dependent on purposeful research leading to new and improved products and ways of producing, which are then spread across sectors and nations. Empirical studies estimating this process use cross-national data on per capita output (gross domestic product per person), levels of physical and human capital, and characterizations of the demographics of the national population and the level and quality of its policies and institutions. They seek to reveal the persistent effect of policy levels and change on the growth rate of per capita output. Education quantity and quality, often characterized by measures of average years of school attainment of gender/age groups (see Barro and Lee forthcoming) and by test score indicators, are typically one of the central variables of interest. Again, the focus is on the determinants of market-based outcomes. The findings from this literature are diverse and controversial.

In this paper, we emphasize that a full evaluation of the effect of schooling on social well-being requires that we move beyond these market-based effects of education. As we show, the list of the potential effects of schooling that are not reflected in estimates of market returns is extensive, and involves both nonmarket effects that are private (in the sense of being captured by individuals) and social effects involving the public goods or "spillover" effects of schooling. We argue that these effects may be large, and under certain assumptions may be as large as the market-based effects of education. Irrespective of their magnitude, these effects are relevant for determining the optimal level of social (and public-sector) investment in schooling. We first catalog the market, private nonmarket, and social outcomes of schooling, and cite some of the more important contributions to the research literature providing evidence of such impacts. We cite papers that emphasize market-based and market-valued contributions of education in both the "rate of return" and "growth" literatures, and concentrate on the studies that attempt to assess the private nonmarket and social effects of schooling.[2] Our review includes studies that use data from developing countries.

As we have indicated, the catalog of private nonmarket and social effects of education is long, and includes such relationships as these:

- a likely positive link between one's own schooling and the schooling received by one's children;
- a likely positive association between one's own schooling and the health status of one's family members;
- a likely positive relationship between one's own education and one's own health status;

[2] Prior studies that also address this question are Haveman and Wolfe (1984, 2001), Michael (1982), McMahon (2000), Greenwood (1997), and Wolfe and Zuvekas (1997). Behrman and Stacey (1997) discuss a variety of sources of these nonmarket effects.

- a likely positive relationship between one's own education and the efficiency of choices made, such as consumer choices (the efficiency of which contributes to a well-being similar to the contribution of money income);
- a relationship between one's own schooling and fertility choices (for example, decisions of one's female teenage children regarding nonmarital childbearing); and
- a relationship between schooling in one's neighborhood and youth decisions regarding their level of schooling, nonmarital childbearing, and participation in criminal activities.

After presenting the catalog of social and private nonmarket effects of schooling and the results of the literature that provides evidence on the extent of these effects, we propose a method for valuing the private nonmarket effects of schooling under a set of demanding assumptions. Then, we present some illustrative estimates of these values, recognizing the heroic nature of the assumptions on which they rest. We find that the values of these private nonmarket returns to education are potentially very large, though as yet not accurately estimated. We conclude by noting that evaluating both the optimal level of social investment in education and the public/private balance in financing education requires a comprehensive assessment of all of the returns to schooling—market, nonmarket, and external/public goods effects.

## The Size of the Education Sector: Some Background

The education sector in western developed countries (in particular, the OECD countries) is very large, and substantial financial contributions by governments and private citizens are required to cover the total costs of providing schooling services. In all of these countries, the bulk of the social costs of providing schooling services at the elementary and secondary level are borne by taxpayers, as most schools are publicly funded. Among the set of countries shown in Table 1, 1997 spending for primary education is highest in Denmark—$6,913 per student (in 1997 dollars, translated by the OECD purchasing power parity index)—with Austria and Switzerland close behind. At the secondary level, Belgium records the highest per student expenditure at $9,111, followed by Austria. Switzerland, the United States, France, and Denmark all spent more than $7,000 per secondary student in 1997. At the higher education level, Japan had the highest expenditures per pupil at $18,914, followed by Switzerland, the United States, and Canada, all with per pupil expenditures greater than $14,000. Turkey had the lowest per pupil higher education expenditure at about $2,400.

Table 2 presents a tabulation of the percentage of national GDP

Table 1
Public Spending per Pupil: Selected Countries, 1997

| Country | Primary | Secondary | Higher Education |
|---|---|---|---|
| Australia | $3,751 | $5,794 | $11,240 |
| Austria | 6,258 | 8,213 | 9,993 |
| Belgium[a] | 5,205 | 9,111 | — |
| Canada | — | — | 14,816 |
| Czech Republic | 1,942 | 3,643 | 5,478 |
| Denmark | 6,913 | 7,285 | 7,294 |
| Finland | 4,643 | 5,009 | 7,190 |
| France | 3,735 | 7,118 | 7,058 |
| Germany | 3,460 | 4,536 | 9,621 |
| Greece | 2,351 | 2,581 | 3,990 |
| Hungary | 2,035 | 2,093 | 5,430 |
| Iceland | — | — | — |
| Ireland | 2,571 | 3,868 | 8,171 |
| Italy | 5,073 | 6,284 | 5,972 |
| Japan | 5,203 | — | 18,914 |
| Korea | 3,327 | 3,909 | 6,227 |
| Luxembourg | — | — | — |
| Mexico | 871 | 1,651 | 4,628 |
| Netherlands | — | — | — |
| New Zealand | — | — | — |
| Norway | — | 4,174 | 10,108 |
| Poland | 1,446 | — | 4,395 |
| Portugal | 3,248 | 4,264 | — |
| Russia | — | — | — |
| Spain | 3,560 | 5,386 | 5,335 |
| Sweden | 5,520 | 5,429 | 12,785 |
| Switzerland | 6,237 | 7,243 | 16,376 |
| Turkey | — | — | 2,397 |
| United Kingdom | 3,206 | 4,982 | — |
| United States | 5,961 | 7,462 | 14,864 |

Note: Data adjusted to U.S. dollars using the purchasing power parity (PPP) index.

[a] Data for Flemish Belgium only.

Source: Organization for Economic Cooperation and Development (1996, 1998, and 1999) and unpublished data from www.oecd.org.

allocated to all levels of schooling, and for the primary/secondary and higher education components of the education sector. Across the countries, the public sector allocates an average of about 5.1 percent of GDP to the provision of schooling services. This percentage ranges from 3.5 to 3.6 percent in Greece and Japan to 6.5 percent or more in the Nordic countries. On average, about 3.6 percent of GDP is allocated to primary and secondary schooling, and 1 percent of GDP is allocated to higher education. This tabulation of public sector costs, however, understates the full cost of providing educational services, especially at the higher education level. Whereas about 93 percent of the total costs of primary

Table 2
Total Public Direct Expenditures on Education as a Percentage of the Gross Domestic Product: Selected Countries, 1997

| Country | All Institutions[a] | Primary and Secondary[b] | Higher Education |
|---|---|---|---|
| Australia | 4.3 | 3.3 | 1.0 |
| Austria | 6.0 | 4.2 | 1.3 |
| Belgium[c] | 4.8 | 3.3 | 0.8 |
| Canada | 5.4 | 4.0 | 1.2 |
| Czech Republic | 4.5 | 3.2 | 0.7 |
| Denmark | 6.5 | 4.3 | 1.1 |
| Finland | 6.3 | 3.8 | 1.7 |
| France | 5.8 | 4.1 | 1.0 |
| Germany | 4.5 | 2.9 | 1.0 |
| Greece | 3.5 | 2.5 | 1.0 |
| Hungary | 4.5 | 2.9 | 0.8 |
| Iceland | 5.1 | 3.9 | 0.7 |
| Ireland | 4.5 | 3.4 | 1.0 |
| Italy | 4.6 | 3.4 | 0.6 |
| Japan | 3.6 | 2.8 | 0.5 |
| Korea | 4.4 | 3.4 | 0.5 |
| Luxembourg | 4.2 | 4.1 | 0.1 |
| Mexico | 4.5 | 3.3 | 0.8 |
| Netherlands | 4.3 | 2.9 | 1.1 |
| New Zealand | 6.1 | 4.7 | 1.0 |
| Norway | 6.6 | 4.4 | 1.3 |
| Poland | 5.8 | 3.8 | 1.2 |
| Portugal | 5.8 | 4.4 | 1.0 |
| Russia | — | — | — |
| Spain | 4.7 | 3.5 | 0.9 |
| Sweden | 6.8 | 4.7 | 1.6 |
| Switzerland | 5.4 | 4.0 | 1.1 |
| Turkey | — | — | 0.8 |
| United Kingdom | 4.6 | 3.4 | 0.7 |
| United States | 5.2 | 3.5 | 1.4 |
| Average for Year | 5.1 | 3.6 | 1.0 |

Note: Direct public expenditure on educational services includes both amounts spent directly by governments to hire educational personnel and to procure other resources, and amounts provided by governments to public or private institutions.

[a] Includes pre-primary and other expenditures not classified by level.

[b] Because of the implementation of a new classification system, post-1996 data are not comparable with earlier data.

[c] Data for Flemish Belgium only.

Source: Organization for Economic Cooperation and Development (OECD), Education Database; Annual National Accounts, vol. 1, 1997; and *Education at a Glance*, 2000. (This table was prepared July 2000.)
Data drawn from *Digest of Education Statistics, 2000* <http://nces.ed.gov/pubs2001/digest/dt412.html>

and secondary schooling are borne by the public sector in the United States,[3] the public sector bears only about 30 percent of the total costs of higher education, defined to include the value of the time spent by students as indicated by the earnings that they forgo by choosing to seek education rather than working and earning. About 20 percent of the total costs (so defined) are borne by parents and students in the form of tuition, fees, books, and supplies. According to one calculation for the United States for the early 1990s, over 50 percent of the full cost of higher education is accounted for by such forgone earnings.[4]

When these privately borne financial and forgone earnings costs are accounted for, the full cost of higher education is about three times the public sector cost indicated in Tables 1 and 2. If the social cost in the form of privately borne costs plus forgone earnings is added to the public sector costs reported in Table 2, the average percentage of GDP allocated to higher education would rise from 1 percent to 3 percent, and the average total social cost of education would increase from 5 percent to 7 percent.

An important question concerns the social benefits attributable to this enormous allocation of resources to the provision of schooling services. Because of the large role of the public sector in financing schooling services, the provision of education services is effectively removed from the market test. As a result, the private benefits of education, as reflected in the willingness to pay of private beneficiaries of schooling services—or, more precisely, the private willingness-to-pay value of incremental schooling—cannot be inferred from market demands, prices, expenditures, and surpluses. Direct measures of these values are required. However, even a full measure of the privately captured benefits from incremental schooling would fail to reflect another source of the gains from education, those in the form of external effects or public goods. These too are important in assessing the full social value of schooling, and like the private gains, these too must be directly measured and assessed.

## Market and Nonmarket Effects of Education: A Catalog

Traditionally, economists have sought to measure the private returns to schooling, in particular, the private market returns reflected in the

[3] This large absolute and proportional public expenditure pattern at the elementary and secondary level also exists in most other OECD countries, suggesting a relatively small contribution of private spending in support of schooling services at levels below the higher education level.

[4] See Edgmand, Moomaw, and Olson (1994).

effect of additional schooling on earnings.[5] Because not all of the well-being gains that people obtain from schooling are reflected in labor market returns, this approach yields but a partial measure of the full, privately captured returns to education. At least as seriously, it totally neglects the external and public-good-type benefits associated with increased schooling.

In this section, we construct a comprehensive list of the components of the social gains (or losses) associated with education, including private market returns, private nonmarket benefits, and the external and public-good-type benefits of education. Note that neither of the latter two categories is reflected in the traditional economic estimates of the private returns to schooling reflected in market earnings differences. Our emphasis on these latter two components—the privately captured nonmarket gains and the external/public goods effects of education—reflects our view that a full accounting must consider all of schooling's effects, and not simply those recorded in a single market.

In the Appendix, we present an accounting framework for assessing the social costs and benefits of investments in human capital. The categories of social gain that we distinguish in the following catalog derive from this accounting framework.

In Table 3, we identify a number of categories of market and nonmarket (both private and external/public goods) benefits attributable to schooling, together with a description of the research studies that reflect the magnitudes of these benefits. The studies identified in this table make extensive use of statistical controls for characteristics such as age, race, and other relevant factors in deriving estimates of the magnitude of the effects that are attributable to education.

## Private Market Returns (Categories 1 and 2)

The first two outcomes categories in Table 3—labor market productivity and nonwage labor market remuneration—capture the gains to education reflected in the traditional "returns to schooling" studies discussed above. Figures 1 and 2 illustrate the simple relationship between schooling and earnings both at a single point in time and over time; the recent increase in the earnings returns to schooling stands out. As of 1998, median earnings of full-time college graduates were $46,285,

[5] The basic equation that is estimated in assessing the private market return to schooling is $Y_i = \alpha + \beta S_i + \mu_i$, where $Y_i$ is earnings of individual i, usually specified in log form, $S_i$ is the individual's level of schooling, $\beta$ is the return to schooling parameter to be estimated, $\alpha$ is the estimated constant term, and $\mu_i$ is the error term. Added to this are additional control variables to reduce bias from ability and experience.

Table 3
Catalog of Outcomes of Schooling

| Outcome Category | Economic Nature | Existing Research on Magnitude |
|---|---|---|
| 1. Individual market productivity | Private; market effects; human capital investment | Extensive research on the magnitude of market earnings (Schultz 1961; Mincer 1962; Hansen 1963; Becker 1964; Conlisk 1971) and of changes over time (Allen 2001). Debate over role of work while acquiring schooling (Light 2001). Analysis exploring approaches to eliminating ability bias and publication bias (Ashenfelter, Harmon, and Oosterbeek 2000). |
| 2. Nonwage labor market remuneration | Private; market and nonmarket effects | Some research on differences in fringe benefits and working conditions by education level (Duncan 1976; Lucas 1977; Freeman 1981; Smeeding 1983) and wage level (Vanness and Wolfe 2002). |
| 3. Intrafamily productivity | Private; some external effects; market and nonmarket effects | Relationship between wife's schooling and husband's earnings apart from selectivity is established (Benham 1974). Suggestion that relationship is stronger in entrepreneurial families (Wong 1986) and among those whose spouse is in a skilled position (Neuman and Ziderman 1990). Also, some evidence that own schooling influences spouse's health and decreases mortality (Auster, Leveson, and Sarachek 1969; Grossman 1975; Grossman and Jacobowitz 1981). |
| 4. Child quality: level of education and cognitive development | Private; some external effects; market and nonmarket effects | Substantial evidence that a child's education level and cognitive development are positively related to the mother's and father's education (Wachtel 1975; Murnane 1981; Sandefur, McLanahan, and Wojtkiewicz 1989; Dawson 1991; Haveman, Wolfe, and Spaulding 1991; Ribar 1993; Haveman and Wolfe 1994; Duncan 1994; Angrist and Lavy 1996; Ermisch and Francesconi 1997; Smith, Brooks-Gunn, and Klebanov 1997; Lam and Duryea 1999; Duniform, Duncan, and Brooks-Gunn 2000). Extended to a child's self-esteem (Axinn, Duncan, and Thornton 1997). Some evidence that a child's education is positively related to the grandparents' schooling (Blau 1999). Some evidence that education of adults in the neighborhood increases probability of a child's graduating high school (Clark 1992; Duncan 1994; Ginther, Haveman, and Wolfe 2000). Some evidence that increased women's literacy leads to higher human capital of children in developing countries (Behrman et al. 1999). |

Table 3 *(continued)*
Catalog of Outcomes of Schooling

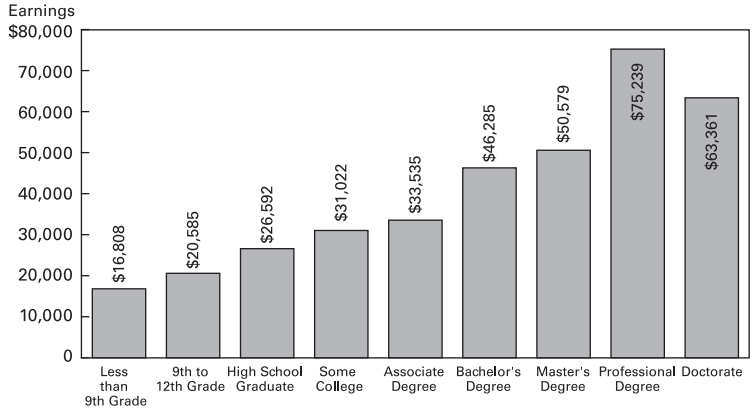
| Outcome Category | Economic Nature | Existing Research on Magnitude |
|---|---|---|
| 5. Child quality: health | Private; some external effects | Substantial evidence that child health is positively related to parents' education (Edwards and Grossman 1979; Shakotko, Edwards, and Grossman 1981; Wolfe and Behrman 1982; Behrman and Wolfe 1987; Grossman and Joyce 1989; Strauss 1990; Thomas, Strauss, and Henriques 1991; King and Hill 1993; Glewwe 1999; Lam and Duryea 1999). |
| 6. Child quality: fertility | Private; some external effects | Consistent evidence that a mother's education is related to a lower probability that daughters will give birth out of wedlock as teens (Antel 1988; Sandefur and McLanahan 1990; Hayward, Grady, and Billy 1992; An, Haveman, and Wolfe 1993; Lam and Duryea 1999; South and Baumer 2000; Haveman, Wolfe, and Wilson 2001). |
| 7. Own health | Private; modest external effects (Note: Some of the own health benefits from education will be captured in increased earnings, and hence included in *category 1*) | Considerable evidence that one's own schooling positively affects one's health status (Leigh 1981, 1983; Kemna 1987; Berger and Leigh 1989; Grossman and Joyce 1989; Kenkel 1991; Strauss et al. 1993; Sander 1995); also increases life expectancy (Feldman et al. 1989; King and Hill 1993; Crimmins and Saito 2001); also lowers prevalence of severe mental illness (Robins 1984) including depression (Herzog et al. 1998) and improves ability to deal with stressful events (Thoits 1984) and anger (Schieman 2000). High school graduation lowers mortality rate (Muller 2002). Health advantage of more schooling increases with age (Ross and Wu 1988, 1995). |
| 8. Consumer choice efficiency | Private; some external effects; nonmarket effects | Some evidence that schooling leads to more efficient consumer activities (Michael 1972; Benham and Benham 1975; Pauly 1980; Rizzo and Zeckhauser 1992; Morton, Zettelmeyer, and Silva-Risso 2001). Home-production schooling may have long-term impacts (Corman 1986). College graduates maintain computational skills over longer period (Pascarella and Terenzini 1991). |
| 9. Labor market search efficiency | Private; nonmarket effects | Some evidence that costs of job search are reduced and regional mobility increased with more schooling (Metcalf 1973; Greenwood 1975; DaVanzo 1983). Job turnover lower for women with more schooling (Royalty 1998). |
| 10. Marital choice efficiency | Private; nonmarket effects | Some limited evidence of improved sorting in marriage market (Becker, Landes, and Michael 1977). |

Table 3 *(continued)*
Catalog of Outcomes of Schooling

| Outcome Category | Economic Nature | Existing Research on Magnitude |
|---|---|---|
| 11. Attainment of desired family size | Private | Evidence that contraceptive efficiency is related to schooling (Easterlin 1968; Ryder and Westoff 1971; Michael and Willis 1976; Rosenzweig and Schultz 1989). In developing countries, fertility declines (King and Hill 1993; Lam and Duryea 1999). |
| 12. Charitable giving | Private and public; nonmarket effects | Some evidence that schooling increases donations of both time and money (Mueller 1978; Dye 1980; Hodgkinson and Weitzman 1988; Freeman 1997). |
| 13. Savings | Private; some external effects | Controlling for income, some evidence that more schooling is associated with higher savings rates (Solomon 1975). |
| 14. Technological change | Public | Some evidence that schooling is positively associated with research, development, and diffusion of technology (Nelson 1973; Mansfield 1982; Wozniak 1987; Foster and Rosenzweig 1996). Some evidence that technological change increases returns to those with more education (Bound and Johnson 1992; Autor, Katz, and Krueger 1998; Bartel and Sicherman 1999; Allen 2001). |
| 15. Social cohesion | Public | Descriptive evidence to suggest that schooling is positively associated with voting (Gintis 1971; Campbell et al. 1976; Wolfinger and Rosenstone 1980; Hauser 2000); with reduced alienation and social inequalities (Comer 1988); with opposition to government repression and reduced support for use of violence in protests (Hall, Rodeghier, and Useem 1986). Suggestion that own education is associated with trust of others and membership in community organizations (Helliwell and Putnam 1999). |
| 16. Self-reliance or economic independence | Private and public | More education associated with reduced dependence on transfers during prime working years (Antel 1988; Kiefer 1985; Rudd, McKenry, and Nah 1990; An, Haveman, and Wolfe 1993). |
| 17. Crime reduction | Public | Some evidence that schooling is associated with reduced criminal activity (Yamada, Yamada, and Kang 1991; Ehrlich 1975; Freeman 1995; Lochner and Moretti 2001). Some evidence that education is associated with a reduction in recidivism (Sherman et al. 1998). Some suggestion that quality preschool is associated with a reduction in crime (Reynolds 2000). |

Source: Updated and adapted from Haveman and Wolfe (1984) and Wolfe and Zuvekas (1997).

**Figure 1**
**Median Earnings of All Full-Time Workers, by Educational Attainment, 1998**




Note: The income estimates in this table are based solely on money earnings before taxes. Noncash benefits are not included. The population is both sexes, 25 years and over, who worked full-time all year in 1998.
Source: U.S. Census Bureau, *Current Population Reports*, P-60 Series, Table P-06.

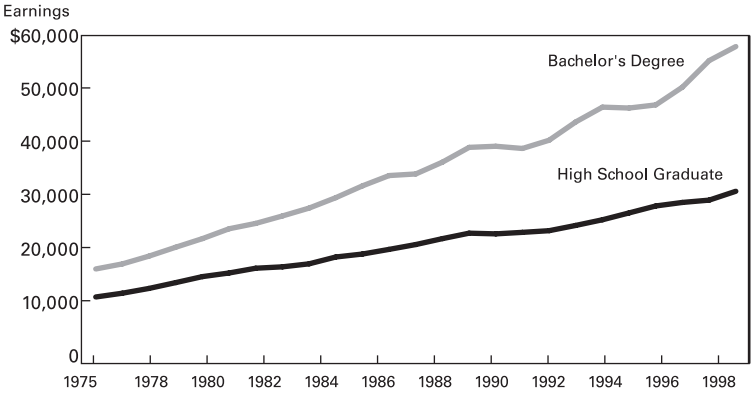
versus $26,592 for those with only a high school degree. This differential has grown over time in nominal and real terms.[6]

As we have noted, there is an extensive literature estimating the private market returns to schooling. The studies typically make use of individual survey data that include variables describing labor market earnings, the amount of schooling attained, and a variety of other personal characteristics that may affect people's earnings. At a minimum, these other characteristics include gender, age, and often some measure of work experience; the more reliable studies also attempt to control for ability, often by including some assessment of IQ scores or other indicators. The results from these studies vary over time and by the model estimated.

Increasingly, researchers have become concerned with the reliability of these estimates because of the difficulty of controlling for unmeasured and unobserved factors that may both affect earnings and be correlated with the measured variables, especially schooling. If these factors—"ability," "drive," and "family background" come immediately to

[6] It should be noted that the returns implied by these comparisons may overstate the true private marketed returns to schooling, as they fail to control for important factors such as ability and experience.

**Figure 2**
**Mean Earnings of Male Workers 18 Years or Older by Highest Educational Level, 1975 to 1998**




Source: Linda Levine, "Education Matters: Earnings by Highest Year of Schooling Completed," CRS Report for Congress 95-1081E. Updated October 1, 1999.

mind—are not adequately controlled for, the estimated private market returns to education will be overstated. As an example of the potential for overstating these private market returns to education, Light (2001) concludes that the omission from the estimation of work experience while in school results in estimates of the earnings returns from schooling that are from 4 to 20 percent greater than those found when this factor is statistically controlled for.

A recent literature review by Ashenfelter, Harmon, and Oosterbeek (2000) compares results across several types of studies of the labor market returns to education, distinguished by model, sample, extent of control for relevant variables, and the nature of the labor market (such as country). In their discussion of the potential bias in estimated returns caused by unobserved variables, they focus on the absence of reliable measures of "ability," and hence the difficulty of directly controlling for this trait. They note that researchers have adopted a variety of approaches designed to reduce bias caused by the absence of direct measures of "ability," including the following:

- explicitly including direct measures of ability such as test scores;
- use of data that include information on siblings or twins, so as to control for the common genetic effect (thought to include "ability") among observations; and

- use of instrumental variables representing schooling attainment, generally based on so-called natural experiments.[7]

The first of these approaches is criticized because of the weakness of the variables available to directly measure ability. The second approach also has severe limitations in that individual abilities, apart from their common family source, remain uncontrolled. Those who adopt the third approach (see Card 2001) are open to questions regarding the validity of the instrument chosen for the estimation; in fact, few good instruments seem to be available. All of these approaches are, in addition, subject to the problem of downward-biased estimates of the effect of education on earnings, caused by the presence of measurement error in both schooling and earnings.

Ashenfelter, Harmon, and Oosterbeek then perform a meta-analysis over 27 studies in nine countries of the private market returns to schooling. They find that across these studies, which adopt various approaches to control for unobserved variables, researchers continue to find high private market returns to education. For example, across all of the studies the estimated rate of return to schooling averages 7.9 percent (standard deviation = 0.036). When direct controls for ability are employed, the average return drops to 6.6 percent (standard deviation = 0.026); when data using twins are employed, the average return is 9.2 percent (standard deviation = 0.037); when an instrumental variable approach is employed, the average return is 9.3 percent (standard deviation = 0.041). The authors then adjust for "publication bias" (the tilt inherent in the scholarly publication process leading to a higher probability of acceptance for studies with statistically significant results) and find estimated rates of return from 6.4 to 8.1 percent, with higher rates in this range from studies using an instrumental variables approach.[8] Taken as a whole, estimates of the rate of return are quite consistent and do not change substantially in response to any of the approaches used to adjust for any bias due to unmeasured ability.

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[7] In this approach, the researcher first estimates the effect of an instrumental variable (one that is believed to be associated with the level of schooling but not labor market earnings) on the level of schooling, and then, as a second step, employs predicted schooling variables from the first stage estimation in a model explaining the level of earnings. See note 1.

[8] Comparing the United States to other countries, the authors find rates of return in the United States that are about 1.3 points greater than in other countries (primarily the United Kingdom, which is the source of data in most of the other cases), and they attribute that to the large relative increase in education-related earnings in the United States in recent decades. For example, Ashenfelter and Rouse (1998) find that in the United States the return to an additional year of schooling had grown from 6.2 percent in 1979 to about 10 percent in 1993.

**Nonmarket Private Returns (Categories 3 through 11)**

*Intrafamily Effects.* Categories 3 through 6 in Table 3 refer to the direct effect on other members of a family when one family member (typically, a parent) is more educated. Consider, for example, the effect of the education of one spouse (say, the wife) on the earnings of the other spouse (the husband) (category 3). The research on this relationship finds a positive and significant effect, suggesting that the information, advice, and assistance in skill acquisition and coping with challenges provided by a more-educated spouse has a larger effect on the other spouse's earnings than the contributions of this sort made by a less-educated spouse. In effect, a spouse's education is a close substitute for a person's own formal education. Studies outside of the United States have explored whether this effect differs by spouse's occupation. Evidence from both Hong Kong and Israel suggests stronger effects for entrepreneurial families and spouses in skilled positions (Wong 1986; Neuman and Ziderman 1990). Some studies also indicate that one's schooling has a positive impact on the health of the spouse.

The educational level of children is clearly tied to the schooling of the parents (category 4). Children of parents who graduate from high school are themselves far more likely to graduate from high school than are children of parents without a high school degree, and parental schooling beyond the high school level increases this probability (Sandefur, McLanahan, and Wojtkiewicz 1989).[9] Similarly, parents with more education tend to have children with a higher level of cognitive development (and "noncognitive" skills[10]), as well as with higher future earnings. There is also evidence of a positive relationship between the educational level of young adults in a community and the probability that children living in the community will complete secondary schooling. Complementing these estimated relationships is recent evidence that grandparents' schooling also is associated with higher levels of children's cognitive development (Blau 1999).

The studies in category 5 suggest that increased schooling of parents, particularly mothers, is also positively associated with higher health status levels of infants and children (as indicated by lower rates of infant

[9] The relationship between parental education and a variety of children's attainments is explored in detail below in the section "On Estimating the Value of Nonmarket Impacts of Education."

[10] Bowles, Gintis, and Osborne (2001) provide evidence that children's and youths' noncognitive skills (such as attitudes toward risk, ability to adapt to new economic conditions, industriousness, perseverance, and the rate of time preference) are related to future labor market and other indicators of success, and that these noncognitive skills are not captured by measures of cognitive skills. They also suggest that such noncognitive skills and behaviors may be "learned" from parents, and that more and better parental education contributes to children's possession of these skills.

mortality and low birth weight). Similarly, the rate of vaccinations among children is positively related to the educational level of their parents. Evidence for these linkages between parental education and children's health status is also found in studies using data from less-developed countries. The level of parental schooling also seems to be negatively related to the probability that one's child will give birth out of wedlock as a teenager (category 6).

*Own Nonmarket Effects.* Categories 7 through 11 summarize a variety of potential effects of education on one's own well-being that are not captured in labor market performance, and hence are excluded (at least in part) in the estimated privately captured economic returns to schooling.[11]

For the individual, increased schooling appears related to better health and increased life expectancy (category 7). This may be attributable to schooling-related occupational choices (choosing occupations with relatively low occupational hazards), locational choices (electing to live in less-polluted areas), information or skills in acquiring health-related information, nutrition and lifestyle (more exercise; less smoking),[12] and/or more appropriate medical-care usage. Although the improvement in one's own health status and life expectancy may simply reflect a third factor that "causes" both more schooling *and* better health, the absence of any obvious prior cause and the strength of the statistical relationship between schooling and these health-related outcomes suggests that one's own schooling may be the causal factor.[13]

Though some portion of the benefits of increased health status and life expectancy may be reflected in higher labor market earnings, it seems clear that nonmarket private gains from this relationship do exist (for example, consider the reduced pain and suffering, reduced anxiety in response to negative life events, reduced mortality, lower medical-care time and money expenditures). In addition, some of the benefits of one's own health improvements may be in the form of external benefits,

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[11] Two components of potentially important private nonmarket benefits are not included in the table. The first is the consumption value of schooling—the well-being that people experience from the process of attending school and the learning experience that is conveyed. The second is the consumer surplus associated with the benefits that are distinguished and that are valued by their implicit market price. (See the Appendix for a discussion of this source of well-being.) We were unable to identify empirical studies assessing the magnitude and value of gains from either of these sources.

[12] Although economists are reluctant to claim the existence of a causal link, recent studies suggest that persons with more schooling are less likely to smoke, and among persons who do smoke, those with more schooling smoke less per day. An additional year of schooling reduces average daily cigarette consumption by 1.6 for men and 1.1 for women. People with more education are also less likely to be heavy drinkers and tend to engage in more exercise per week (about 17 minutes for each additional year of schooling) than are less-educated people (see Kenkel 1991).

[13] A study using sibling data from Nicaragua finds evidence in both fixed and random effects models that the relationship between more schooling and better health is not due to unobserved or unmeasured factors, but is, in fact, causal (Behrman and Wolfe 1987).

ranging from the reduced spread of contagious disease to increased utility of relatives and friends whose well-being depends on one's own health.

An additional benefit accruing to the better-schooled individual comes in the form of increased knowledge and savvy regarding market transactions, referred to as "consumer efficiency" (category 8). Michael (1982) translates the finding that a person with an additional year of schooling is significantly more efficient as a consumer into dollars of additional income. Similarly, Benham and Benham (1975), analyzing the market for eyeglasses, find that persons with more schooling tended to pay less for glasses than those with less schooling; Morton, Zettelmeyer, and Silva-Risso (2001) report similar findings for the price paid for new cars. Rizzo and Zeckhauser (1992) find that the charge per unit of time that a physician spent with a patient was lower for better-educated individuals than for those with less education.

Categories 9 through 11 in Table 3 refer to the linkages between one's success in making choices involving the labor market, marriage, and family size and the level of schooling. In all of these cases more schooling is positively related to the quality of choices, perhaps through information gains through schooling that promote more efficient decisions. Part of this gain may be simply in the ability to accomplish better matches—in the labor market, for example—but another part may be in the reduction of time spent in the search.[14] Royalty (1998) provides evidence on another outcome associated with labor market efficiency—namely that for women, more schooling is associated with lower job turnover. Studies of assortative mating suggest that schooling is associated with "better" choices regarding marital partners (Becker, Landes, and Michael 1977) and with lower rates of divorce (Martin 2002). Better-educated people also tend to be more successful in securing desired family sizes; more schooling may enable one to gather information on how to avoid unwanted births and possibly also to reduce the probability of subfecundity. Evidence of this relationship also exists for developing countries.

### External (to the Household) and Public Goods Effects (Categories 12 through 17)

Beyond the gains to one's self and family are those seldom-noted and rarely evaluated external and public goods effects of one's education that

[14] In addition to the individual, employers may also gain if more-schooled individuals yield a superior labor market match. Improved matching of employees to jobs reduces a variety of costs that are otherwise borne by employers, including training costs, recruiting costs, and the loss of productivity during employment transitions. Acemoglu and Angrist (1999) seem to include such effects in their effort to measure aspects of the gain from schooling beyond those included in the traditional return estimates.

accrue to others in society. There is evidence that the amount of time and money devoted to charity is positively associated with the amount of schooling one has, after controlling for income, the other primary determinant of donations (category 12). For example, one study found that college graduates volunteered nearly twice as many hours and donated 50 percent more of their income than high school graduates (see Hodgkinson and Weitzman 1988). The positive contribution of schooling to savings (category 13) may have a public-good aspect to the extent that the capital market is imperfect and aggregate savings are less than optimal. Similarly, increased education may lead to social cohesion and may enable one to better accommodate technological and social change (categories 14 and 15). Persons with more schooling may make more-informed choices when voting and may participate more fully in their communities. Persons with more schooling may contribute to the common good in other ways. For example, there is evidence that schooling is positively related to being more trusting of others, to having an increased participation in community organizations (Helliwell and Putnam 1999), and to having a higher probability of nonviolent protests against government-sponsored repression (Hall, Rodeghier, and Useem 1986).

There is evidence that more schooling is associated with a lower probability of receiving transfer benefits, either disability-related benefits or welfare (category 16). Recent analyses have found that higher education of mothers reduces the probability that their daughters will, if eligible, elect to receive welfare benefits. Criminal activity in the community tends to be negatively related to the average level of educational attainment of members of the community (category 17).

The relationships listed in categories 3 through 17 represent potential effects of schooling that are not captured in traditional estimates of the private economic returns to education. We have characterized these as private nonmarket and external/public goods effects attributable to education. In all cases, research studies document the direction of the relationship, and in some cases its magnitude. To be sure, in some cases the strength of the evidence is less strong than one would desire. Among the most robust and substantial influences are the relationships between parents' schooling and the levels of health, schooling, and childbearing of their children. The linkages between one's own schooling and own health are also well documented. One is left with the impression that schooling has substantial benefits beyond those usually tabulated by measures of labor market productivity and fringe benefits.

## On Estimating the Value of Nonmarket Impacts of Education

To translate these private nonmarket and external/public goods benefits into information relevant for public sector decisions on the

allocation of resources to education, the value of each of the separate categories of effect, and of the entire bundle of these effects, must be estimated. In Haveman and Wolfe (1984), we developed a method to estimate the marginal value of schooling attributable to the private nonmarket components of these effects (categories 3 through 11). This method is based on a traditional household production function relationship that relates the contributions of schooling and market inputs in producing nonmarket outcomes. Consumers, acting as firms, efficiently combine inputs, including schooling services, so as to yield a consumption frontier for goods or services that enter their utility function. These consumers maximize utility subject to this consumption frontier. Studies that establish a reliable relationship between education plus some other input that carries a market price, and a nonmarket outcome—such as health, consumer efficiency, educational attainment of children, and so forth—can be used with this method to generate estimates of the marginal value of schooling.

To implement this approach, each of these studies must have a coefficient estimate relating schooling to the outcome of interest, as well as controls for other additional variables likely to be associated with that outcome. In addition, each study must include another input to "production" of the nonmarket outcome of interest that has a market value that is not subject to market imperfections. In addition, when this input is used in the "production" of the outcome of interest, its use must be exclusive—that is, the amount of the input used in producing the outcome of interest is "used up" in the production of the output. Examples of inputs with such a market value might include physician visits, spending on police in the community, private music lessons, and so forth. When such inputs are not available, income may be used under the assumption that income will be spent on the output only until the marginal product per dollar spent is equal to that of other inputs including schooling. The coefficient on income then represents the marginal product of income spent on the outcome under study.

The following simplified model illustrates this approach, using a single nonmarket good. The model makes the standard economic assumption that individuals or households efficiently combine schooling with other market inputs to produce the nonmarket outcome. A well-known result in economics is that efficient producers will equate the ratio of the marginal product to input price, across all inputs. This relationship also holds in the production of the nonmarket outcome, with schooling and at least one other market input. That is,

$$\frac{MP_{SCH}}{P_{SCH}} = \frac{MP_X}{P_X}, \tag{1}$$

where $MP_{SCH}$ is the marginal product of schooling in producing the nonmarket outcome, $MP_X$ is the marginal product of any input $X$ with market price $P_X$, and $P_{SCH}$ is the implicit price or willingness to pay for additional schooling in producing the nonmarket outcome. A little rearranging yields the following formula for computing the implicit price or willingness to pay for additional schooling in producing a nonmarket outcome:

$$P_{SCH} = \frac{MP_{SCH}}{MP_X} \times P_{X.} \tag{2}$$

This equation for the implicit value of additional schooling in producing a particular private nonmarket output is intuitively appealing. If the marginal products of schooling and the other input are equal, the implicit willingness to pay for the effect of schooling on this outcome will be equal to the price of the other input. If the marginal product of schooling is double that of the other input, the implicit value of schooling is twice the unit price of the other input.[15]

Implementing this method involves estimating the productive relationship ($MP_{SCH}$ ) between schooling and each private nonmarket outcome. It also requires estimating the productive relationship ($MP_X$) between each outcome measure and another input. The latter input should be one that is competitively marketed. Once these marginal productivities are estimated, they can be combined with the private cost of the privately purchased input in order to estimate the implicit willingness to pay for additional schooling for each outcome, using the formula given in equation (2). The implicit value for each individual outcome can then be summed to produce the total incremental value of additional schooling.

This approach, it should be noted, requires that several conditions hold if the estimates are to be reliable. A brief listing of them here will make clear the tentative nature of estimates obtained from applying this method. First, consumers must not be constrained in their choice of homogeneous schooling services and market inputs in producing the private nonmarket good or service. Second, the value of the market input must reflect the operation of a smoothly functioning competitive market; only if this holds will the value imputed into marginal units of schooling reflect a willingness to pay as it would be revealed in a market. Third, it

[15] Extension of the simple model presented here to the production of multiple nonmarket and market outcomes, such as wage income, is straightforward (see Haveman and Wolfe 1984). The total willingness to pay for additional schooling across all nonmarket and market outcomes is the sum of the implicit willingness to pay for each individual outcome. Our fully developed model accounts for the nonexclusivity (nondivisibility) of schooling in producing multiple outcomes.

must be assumed that the composition of other inputs in the production process does not change with changes in schooling. That is, the gains attributed to schooling must reflect the direct increase in the productivity of labor and not the potential effects of schooling in improving the efficiency with which resources are combined in producing the output, or any changes in the amount of time more-schooled individuals spend in a given activity.[16] Finally, the empirical studies on which this model rests must provide estimates of linkages both of schooling and of the market input to the nonmarket output that are not biased and inconsistent because of unobserved characteristics. This is a strong assumption, given the single-equation regression framework that underlies most of the studies that we cite. Hence, this method must be viewed as yielding a first-cut approximation of the private nonmarket values and as a guide for further research.[17]

While recognizing these assumptions, we nevertheless use this approach to generate a few first-cut estimates of the value of nonmarket impacts; these are shown in Table 4. We convert a small number of impacts into the marginal relationship, or further into a willingness-to-pay estimate. We base our results on coefficients obtained from the studies listed in the third column of the table. Estimates of the implicit value of the private nonmarket effects of schooling are provided for the cognitive development of children (category 4),[18] consumption

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[16] Welch (1970) first discusses this important distinction. A discussant of this paper argues that this condition is not likely to hold, resulting in overestimates of the value of the private nonmarket outputs of schooling. Moreover, if it does not hold, the value of the additional resources used in the reorganized production process must be accounted for in the calculation of the net value of incremental schooling. For further development of this point, see Rosenzweig and Schultz (1982).

[17] Paul Schultz, in his discussion of this paper, states: "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 [of this method]." Such research might be similar to the approaches used in trying to better identify the market private returns to schooling discussed above, including the use of data on siblings and the application of instrumental variable techniques.

[18] For example, a recent study by Ermisch and Francesconi (2000) and the special tabulations of Ermisch (1999) provide estimates of the impact of mother's education and household income on the level of schooling achieved by children (category 4) in the United Kingdom, using data drawn from the British Household Panel Study. The coefficient estimate for household income (the input with market values) is 0.098 (t-statistic = 1.668) for girls, indicating that, at the margin, an additional dollar of household income increases the expected level of schooling. The mother's education is represented by dummy variables for six levels of schooling ranging from less than O level to first and higher (with no qualification as the omitted category) in an ordered logit estimation. The simulation of the effects of a mother's education and family income (at the youngest age that they observe it, mainly around age 16) on the distribution of a daughter's qualifications is 0.218 for a mother's vocational degree on the probability that the daughter will have a vocational degree, and 0.255 for a mother's first or higher degree on the probability of the child having a vocational degree, while the relationship of family income to a vocational degree is 0.187.

Table 4
Estimates of the Annual Value (Willingness to Pay) or Impact of Additional Schooling

| Outcome | Value or Impact | Source of Coefficients |
|---|---|---|
| Cognitive Development of Children | $350 in family income for high school diploma (vs. no diploma) and $440 for some college (vs. high school diploma) | Angrist and Lavy (1996)[a] |
| | $860–$5,175 per year in future family income for an additional year of schooling | *Murnane (1981)[b]; *Edwards and Grossman (1979)[c] |
| | £1166–£1727 in family income for mother's educational attainment of vocational/first and higher degrees | Ermisch (1999) |
| | $4,008 in permanent family income for an increase in 4.8 years of grandfather's schooling; $2,692 in permanent family income for an increase in 3.6 years of grandmother's schooling | Blau (1999) |
| Consumption Efficiency | $290 in household income for an additional year of schooling; save approximately $5.50 per pair of eyeglasses for an additional year of schooling | *Michael (1975); *Benham and Benham (1975)[d] |
| Own Health | $8,950 in increased net family assets for an additional year of schooling | *Lee (1982) |
| | 1.6 (1.1) fewer cigarettes smoked per day by men (women) for an additional year of schooling; and 34 more minutes of exercise per two weeks | Kenkel (1991)[e] |
| | 1.85 (1.25) (1.37) greater relative risk of death from heart disease for males aged 45–64 (males aged 65–74) (females aged 65–74) with 8–11 years of schooling compared with those with 12 or more years of schooling | Feldman et al. (1989)[f] |
| Reduction in Criminal Activity | $170 reduction in per capita expenditure on police for an additional mean year of schooling in community | *Ehrlich (1975) |
| Volunteer Hours | $51 for males per year; $30 for females per year | Freeman (1997) |

Source: Estimates indicated by an asterisk (*) are taken from Haveman and Wolfe (1984), Table 2. All other values and impacts are based on coefficients in studies listed in the third column. All values are in 1996 dollars except as noted.

[a] Based on National Longitudinal Survey of Youth (Table 8, column 4 estimates).

[b] Based on measurement of cognitive development on Iowa Test of Basic Skills using children in grades three through six whose families participated in the Negative Income Tax experiment in Gary, Indiana. For conversion see Haveman and Wolfe (1984).

[c] Based on data from cycle II of the Health Examination Survey using the mean of the estimated value of the mother's and father's education.

[d] Based on 1970 Health Interview Survey (HIS); n = 10,000, of which 1,625 obtained eyeglasses in 1970.

[e] Based on 1985 Supplement to the HIS on Health Promotion and Disease Prevention; n = 14,177 males and 19,453 females.

[f] Based on 62,405 persons in Matched Records Study, whites only (see Feldman et al. 1989).

efficiency (category 8), own health (category 7), reduction in criminal activity (category 17), and charitable giving (volunteer hours) (category 12).

The estimates of these privately captured, though nonmarket, benefits shown in Table 4 are substantial. The willingness to pay for the cognitive development gains of one's children attributable to an additional year of one's own schooling vary substantially, but it is not unreasonable to impute an average annual family gain of at least $500. Improvements in the efficiency of consumer choices attributable to another year of schooling would seem to convey an average of at least $300 per year in benefits. The value of the improvement in one's own health from additional schooling seems substantial—a one-time payment of several thousand dollars for an additional year of schooling. Somewhat smaller, though not trivial, annual gains are also attributed to the reduction in criminal activity associated with additional schooling in a community and the willingness-to-pay value of the additional volunteer activity associated with a year of incremental schooling.

It is not unreasonable to suggest that, when the social gains from all of the categories of private nonmarket and external/public goods identified in Table 3 are taken into account, their sum could equal estimates of the annual earnings impacts of an additional year of schooling[19]

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Using the formula of equation (2), we derive the marginal value of a mother's vocational degree on the probability that the daughter will have a vocational degree, in terms of annual family income, as follows:

$$P_{SCH} = \frac{MP_{SCH}}{MP_X} \times P_X = \frac{.218}{.187} \times £1{,}000 = £1{,}166.$$

This translates into a pound value of £1,166. The pound value of a mother's first or higher degree on the probability that the daughter will have a vocational degree, in terms of annual family income, is £1,364. Similarly, the simulated value of a mother's vocational degree on the daughter's first or higher degree is 0.107, and the simulated value for a mother's having a first or higher degree on her daughter's achieving the same degree is 0.152. In this case, family income has a simulated relationship of 0.088, providing economic estimates of a mother's additional schooling of £1,216 and £1,727, respectively (both levels of schooling for the mother are statistically significant at the 1 percent level). In this estimate as well as others in Table 4, we use earnings or income as the variable to infer the willingness to pay for incremental schooling. It should be noted that these variables may be endogenous to the labor supply choices; wage rates would be a preferable variable on which to base our estimate, but they are seldom reported. Moreover, in using family income or assets, as in some of the estimates, we are implicitly capturing the value of the utility change of an increase in education to the family and not only to the person whose education is being varied. (We thank Bruce Chapman for pointing out this implication to us.)

[19] These annual economic gains in the form of increased earnings attributable to an additional year of schooling are on the order of $2,000 to $4,000 per year, depending on the study (see, for example, Figures 1 and 2).

captured in the traditional returns-to-schooling studies.[20] If that is the case, the full social rate of return to an additional year of schooling could be twice the private economic rates of return to education—ranging from about 7 to 9 percent—estimated in the traditional studies.

## Policy Implications and Conclusions

The conclusion that the full social gains from additional schooling exceed—perhaps substantially—the 7 to 9 percent private rate found in the returns-to-schooling literature has important implications for public policy. Because of these private nonmarket and external/public goods effects, the answers to two central policy questions should be fundamentally assessed. These two questions are:

- What volume of the nation's resources should be allocated to the production of schooling services?
- Who should be paying for these schooling services?

If the nonmarket private and external/public goods effects of education are equal in value to the private market returns, the full rate of return could be as high as 14 to 18 percent. Because few other public or private investments seem able to claim returns of this magnitude, a reallocation of resources from other uses to the education sector may be in order.

This leaves open the question of who should bear the cost of the efficient level of schooling services. There are two primary candidates—the private citizens who receive these services (and their families) and the public sector. While our results suggest that the full value of the private nonmarket and external/public goods effects of education may be substantial and, hence, should be reflected in resource allocation decisions, they say little about the balance between the total privately captured benefits and the spillover/public goods components of the full social benefits of education.

One might conclude from our calculations that the private nonmarket gains from education are substantial, leading to the judgment that a greater share of the full social benefits of schooling is captured by students and their families than is suggested by the traditional economic returns estimates. If that were so, the case for increases in tuition and fees as an efficient means of financing schooling, especially at the higher educational level, would be strengthened. Of course, an increase in the

[20] To our knowledge, very few estimates of the social returns to schooling exist. One of the few attempts uses an instrumental variable approach to attempt to capture labor market productivity beyond that captured in private worker-based rates of return. This approach is akin to efforts to identify the social returns to schooling reflected in the endogenous growth literature. See Acemoglu and Angrist (1999).

price charged for market purchases of schooling services implies little regarding the nature and magnitude of targeted student aid designed to increase educational opportunities for those students lacking the resources necessary to pay for these services (and constrained from borrowing to pay for them).

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## Appendix: The Concept of Human Capital and Its Value: A Framework

In this appendix, we view education and schooling as a form of human capital. We present a framework for thinking about the value to society of both a stock of human capital—say, a person with a given level of skill and education—and the social value of an investment in human capital. This framework is comprehensive, in that it attempts to reflect

the full set of social gains and social costs associated with existing human capital and the gains and costs of an investment in human capital.

Consider an individual at some point in her life, say age 16, who possesses some level of education, knowledge, and skills—human capital. By engaging in activities that contribute to the production of goods and services, she uses her human capital to produce outputs that are of value to the citizens of the nation, including herself. In the course of living and contributing to production, she uses up (or consumes) a variety of goods and services, and, therefore, the resources that are allocated to these outputs. Hence, she both employs her education and training in activities that contribute to social output, and in the process uses up resources that could be used to produce other things of value to society if they were not diverted to her. From the perspective of economic analysis, the value of her contributions to goods and services is measured by the willingness of people to pay for them; the value of the resources consumed is measured by the full social opportunity costs associated with them.

Assume that for the current and each future year of her life we know both the value of what she contributes to society's output, and the value of social resources that she uses up or consumes. If we know the rates of time preference—or interest rates—of people who are positively and negatively affected by her activities, we can account for the fact that the value today of these future streams is less than if they were realized immediately. With this information, we can calculate the *present value* of the full lifetime stream of both the positive and negative contributions of her activities to social output.

The difference between the present value of her contributions to social output—call it her Gross Product—and the value of the social resources that she consumes is her net contribution to the nation, her Net Product.

Consider, now, that we are contemplating this same person but with an additional year of education, holding everything else about her constant. Given this framework, we can now pose the question of whether this additional year of schooling is a worthwhile social investment. The answer is clear: The additional investment is worthwhile if the person *with* the additional schooling has a greater Net Product than that same person *without* the additional year of schooling. In this case, the person's contributions to social output caused by the additional schooling exceed the social costs of providing those schooling services.

To see more clearly the nature of the gains associated with human capital and the costs required to produce human capital, it is helpful to decompose both the gain and cost components. Such a decomposition will more clearly reveal what is and what is not included in an assessment of the value of investments in education or human capital.

Table A1 is an annual statement of the production and consumption activities of the people who make up the society. The left side of the ledger tabulates contributions of these citizens to social output, and the right side calculates the value of society's resources that are consumed by the nation's citizens in any given year. Let us consider each of the two sides of the ledger in turn.

## The Value of Gross Annual Product

The left side of the ledger itemizes the value of people's annual contribution to social output, the Value of Gross Annual Product. In making this tabulation, we adopt a comprehensive accounting stance, and include all of society's members.

Some of the activities of people yield contributions to the output of goods and services that pass through a market. Neglecting the complexities of self-employment, workers are likely to be employed by a firm and compensated for their labor effort. If the economy is a smoothly functioning market economy, the hourly wage is an estimate of the value of one hour's contribution to output; annual earnings (including fringe benefits) equal the value of the contribution to output for the entire year. This annual return reflects the knowledge and skills (human capital) that people possess and apply to market work during the year. We label this component the value of Market Production, or MP.

The logical underpinning of economics distinguishes an additional component of value beyond the market price of the goods and services produced. To the extent that people are willing to pay more than this market price, those purchasers of the goods and services realize a surplus. This Consumer Surplus (CS) is in addition to the value that the market places on goods and services produced. If the value of Market Production is measured using

Table A1
Value of Net Annual Product Balance Sheet

| | |
|---|---|
| Value of Gross Annual Product (VGAP) | Value of Annual Resource Use (VARU) |
| Value of Market Production (MP) [Often approximated by Earned Income (EI) (hourly market wage times hours engaged in Market Production) plus Fringe Benefits.] | Opportunity Cost of Food, Shelter, and Clothing Consumption (FSC) [Often approximated using market prices.] |
| Value of Home Production (HP) [Nonmarketed; often approximated by hourly market compensation times hours spent in Home Production.] | Opportunity Cost of Transportation and Medical Care Consumption (TMC) [Often approximated using market prices.] |
| Value of Volunteer Activities (VA) [Nonmarketed; approximated by hourly market compensation times hours spent in Volunteer Activities.] | Opportunity Costs of Education and Training Consumption (ET) |
| Consumer Surplus (CS) associated with Market Production (MP), Home Production (HP), and Volunteer Activities (VA) | MINUS Producer Surplus (PS) associated with FSC, TMC, and ET inputs when valued by market prices |
| Value of Leisure Activities (LA) | |
| Value of External Benefits (EB) Net Value to society, in excess of (MP + HP + VA + CS) | Value of External Costs (EC) Net value to society of costs in excess of (FSC + TMC + ET) |

the market price of the output (as opposed to the full willingness of people to pay), the value of Consumer Surplus must also be included in the account. We enter it on the left side of the table after discussing the surplus values associated with other activities in which citizens engage.

The second entry on the left side of the ledger is the value of Home Production, labeled HP. In addition to productive activities that earn market rewards, citizens spend time in home-based work activities—caring for children, household maintenance, cooking, and numerous other tasks. These contributions to social output do not pass through a market, and people do not receive a monetary payment for doing them. Nevertheless, these contributions are as real as contributions that pass through a market; they also have value. Thus, a question arises concerning how to value such output.

Analysts often use an estimate of the market wage (including fringe benefits) that the person is (or would be) paid for Market Production as an approximation to the value to the individual of an hour spent in Home Production. The logic behind this reasoning is straightforward. If we assume, for a moment, that the individual allocates time over MP and HP, we know that each hour of MP earns her compensation equal to her market wage. Each hour of HP also grants "value" to her. If we further assume that each successive hour of HP grants less value than the previous hour, the individual will allocate hours to HP provided the value granted is greater than the market wage. Once the value granted from HP falls below the market wage, the individual will stop allocating hours to that type of production. Thus, one estimate of the value of Home Production is the hours spent in Home Production multiplied by the market wage rate (estimated if necessary and defined to include fringe benefits) to yield the aggregate value of home-based productive activities.

Of course, one implication of this reasoning is that producers of Home Production

receive value above their market wage rates. We will address this Producer Surplus in the next section. Here, however, we must address the Consumer Surplus associated with Home Production. Just as purchasers of marketed goods and services may be willing to pay more than the market price of those goods and services, "purchasers" of Home Production may be willing to pay more than the market price (now used as an estimate of the Home Production price) of Home Production. Hence, HP fails to capture the implicit Consumer Surplus associated with home-based productive activities when it is measured using the market wage. We, therefore, separately account for this Consumer Surplus in Table A1.

After allocating time to the market and to the home, citizens have some time left for volunteer activities—time contributions to church, the local food pantry, neighborhood associations, school, and so on. The time that people spend in volunteer activities also yields services that are valuable to society, and again the appropriate concept for measuring the value of these services is the willingness to pay of all those who directly benefit from these outputs.

In practice, it is devilishly hard to approximate this value. Again, the hours do not pass through a market, and the value placed on them by the individual may be quite different than the value placed on them by society. However, as with home-based activities, analysts often equate the value of an hour of Volunteer Activities with the value of an hour of Market Production, again multiplying an estimate of hourly compensation by the number of hours citizens are engaged in Volunteer Activities. The logic is analogous to that used in the discussion of Home Production, extended to these activities. We enter the value of Volunteer Activities as the third item on the left side and label it VA.

Again, this estimate, based as it is on market values, neglects the implicit Consumer Surplus associated with Volunteer Activities. As we have noted, if the valuation of these productive human capital activities is based on prices reflected in the market, the estimated product will understate the full willingness to pay. To acknowledge this, we collect the Consumer Surplus values associated with MP, HP, and VA when valued by market prices, and include them in the left column of the ledger. They are labeled CS.

Beyond the hours not required for sleep and maintenance or used in these productive activities, people have residual hours of leisure that yield utility or well-being for themselves. Because each individual citizen is included as a member of society, the value of these leisure activities must also be tallied. The willingness-to-pay principle that guided the valuation of market, home-based, and volunteer activities also serves as the conceptual basis for valuing leisure hours. As with the other nonmarketed activities, analysts have attempted to use the expected market wage of people to approximate the value of their leisure hours. However, in this instance it is more difficult to make the case that people equate the market wage rate with the value of leisure hours, which is necessary for establishing the market wage rate as a reliable guide for valuing leisure hours. We include the willingness to pay for hours used in Leisure Activities as an entry in the table, and label it LA.

The last entry in the left column captures an important, but so far neglected, aspect of the value of the productive activities of citizens. To this point, we have assumed that the value of market, home-based, volunteer, and leisure activities can be secured from assessments of members of society (including the person whose human capital services are being valued) who directly benefit from these activities. In fact, these activities, particularly Home Production and Volunteer Activities, may increase the well-being of members of society who do not directly gain from the goods and services generated. For example, citizens in general may experience feelings of altruism (or "warm glow") when observing the benefits from the services of other citizens engaged in socially productive volunteer activities. This extra "spillover" or external value constitutes additional output, for example, in the form of better urban living conditions as a result of decreased homelessness, crime, or drug addiction, and must be included on our ledger. We label these external, public good-type benefits EB.[21]

The sum of the items in the left column of the ledger, then, is the annual social value

[21] Although our examples indicate positive external effects, it should be noted that the productive activities reflecting the use of human capital may also generate negative effects. Hence, EB is appropriately thought of as a net value.

of the productive activities of citizens, with given education, training, skills, and other human capital characteristics. Because it captures the value of the services yielded by the human capital of citizens, without taking account of the social costs entailed in producing these outputs, this sum forms the gross annual return on human capital.

## The Value of Annual Resource Use

Consider a unit of physical capital, such as a truck. For the truck to function productively, inputs for its operation, maintenance, and repair are required. In calculating the net value of the productive services of the truck to society, the analyst needs to take account of the value of these required inputs. The same is true of services rendered by people who embody human capital. Hence, we need a right side of the ledger to reflect the value of the annual resources diverted from other social uses in order to support and sustain the productive activities of human capital. These resources enable the person to live, work, and contribute the gross output indicated on the left side of the ledger.

Many of these inputs pass through a market; thus, valuing the opportunity cost to society in providing them to the individual is straightforward. However, the generation of these inputs for supporting human capital may also generate surpluses—in this case, producer surplus—that need to be taken into account in assessing these social opportunity costs. Moreover, the production and use of these goods and services may also impose external costs on society that are not reflected in market prices, and these costs must be included as well.

The primary required resources can be categorized in a rather straightforward manner; in each case it is the value of these inputs to society that must be assessed:

- Food, Shelter, and Clothing (FSC)—the basic necessities of life;
- Transportation and Medical Care (TMC)—other necessities with cost structures that are different from FCS;
- Education and Training (ET)—inputs supporting investments in human capital that will be used in productive activities in future periods;
- Producer Surplus (PS)—an offset to the market price of these required inputs, reflecting opportunity costs of productive factors that lie below market prices; and
- External Costs (EC)—nonmarketed costs generated in the process of producing these inputs to human capital, for example increased congestion or pollution.

The first entry on the right side of the ledger is the value of annual Food, Shelter, and Clothing (FSC) consumption by people. In concept, the social opportunity cost of these goods and services is the amount that would have to be paid to each unit of labor, land, and capital in order to divert it from some other activity into the production of FSC. A proxy measure of the opportunity cost of a unit of any one of these is its market price. Then the value of the annual resource use of these goods and services is the amount of each purchase multiplied by its market price.

If this market-based value is used to establish the value of FSC, social opportunity costs will be overvalued. Following the discussion of Consumer Surplus, we can argue that each successive unit of goods and services costs more to produce than the previous one, possibly because of higher labor costs or less efficient plants and equipment. However, the market price reflects the required cost to produce the last (or marginal) unit of these goods and services. If we value all the units produced at that market price, we overstate the total value of resources used. The magnitude of this overstatement is known as Producer Surplus, and must be subtracted from the total value of resources used on the right side of the ledger.

The second entry, Transportation and Medical Care (TMC), also reflects the value of inputs required for the productive use of human capital. As with FSC, the value of TMC is the social opportunity cost of the labor, land, and capital resources used in the production of these services, and analysts have made use of their market prices in developing proxies for the more difficult to measure, but conceptually accurate, social opportunity cost valuation. As we described above, such market prices tend to overstate the full social opportunity cost, by the amount of Producer Surplus; again an offset is required. However, in the case of TMC, market prices are far less reliable proxies of social opportunity costs than they are for FSC. Both medical care and transportation services enjoy public subsidies,

which lead to market prices that do not accurately reflect social costs. Hence, we include them separately in the ledger. The third entry, the value of Education and Training (ET) services consumed, represents the full social opportunity costs of the resources allocated to activities that augment the level of individual human capital stocks during a year. Unlike other real resource inputs required for productive activities that employ human capital—for example, consumption represented by FSC—the resources consumed for investments in human capital do not yield immediate increases in the value of productive activities that are reflected in the left side of this year's ledger. The added human capital stock will be put to productive use only in future periods, yielding gains in Gross Annual Product in these "out" years. For example, if the value of an hour of a person's contributions to Market Production (MP) is proxied by the hourly wage, the returns from the augmented human capital at the end of period *t* will be reflected in a higher hourly wage in future periods, implying increased market productivity in these periods. Because the value of a person's human capital stock is the discounted present value of the lifetime stream of her gross outputs, the gains that offset the value of the ET resource costs are reflected in the value of the human capital stock.[22]

As with TMC values, the market price of ET is a weak proxy for the relevant costs, due to public subsidies to both students and schools. And, as with FSC and TMC, Producer Surplus values will not be reflected in ET costs if market prices are used to assess the value of this resource use; again, these must be reflected as an offset on the right side of the ledger.

The next entry on the right side of the table is Producer Surplus, labeled PS. The value of PS is entered in the ledger with a minus sign, as it serves to offset the overstated costs of FSC, TMC, and ET when measured by market prices. As we have noted, if the valuation of the resources consumed in supporting the productive use of human capital is based on implicit or explicit market prices, the estimated value will exaggerate true social opportunity costs. Hence, we collect the Producer Surplus values associated with market-based estimates of these resource costs, and enter them on the right side of the ledger, but as an offset to the total resource cost.[23]

External Costs (EC), the final entry on the right side of the ledger, have the same conceptual basis as the value of External Benefits (EB) listed on the left side of the ledger. To the extent that those who bear the direct opportunity costs of the resources consumed in supporting the productive use of human capital do not experience the external or public goods costs of this consumption, they must be reflected in a separate entry in the ledger. An example of such costs borne by society but not directly reflected in the consumption of resources included in FSC, TMC, and ET are the pollution or congestion costs that may be associated with these uses of labor, land, and capital resources.

The sum of the items on the right side of the ledger is the annual social opportunity cost of the consumption of resources that support the productive activities associated with the use of human capital. When this sum is aggregated over all citizens in society it is the Value of Annual Resource Use (VARU) associated with the use of the human capital of the society.

We can now combine the two sides of the ledger. The gross annual value to society of the productive activities of human capital (the left side) minus the cost of the real consumption attributable to these activities (the right side) is the Value of Net Annual Product (VNAP) of human capital. VNAP is the value of the net annual contribution of

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[22] The decision to allocate time to Education and Training is more complicated than the decision to allocate time to other activities. The cost to society of an individual's choice to engage in education or training includes both the resource costs of the labor and capital inputs associated with the training, and the value of the individual's time devoted to that training in terms of lost output. Like the decision to allocate time to HP or VA, the individual will allocate time to ET as long as the value of that time to the individual exceeds the returns to time devoted to alternative uses. However, the time devoted to ET results in an increment to human capital, which in turn raises the individual's future productivity and wage rate and thus the value of all forms of the individual's future productive activities.

[23] As with the value of Consumer Surplus, we include the Producer Surplus associated with the individual's own time spent in resource-using FSC, TMC, and ET activities.

human capital to aggregate output. It can also be considered the net annual social benefit of human capital, or the return on the stock of human capital existing at a point in time.

By extrapolating from this framework, then, we can define the annual social value of investing in one more unit of human capital—say, one more year of education for one person. The annual value of that investment is the *increase* in the Value of Net Annual Product of the society attributable to that choice, which equals the difference between the *increase* in the Value of Gross Annual Product and the *increase* in the Value of Annual Resource Use. The discounted present value of the full set of annual *increases* in the Value of Net Annual Product of the society attributable to that choice is the net social value of the investment. The social rate of return implied by the investment is the discount rate that would equate the present value of the full stream of increments to the Value of Gross Annual Product and the present value of the full stream of increments to the Value of Annual Resource Use.