Human Capital Policy

James J. Heckman and Peter J. Klenow

University of Chicago

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One of the least-read chapters of Gary Becker's *Human Capital* addresses the question "Is There Underinvestment in Education?". His answer was strongly dependent on how the growth residual was allocated between education and capital. If it was allocated to education, Becker found that the return to human capital was considerably higher than the return to physical capital in the United States. If the residual was instead allocated to physical capital, the return was considerably lower. Becker's empirical methods have been faulted but his question remains relevant both for the U.S. and other countries.

This paper returns to Becker's question, drawing on the research that has appeared in the 33 years since he addressed it. We consider the return to human capital broadly, not just the return to education. We ask (1) What is the evidence on the economic and social returns to human capital investment? (2) Is there evidence of market failure or externalities, and do they warrant higher subsidies to human capital investment? In the remainder of this section we summarize the main points of our discussion on the following topics: 1. Human Capital Externalities; 2. Public and Private Training; 3. School-based policies and 4. Tax Policy.

Summarizing the debate on human capital externalities in the 1960s, Becker (1964) wrote

> *"... earnings greatly understate the social productivity of college graduates (and other educated persons) because they are (allegedly) only partly compensated for their effect on the development and spread of economic knowledge" (p. 209).*

The debate continues, much at the same level, 30 years later. In advancing human capital as the main source of country differences in per capita incomes, Mankiw (1997) apportions a substantial role to externalities:

> *"The idea that human capital generates positive externalities appears in many recent discussions of economic growth and is, in my view, very appealing. It explains, for instance, why all countries choose to subsidize education, why developing countries are concerned about the brain drain, and why good students prefer to be at schools with other good students. Once we start thinking about externalities, it seems unlikely that they are the same at all levels of schooling. One externality often mentioned is that educated people generate good ideas that enter society's pool of knowledge. This externality might well flow largely from the most educated members of society. If so, differences in secondary and higher education would be more important than differences in primary education." (Mankiw, 1997)*

Human capital externalities also serve as the linchpin of recent theories of economic growth, such as those by Lucas (1988), Romer (1990), and their multitudinous progeny. In Lucas (1988), individual workers are more productive the higher the level of human capital possessed by other workers. In Romer (1990), devoting human capital to generating and adopting ideas lowers the cost of idea creation and adoption for all in the future. If these hypotheses are correct, then *laissez faire* policies result in underinvestment in human capital and a subsidy to investment in human capital can raise income and welfare.

Does the view among theorists of important human capital externalities have a solid empirical basis? The answer is "No". But one must be cautious about reaching a firm conclusion because the evidence is disappointingly limited. Before considering the evidence, we wish to stress that most economies already subsidize human capital investments substantially. Evidence for externalities at some base level is not evidence that subsidies to human capital should be boosted from their current levels. Existing subsidies may have already eliminated a gap between social and private returns. We estimate that, to justify the current level of subsidies to public college instruction in the U.S., the social marginal product of the human capital gained from college education has to be about 30% higher

than the private marginal product. If externalities are positive but not sufficiently large, then existing subsidies are actually too generous, at least on efficiency grounds.

In section 1 we survey the evidence on human capital externalities. As a starting point, we look across countries and find that each additional year of schooling is associated with about 30% higher GDP per capita. In contrast, across individuals within a country, each additional year of schooling is associated with roughly 10% higher wages (see Psacharopoulos, 1994, for evidence for many countries). When we add a proxy for on-the-job training (average work experience of the population), the cross-country coefficient falls to about 25%, still much higher than what is estimated from cross section earnings equations. Taken at face value, this large discrepancy between macro and micro "rates of return" suggests that there are huge positive externalities to schooling. But there are reasons to expect that countries with high levels of schooling have high levels of technology. Causality may run from technology to income/lifespan to schooling, so that macro regressions attribute too large an output effect to schooling. When we include life expectancy in the regression to proxy for country differences in technology, the macro schooling coefficient falls to about 10% - in the ballpark of micro schooling coefficients. Thus the macro vs. micro evidence for human capital externalities is not robust. In surveying other studies, we find that the evidence for externalities at the U.S. state or city level (rather than country level) is equally fragile.

Studies of "dynamic externalities" to human-capital-intensive R&D are more numerous and the evidence from these studies is more robust (see Griliches, 1997, for a survey). Regressing firm productivity growth on own-firm R&D investment and the R&D investment

of other "technologically close" firms, the literature consistently finds significant positive effects of the R&D expenditure of other firms on the productivity of a given firm. Another finding common in the literature is larger effects on productivity growth of the R&D investment rates the higher the level of aggregation. Although this evidence is consistent with substantial positive externalities to R&D, the available studies are plagued by simultaneity problems. It is entirely plausible that there are no spillovers at all. The existing evidence may be a consequence of common shocks and/or cyclical changes in productivity due to changing factor utilization. Convincing instruments for R&D that might be used to ameliorate the simultaneity problem have proved to be elusive.[1]

In section 2 we survey evidence on the return to public training initiatives. In response to the recent changes in the wage structure, which many attribute to skill-biased advances in technology (see, e.g. Berman, Bound and Griliches, 1994), policymakers have advocated raising the skills of individuals at the bottom of the earnings distribution, while scaling back traditional welfare and income transfer programs that discourage work and investment in skills. We document in Section 2 that public training programs have been largely unsuccessful. Even the most expensive and highly praised programs yield only modest improvements in the earnings and employment of their participants. This is somewhat surprising since *private* on-the-job training makes up a large fraction of human capital investment and is often quite productive.

There are two reasons for differences between the impacts of public and private training. First, there may be unobservable skill and motivational differences between individuals who receive public and private training which make training less effective for those participating

in public programs. Firms may be offering training only to workers who will benefit, while government programs often make little attempt to screen participants and may even be seeking out the least employable (Heckman, Smith, and Taber, 1996). Second, public training programs appear to be less effective at producing skills for any trainee. Curricula in these programs rarely respond to market forces, and there are few true market incentives in them that guide the choice of training offered. Both factors are likely to be responsible for the poor performance of government programs. In this regard, the training of workers is best left to private firms which select workers who will benefit from additional training and which can tailor their programs to the specific needs of the market. Policies that encourage firms to train unskilled workers are likely to be more effective than programs that offer free public training for anyone who wants it. Programs should direct training to the private sector.

In section 3 we study policies designed to improve access to higher education among the children of low-income families, as well as proposals designed to encourage all individuals to undertake more formal schooling. Some advocates of these policies argue that the return to schooling is high among children from low-income families, because they and their parents are unable to borrow against their future earnings to finance a college education. If this is true, expanding school subsidies or student loans should lead to a large increase in college enrollment or an improvement in the quality of colleges attended by disadvantaged youth. Alternatively, if other family characteristics or individual ability differences are the cause of low enrollment rates among students from poor families, then additional loans and subsidies will have little effect on their college participation. Drawing on the research of Cameron

and Heckman (1997, 1998a,b), we find that the case for liquidity constraints is greatly exaggerated.

Baily, Burtless, and Litan (1993) argue that there is a dramatic imbalance between public expenditures on post-secondary schooling in favor of youth who receive academic training at college compared to alternative forms of human capital acquisition for youth who do not. Because a large part of public spending on college education is on community colleges, which provide both academic and vocational training, the alleged imbalance may not be real. It is not clear which group receives more investment subsidies from the government once public spending on training programs is added to public expenditures for colleges and universities. Low-ability individuals receive assistance for vocational and job-oriented training, while more able individuals typically receive subsidies for more advanced forms of schooling.

Substantial public funds are also spent on primary and secondary education. Within current ranges, marginal changes in spending on primary and secondary schooling (as reflected in dollars per pupil or class size) appear to have, at best, modest effects on the future earnings of students. This is not say that schooling quality doesn't matter. But it is unlikely that quality improvements will be a major source of benefit for the U.S. economy. Evidence on the effectiveness of schooling policy is more dramatic in less developed countries where levels of quality are much lower.

Recently, an increase in public spending on early childhood investments has been advocated, and there has been a renewed focus on the problems created by dysfunctional families. Programs that are inefficient in terms of their impact on earnings may be justified

by their impact on social externalities. If raising the income of unskilled youth reduces crime rates and teenage pregnancy, the value of programs that redistribute income to improve the skills of those youth is likely to be significantly larger than traditional cost-benefit measures of net financial gain would indicate. For example, crime costs Americans more than $450 billion annually, according to a comprehensive study by Miller, Cohen, and Wiersema (1996) for the National Institute of Justice. Grogger (1996) estimates that the 20% decline in real wages for men ages 16-24 since the mid-1970s has led to a roughly 15% rise in crime rates among them. Because older adults commit much less crime and cause fewer other social problems, it is more difficult to use crime reduction as a justification for programs directed toward them.[2] For disadvantaged youth — a major source of social problems— arguments focusing on social externalities are more relevant.

Dysfunctional families are inefficient producers of skill. Many families do not provide their children with adequate learning environments and guidance — important sources of human capital formation. The large increase in out-of-wedlock birth rates to teenagers in the past 15 years has undermined family skill formation. Policies designed to improve the home environments of children, teach parenting skills to young mothers and fathers, or provide alternative places for learning attempt to alleviate this problem directly. Some of these policies have been quite effective. Studies of intensive pre-school programs for disadvantaged children combined with parenting skills training for their parents have shown promising results. These studies of early intervention have found improvements in student achievement and pro-social attitudes, while reducing criminal propensities during adolescence and adulthood. Recent mentoring programs for economically-disadvantaged adoles-

cents have also shown some promise. Programs specifically targeted to the needs of young disadvantaged students appear to be much more effective at improving their education and skills than do broad-based initiatives like improved school quality or increased college loans. We amend Becker's original model of human capital accumulation to recognize the dynamic synergies in learning. Learning begets learning and the sooner it begins, the greater the returns from it.

In section 4 we discuss the effects of current federal tax policy on human capital investment. The structure of the tax system affects how much individuals invest in human capital and which investments they make. We conclude that investments made on the job or through an employer are encouraged over more traditional academic schooling. While revenue-neutral increases in progressive taxes discourage investment most among the highly skilled, and may even encourage investment among the very unskilled, other tax provisions that favor the most skilled make it difficult to determine who is hurt or helped by our current tax system. The earned income tax credit makes this determination even more problematic since it produces an incentive for human capital investment for some low-skill workers but a disincentive for others. We summarize the available evidence on the gains to moving from progressive to flat taxes in promoting human capital formation in the U.S. economy. We argue that taxes on human capital are appropriate provided that progression is eliminated from the system and that tuition is made tax-deductible. However, tax reforms currently under discussion are unlikely to have substantial effects on human capital investment.

Finally, it is important to consider all avenues of policy together when designing a

strategy for skill formation. In section 5 we take a life-cycle approach to human capital development in suggesting how the three types of policy we discuss (training, schooling, and tax policy) can be restructured to best promote skill formation among those likely to benefit from further investments. Firms, schools, and the family are all important producers of human capital. Government policies, to the extent that they are warranted, should promote private training and compensate for the home environments of disadvantaged children. Adolescent mentoring programs can sometimes make up for shortcomings in earlier schooling or family conditions by raising motivation and skill levels. Once an individual becomes an adult, however, it is much more difficult and costly to raise skill levels. If the social costs of poverty and unemployment are high enough, it may still be optimal to encourage firms to train younger workers. As a worker ages, the returns to additional investment decline while the costs rise. Providing incentives for firms to train qualified workers is an effective mechanism for making sure that wise investments are made. Public training programs typically over-invest in individuals who gain little from additional training. For older unskilled workers, wage subsidies are the most efficient method of raising their income level. Raising their skills is far too costly an option.

1. Human Capital Externalities

Underinvestment in human capital occurs when the social "net present value" (NPV) of investing in human capital exceeds the private NPV of investing in human capital. Positive externalities to human capital lower the private NPV relative to the social NPV. Most governments heavily subsidize the instructional cost of education (as opposed to the opportunity cost of student time), raising the private NPV relative to the social NPV.

Subsidies are justified if there is a wedge between private and social NPV in the absence of subsidies. However, if the subsidies are too large they can reverse the sign of the wedge, leading to overinvestment in human capital. Quantifying the wedge between social and private NPV of human capital investment is a daunting task. In this section we examine evidence on human capital externalities — one potential contributor to the wedge.

For simplicity, assume Mincer's (1974) functional form of a linear relationship between log wages and years of schooling. This specification garners ample empirical support. Heckman and Todd (1997) find that for the past 50 years, the slope of experience-earning profiles is virtually independent of worker schooling levels in the U.S. Psacharopoulos (1994) finds a narrow range of schooling coefficients across studies for many individual countries (a 5 to 15% "rate of return" or slope coefficient on log earnings for each additional year of a worker's schooling). We augment Mincer's model to allow for positive externalities to schooling. Specifically, we posit that, controlling for own schooling, an individual worker may earn higher wages (i.e. be more productive) the higher the level of schooling of *other* workers in the country. By comparing coefficients from a cross-country macro-Mincer regression to those obtained from a cross-individual micro-Mincer regression, we attempt to estimate the size of the externality to schooling.[3]

In running the macro-Mincer (i.e. cross-country) regression, we first net out the impact of country differences in physical capital (equipment and structures). Physical capital tends to be high where GDP and schooling are high. If we did not adjust for it, it could lead us to overestimate the size of the schooling externality. The level of technology is also likely to be positively correlated with GDP and schooling. Countries with higher levels of technology

probably have more advanced medical technology, contributing to longer life expectancy. Since longer lifespan affords a longer working life over which to amortize an investment in schooling, it should induce more schooling. (See Rati Ram, and T. W. Schultz, 1979, for evidence on this effect in India.) Also, if education is a normal consumption good, then we would expect the greater income produced by a higher level of technology to induce more schooling attainment in a country. To the extent that technology is higher where schooling is high, the difference between macro- and micro-Mincer coefficients on schooling will give an upward biased estimate of schooling externalities. Errors in measuring schooling, however, create a bias going the other way. A year of schooling is probably not associated with the same amount of human capital in every country. And the quality of a year of schooling is not likely to be perfectly correlated with average attainment in a country.[4]

What Level of Externality Would Justify U.S. College Education Subsidies?

Before we turn to evidence on the size of human capital externalities, we ask what externality would rationalize the existing level of tuition subsidies for college education in the U.S. According to McPherson and Shapiro (1994), almost 90% of instructional costs at public colleges are financed by federal and state governments. Tables 1A and 1B summarize some of the their evidence. We use their figure for public, as opposed to private, college on the grounds that the typical high school graduate on the margin of continuing college or entering the workforce is considering attending a public college (either a two-year or a four-year institution). McPherson and Shapiro estimate instruction costs of $8760 in 1994 ($7839 paid by the government). Even larger than the cost of instruction is the opportunity

cost of a student's time. Using data from the NLSY, we estimate that a student foregoes about $16,500 in before-tax earnings each year by going to college. Assuming a 40 year workspan, a marginal tax rate of 15%, a real interest rate of 10%, and an experience premium of 2.6%, we calculate that an individual will be indifferent between going to college and working if the private Mincerian return to schooling is 9%. This number is in line with typical estimates of the micro-Mincer coefficient. We further calculate that an optimizing government will be indifferent about an individual going to college if the social Mincerian return to schooling is 12%. i.e., for the government subsidy of instructional costs to be justified, the macro-Mincer needs to be about 12%. The externality must therefore be about 3 percentage points, or about 33% as big as the private wage gains from schooling.[5]

Empirical Estimates

In this section we first report simple regressions using cross-country macro data. We obtain GDP per capita from Summers and Heston (1991),[6] and obtain data on schooling attainment from Barro and Lee (1996). We use years of schooling attained by the population age 15 and over.[7] For constructing the average years of work-experience for each country, we use data from the United Nations (1994) on the age-distribution of the population between 5 and 64. We combine this data with the Barro and Lee (1993) data on schooling enrollment ratios to estimate the share of the 5 to 24 year old population that is working (as opposed to being in school). For each age group, we calculate work experience as (age - schooling attainment - 6). We then take the working-population-weighted average of these experience levels. The resulting experience series are, as one would expect, positively correlated with GDP per capita (e.g. .64 in 1985 and .48 in 1960). Countries with higher GDP

per capita tend to have higher experience levels since their longer life expectancy outweighs their longer time spent in school. Finally, we obtain data on life-expectancy (upon reaching age one) from Barro and Lee (1993).

Table 2 presents the coefficients from simple regressions of the log of GDP per capita on average years of schooling attained in the population age 15 and over. The samples consist of cross-sections of countries at a point in time. These initial regressions do not adjust for physical capital, and are appropriate only if the capital/output ratio is the same across countries. Each additional year of schooling attainment in a country is associated with about 30% higher GDP per capita, whether one looks at 1990, 1985 or 1960. This result continues to hold when an estimate of the within-country variance of schooling attainment is included as a regressor.[8] The coefficients on schooling attainment fall to about 25% when an estimate of the average experience level of the workforce is added to the regression. The coefficients on each year of experience are about 6%. These macro-Mincer coefficients of 25% and 6% are quite high compared to the 10% and 2.6% typically found in micro-Mincer regressions. They are consistent with large positive external productivity gains to economy-wide schooling attainment and experience.

We are deeply skeptical about the validity of the identifying assumptions that justify the regressions presented in Table 2 — that the level of productivity (adjusting for physical and human capital) is uncorrelated with years of schooling and experience. In an attempt to control for the response of schooling to the level of technology in a country, we include life expectancy in the regressions. The idea is that countries with advanced technologies for producing goods and services overall will tend to have advanced medical technologies,

thereby boosting life expectancy. Life expectancy should also, in theory, mitigate an errors-in-variables problem with our experience measure. Specifically, in the same way that human capital theory predicts greater schooling attainment in response to higher levels of life expectancy, theory predicts a higher rate of investment in human capital on the job in response to higher life expectancy. Thus one would expect human capital to rise faster with years of experience the higher the life expectancy in the country. Of course, life expectancy itself is endogenous, and may be a consequence of schooling attainment, directly through information and indirectly by generating more income, some of which is spent on nutrition and medical care. The two are highly correlated across countries (.85 in 1985, .82 in 1960). As the last two rows in Table 2 show, the inclusion of life expectancy sharply lowers the macro-Mincer coefficients on schooling, to 10.6% in 1985 and 7.0% in 1960. These are not at all far from the 9.9% average micro-Mincer coefficient that Psacharopoulos (1994) finds across 56 country studies, or from the many estimates for the U.S..

One concern we have about all of the estimates in Table 2 is that the capital/output ratio may not be the same across countries. Mankiw, Romer and Weil (1992) estimate that capital intensity is substantially higher in richer than in poorer countries in 1985, a result corroborated by Hall and Jones (1996) and Klenow and Rodriguez-Clare (1997). Using Klenow and Rodriguez-Clare's estimates of physical capital intensity in 1985, we adjusted log GDP per worker appropriately. We then re-ran the 1985 regressions in Table 2 for two values of labor's share. Gollin (1996) finds that, after carefully dealing with proprietor's income, labor's share is relatively stable across countries and time and falls in the range 65 to 80%. We use labor shares of 65% and 80% to adjust the log of GDP. As expected,

we find lower macro-Mincer coefficients on schooling after making this adjustment. But the reductions are modest — only a few percentage points. The coefficients on experience remain intact. The upshot of our comparison of the macro- and micro-Mincer coefficients is that they provide no evidence for externalities once controls are made for life expectancy and physical capital. It is plausible, however, that life expectancy steals some of the coefficient that rightly belongs to schooling, since schooling is measured with error and schooling influences life expectancy. i.e. life expectancy is highly endogenous, so it is far from clear that including it is innocuous. We interpret our results as providing no decisive support for or against externalities.

It is worth noting that the proximity of the macro- and micro-Mincer coefficient casts doubt on the signalling interpretation of the micro-Mincer education premium. Under the signalling hypothesis, education is a signal to future employers of a student's ability, and all or part of the micro-Mincer education premium reflects a return to sending that signal. But under this hypothesis we would expect the macro-Mincer coefficient to be smaller than the micro-Mincer coefficient, since the macro-Mincer coefficient should reflect the productive benefits of schooling.

Bias in The Micro Estimates

If ability bias is an important part of the estimated return to schooling, then micro estimates of the return to schooling may be biased upward. In this event the gap between the macro/social-Mincer coefficient and the micro/private-Mincer coefficient may be biased downward.[9] A huge empirical literature investigates ability bias. The 1970s literature - based on the analysis of twins and brothers, and using components of variance methods -

concluded that ability bias was a second-order problem. In a paper typical of this literature, Chamberlain and Griliches (1978) move the Mincer coefficient from .080 to .082 when they adjust for ability bias. Similar results are found in other papers in the literature.

The more recent instrumental variables literature, surveyed in Card (1995), reveals that, if anything econometrically accounting for endogeneity in schooling *raises* the estimated return to schooling, although the magnitudes of the increase are not large. This literature emphasizes heterogeneity in discount rates and not ability. Persons with high discount rates take less schooling. Taking the literature as a whole, adjustments for endogeneity either do not affect or further reduce the gap between estimated private and social marginal products of education.

Other Evidence on Human Capital Externalities

What other evidence is there for human capital externalities of the sort emphasized by Lucas (1988) in which a worker's current marginal product is higher the more human capital there is in the economy at large? Rauch (1993) uses data from U.S. Standard Metropolitan Statistical Areas (SMSAs) and finds that, controlling for a worker's own education and experience levels, the worker's wages are higher the higher the average level of education in the worker's SMSA. Rauch finds that a worker's wages are 3.1% higher (standard error .8%) for each additional year of SMSA average education.

Rauch's evidence is consistent with Lucas' story, but it is also consistent with complementarity between physical capital or technology and labor of varying education levels. Higher education in an SMSA may attract physical capital and technology (or vice versa, or both may be attracted by certain amenities or policies), raising the marginal product of

workers of all education levels. Yet another interpretation is that school quality is higher in SMSAs with higher average education, raising the human capital of all workers educated and working in the SMSA.[10] Heckman, Layne-Farrar and Todd (1996), using Census region data, and the Card-Krueger (1992) specification of earnings, show that human capital quantity, quality stocks and capital stocks operate in a fashion consistent with positive externalities. Thus human capital does not proxy for aggregate capital and one criticism of Rauch's study is eliminated. However, Heckman, Layne-Farrar and Todd reject the Card-Krueger earnings specification and with the model that fits the data they fail to find any systematic evidence of human capital spillovers.

Later work by Rudd (1996) supports the analysis of Heckman, Layne-Farrar and Todd and is focused specifically on testing the analysis of Rauch. Looking at U.S. states, Rudd first reproduces Rauch's finding: controlling for a worker's education, the worker's wages are higher, the higher the average level of education in the state. When state fixed effects are included, however, the result weakens considerably. When he allows for Census-region specific returns to own-education, the result weakens still further. Finally, when he adopts a nonlinear specification of schooling, following Heckman,Layne-Farrar and Todd, the coefficient on state-wide education is no longer statistically or numerically significant.

Tamura (1991) proposes a dynamic version of Lucas' static human capital externality whereby workers learn more the higher the human capital of other workers in the economy. Consistent with this hypothesis, migrants - who typically move to locales with higher average human capital - enjoy faster wage gains from the date of entry into the U.S. (Borjas, 1995). These wage gains could, however, merely reflect selection based on expected wage

gains.

Still another possible form of human capital externality involves the creation and adoption of new technology. More educated workers may be better at creating and adopting new technology, and the new technology may raise the marginal product of all workers (not necessarily in a skill-neutral way). Foster and Rosenzweig (1995) find that faster technological change in Indian agriculture (induced by advances outside of India) raised the return to schooling in India, consistent with this hypothesis. And Foster and Rosenzweig (1996) find that better-educated Indian farmers are first to adopt new seed technology, and are emulated by neighboring farmers.

A problem with all of these stories, however, is that they can be true without there being any uninternalized externality. Workers may be more productive the higher the human capital of their co-workers within the same firm, which would be internalized by the firm in its hiring and salary decisions. Similarly, workers may learn more the higher the human capital of their co-workers within the same firm. As Coase (1937) observed, firms may exist to internalize such externalities and transactions costs. Workers would accept lower wages in return for the opportunity of working around high human capital workers from whom they can learn more. Firms will compete for high human capital workers on these grounds, so that the high human capital workers are compensated for what they teach other workers. Finally, if technology adoption decisions are made by each firm, firms should be compensating better-educated workers for their ability to adopt more advanced technologies and raise the marginal product of all workers in the firm.

An externality requires that workers benefit the higher the level of human capital of

workers at *other* firms. Irwin and Klenow (1994) find evidence suggesting that semiconductor memory chip firms learn from each other about how to lower chip defect rates. This is consistent with the externalities hypothesis. But their result may be a consequence of workers moving between firms, or from upstream equipment embodying the insights gleaned from earlier user experience. Foster and Rosenzweig (1996) find that, controlling for own-farmer education, a farmer is more likely to adopt the new seed technology after it has been used by a neighbor. This evidence is suggestive of externalities, but does not provide an estimate of its quantitative importance.

Studies of externalities to R&D are much more plentiful than studies of human capital externalities. If R&D is intensive in human capital and it is costly to subsidize R&D directly (say because firms are creative in classifying activities as R&D), subsidizing education for scientists and engineers may be efficient. The literature in this area typically finds social returns at least twice those of private returns (see Griliches, 1997, for a survey and references to other surveys). Controlling for its own R&D, a firm experiences faster productivity growth the greater the R&D of "technologically close" firms. And when productivity growth is regressed on R&D, the coefficent tends to be larger the higher the level of aggregation (economy vs. one-digit industries vs. firm). Another interpretation of these findings, however, is that firms are responding to common shocks to the productivity of R&D (say better computer equipment) or the state of the business cycle. Ideally, instruments could be used to deal with simultaneity, but as in many literatures the search for valid instruments has been in vain.

Some indirect evidence on the "room" for human capital externalities comes from growth

accounting excercises. In these exercises, GDP growth is decomposed into contributions from input growth and TFP (total factor productivity) growth. The contribution of inputs is estimated by weighting the growth rate of various inputs by their factor shares, i.e. the Divisia index method. The factor shares reflect *private* marginal products under competitive input and output markets. Thus, positive externalities to human capital, or social marginal products in excess of private ones, should show up in the TFP growth residual.

Using Divisia indices constructed with detailed categories of physical and human capital (e.g. workers with different education and experience levels), Jorgenson (1995) carries out postwar growth accounting for the U.S. and other OECD economies. For the U.S. from 1948-1986, Jorgenson (Volume I, Table 8.5, p. 383) reports that TFP growth explains 17% of GDP growth. He attributes 26% to growth in human capital per worker. TFP growth and human capital growth explain larger shares of the growth in GDP per worker hour: 27% and 40%, respectively.

In a study of the four Asian tigers over 1966-1990 (1960-1990 for Hong Kong), Young (1995) finds that TFP growth explains 32% of the GDP growth in Hong Kong, 17% in South Korea, 2% in Singapore, and 28% in Taiwan. Compared to Jorgenson's findings for the U.S., Young finds that growth in human capital per worker plays only a small role in these countries (5%, 6%, 8%, and 2%, respectively). In terms of growth in GDP per worker hour, he finds that TFP growth explains 49% in Hong Kong, 35% in South Korea, 5% in Singapore, and 54% in Taiwan, with the shares of human capital growth being 8%, 13%, 17%, and 4%, respectively.

Using less detailed measures of human capital than Jorgenson and Young, Klenow and

Rodriguez-Clare find that TFP growth explains 10% of the 1960-1985 growth of GDP in 98 countries, and human capital explains 32%. For growth in GDP per worker, they attribute 20% to TFP and 36% to human capital. They argue that some of the growth in physical and human capital would not have occurred without TFP growth, however, since higher TFP raises the marginal product of physical and human capital. Klenow and Rodriguez-Clare find a much larger role for TFP growth (46%) and a much smaller role for human capital (20%) after they attribute some of the growth in capital to TFP growth.

The pattern in these studies is for residual growth to be at least half as large as the growth attributed to human capital. This leaves ample room for positive externalities arising from human capital. The social marginal product for human capital would typically need to be at least 50% higher than the private marginal product to soak up the TFP residual. This is *not* to say that one *should* attribute all of the TFP residual to human capital externalities. As we argued above, a compelling alternative is that technology in use (e.g. embodied in the quality of equipment) differs over time and across countries.[11] Greenwood, Hercowitz, and Krusell (1997) estimate that improvements in the quality of equipment entirely soak up the TFP residual in the postwar U.S. An important topic for future research is to quantify differences in the quality of equipment in use across countries and over time for many countries.

Of course, technology in use could itself be a response to the level of schooling. But it is important to distinguish direct gains from schooling from gains through technology adoption because the policy implications of the two differ. Issues of openness in the flow of new goods and ideas, intellectual property rights, and university and commercial research

relationships are involved in analyzing technology adoption, not just promotion of system-wide educational attainment.

In summary, the evidence on human capital externalities is weak. The few studies that have been done have not produced robust, precise estimates. One could say there is no strong evidence for human capital externalities, but likewise there is no solid evidence that they are non-existent or small. The evidence for externalties to human capital used in R&D is more plentiful, but the literature has yet to deal satisfactorily with simultaneity problems.

2. The Returns to Other Forms of Human Capital Investment

Public vs. Private Job Training

Most individuals make considerable investments in their human capital after they have completed their formal schooling. Workers often enroll in public or private job training programs or receive training on the job. More than a third of the market human capital produced in a worker's lifetime is produced on the job (Heckman, Lochner, and Taber, 1998a).

Despite high returns to private on-the-job investment, the record of public training programs is not a good one. Few public programs have been successful, despite a substantial amount of spending on such programs. Expenditures for training and employment account for about 20% of total federal outlays for education and training. This amounted to more than $5.6 billion in 1990 and is more than half the *federal* funds spent on higher education or on elementary, secondary, and vocational education combined. These amounts are difficult

to justify based on the earnings and employment impacts of most federal training programs. We examine a few of those programs here.

A. Evidence About Conventional Training Programs

How effective are federal job training programs in moving people from welfare to work and in increasing their employment and earnings? Most programs have shown small, but positive, impacts on adult earnings and no impact (or a negative impact) on the earnings of youth. Table 3 presents estimates of the earnings and employment impacts of a variety of job training programs. The estimated impacts of job training vary across programs and demographic groups. Adult women consistently experience larger earning gains than adult men, and youth generally show negative or insignificant positive gains. Due to these differences, we now examine in detail the effects of public training programs on specific subgroups based on age and sex.

(i) Adult Women

LaLonde (1995) found that employment and training programs directed toward women on welfare increase the earnings of adult female AFDC recipients. Earnings gains (a) are modest, (b) persist over several years, (c) arise from several different treatments, and (d) are sometimes quite cost-effective. Table 3 displays evaluation results for a variety of public training programs that include results for female welfare applicants and recipients. The National Supported Work (NSW) program provided subsidized employment, along with intensive training and job search assistance, at a cost of about $7,100 per recipient. The estimated increases in annual earnings attributed to program participation range between $460 and $810 for the first three years after participation in the program. Much less inten-

sive programs administered by local or state governments often produced similar increases in earnings at less than one tenth the cost. In many cases, job search assistance alone (or coupled with employment subsidies) – which typically costs less than $300 per participant – increased the annual earnings of participating women by more than $400 after 3 years.[12] Low-cost programs appear to be cost-effective, though their effects on earnings are small. More costly programs like the NSW have not produced correspondingly larger increases in earnings.

The estimates from widely-cited studies of the Manpower Demonstration and Training Act (MDTA) and the Comprehensive Employment and Training Act (CETA) shown in Table 3 indicate larger impacts on the earnings of participating women. Increases in earnings for non-white women participating in MDTA programs were nearly 40%. It is important to note, however, that studies of these two programs are non-experimental, and impact estimates vary substantially across studies.

Results from the recent experimental evaluation of the JTPA indicate much lower impacts on earnings – estimates closer to those found for NSW. The average earnings of adult women participating in JTPA increased by 9% for whites and 3.2% for non-whites. Unfortunately, estimated program impacts on earnings are not sufficiently large to move more than a tiny fraction of women out of poverty or off of AFDC.[13] As a general rule, however, conventional employment and training programs are often cost-effective for adult women (especially if the opportunity cost of trainee time is ignored or is sufficiently low), but they do not produce dramatic changes in participant earnings.

(ii) Adult Men

The evidence for adult men is consistent across programs. Rates of return are low but usually positive. The most recent program, JTPA, finds only a 4.6% increase in earnings for participating men. Earlier programs, such as CETA and MDTA, have similar estimated effects, as shown in Table 3. For both JTPA and CETA, differences in program impacts by race are small for men. The estimated impact of JTPA on employment is 2.8%, suggesting that much of the increase in participant earnings can be attributed to increased employment and not higher wage rates. These figures suggest that JTPA may be worth keeping, but it cannot be expected to close the wage gap between skilled and unskilled workers.

(iii) Youth

Evidence from the JTPA experiment indicates that this program produces only low or negative impacts on the earnings and employment of youth, as shown in Table 3. For male youth, the estimated negative effect is implausibly large. Studies of CETA and NSW show similar results. Traditional job search assistance and training programs do not produce positive employment or earnings impacts for youth. Only the Job Corps has a demonstrated positive impact on earnings for adolescents. It is an expensive program, costing around $11,000 per participant (in 1990 dollars), with an estimated return of roughly 8-9%, including all social benefits. There is some basis for supporting expansion of this program, but even for this program the evidence is weak. While earnings and employment rise among participants, nearly 30% of the estimated social benefit of the program results from crime reduction (Long, et al., 1981). This suggests, however, that even programs with low success

rates as measured by earnings may have additional benefits that should be considered.

B. Training Programs for Displaced Workers

As noted above, displacement of older workers with substantial experience in the labor market has become an increasingly important phenomenon in recent years. Displaced workers not only experience long unemployment spells, but they also earn much less than before once they find employment. In response to this trend, Congress passed Title III of the Job Training Partnership Act in 1982 and the Economic Dislocation and Worker Adjustment Assistance Act in 1988.

Leigh (1995) summarizes the evidence on a variety of state-funded programs that provide a similar mix of services as the newer federal programs. Results from evaluations of the Texas WAD and New Jersey UI programs displayed in Table 4 suggest small to moderate wage gains for program participants. Furthermore, government support in the form of unemployment insurance was lower following participation in these programs. A more recent evaluation of training provided under the Trade Adjustment Assistance Act to workers displaced as a result of foreign trade finds modest effects of this long-term training program on the earnings and employment of recipients (Corson, et al., 1993). A modest negative impact on earnings is found for early participants, while a small increase in earnings is found for participants at later ages. While programs aimed at displaced workers appear to be cost-effective, their overall pattern is one of weak impacts.

C. Private Sector Training

Due to a lack of data and a bias in favor of funding studies of government training, the returns to formal private sector training have been studied much less. Bartel (1992),

Bishop (1994), Lillard and Tan (1986), and Lynch (1992) find sizable effects of private sector training. In comparison with studies of public sector training, most of these studies do not attempt to control for the problem that more able persons are more likely to take training, so the estimated rates of return probably overstate the true returns to training by combining them with the return to ability. Mincer (1993) estimates that initial returns to private sector on-the-job training range from 10-30% depending on the data source, but they tend to decline after a few years as technical progress renders the training essentially obsolete. See Table 5. An important feature of private sector training is that the more skilled do more investing even after they attain high skill levels. This is consistent with the idea that skill begets skill. Such complementarity between current skill and investment explains why small investments in the very unskilled are often unproductive.

Private sector training often excludes low-skilled persons (Burtless, 1985). When low-skill workers are trained by the private sector, the amount of training provided to them is typically small when compared to the investments made in more skilled individuals. This is because firms can be exclusive in a way that government training programs for disadvantaged workers are designed not to be. The lack of interest of private firms in training disadvantaged workers indicates the difficulty of the task and the likely low return to this activity.

These findings suggest that while public job training programs raise incomes slightly, they appear to be less effective than private training and produce earnings gains lower than those predicted from analyses of on-the-job training (Heckman, Lochner, and Taber, 1997). This is because training is not nearly as effective for low ability workers. When the model

of Heckman, Lochner, and Taber (1997) is adjusted to match the ability levels of public training recipients, the return to post-school investment is much lower than returns for the average worker. While costs are about 20% less for low ability dropouts and 35% less for low ability high school graduates, the returns are barely half what they are for the average high school dropout and graduate. For individuals of very low ability, training is likely to be costly and ineffective.

The claim that ability matters is supported by evidence from the JTPA program. The impacts of JTPA training on the earnings of participants who were less employable – individuals receiving welfare, without a GED or high school diploma, or who had worked less than 13 weeks in the past year – were generally lower than the impacts for more employable participants. Adult women without a high school diploma or GED experienced less than two-thirds of the gain in earnings of women with a diploma or GED. Adult men without a diploma or GED experienced less than half the gain their more educated counterparts experienced. The results for youth are somewhat more ambiguous. For males, the loss in earnings attributed to participation in JTPA is less for the more educated youth. For female youth who have a diploma or GED, the impact of JTPA on earnings is negative, while the impact is slightly positive for female youth who had neither degree. This evidence suggests that, even within a given program, the effects are likely to be lower for less able trainees.

Differences in the ability of trainees are not the only possible reason for differences in the returns to private on-the-job training and public training programs. Public training may be of lower quality, though many public programs utilize private training institutes

and schools. In addition, many of the JTPA participants do not receive full-time training, though some receive training for more than one year. Finally, there may be an important difference between the effects of classroom training and the effects of on-the-job training. Since many individuals who do not go to college choose not to because they are relatively unsuccessful in school, it is likely that additional classroom training is unproductive for them as well. Alternatively, hands on learning, like that which often takes place on the job, may be much more effective. In this regard, private on-the-job training is likely to be more productive for individuals who learn better outside the formal classroom. Estimates from CETA suggest that program participants receiving on-the-job training experienced larger increases in their earnings than individuals enrolled in classroom training (Westat, 1984). However, results from the JTPA experiment do not show any significant differences between the impacts of on-the-job training and classroom training (Bloom, et al., 1993). While evidence based on U.S. training programs is mixed, part of the productivity of the German apprenticeship program has been attributed to the integration of school with work (Heckman, Roselius, and Smith, 1994).

Even though the evidence is crude, the direction is clear. To the extent that job training can be effective among low-skill individuals, it is best done by the private sector, not the public sector. Firms can choose to train individuals who are likely to gain from that training, and they can tailor their programs to the markets needs. Public job training programs do not do this. Thus, the best hope for generating reasonable returns from job training is to encourage private sector human capital investment. The potential impacts of training on social problems like crime and welfare make it likely that training subsidies

are efficient for younger workers. Unfortunately, even private sector job training may be inefficient for the least able and oldest workers.

3 School-Based Policies

Another policy that influences human capital investment is direct subsidization of schooling. In popular discussions this avenue of skill formation receives the most emphasis. Public colleges are heavily subsidized by the federal government and by state and local governments. Students at both public and private colleges can receive federal grants and loans to aid them with their tuition and living expenses. In addition, public primary and secondary schools are financed almost entirely from governmental sources. Recently, there has been growing interest in extending government subsidies to pre-school age children. Various programs that invest in young disadvantaged children have shown promising results, leading to proposals to expand their utilization. Student mentor programs for adolescents have also received growing attention, since a few model programs have shown enormous improvements in high school graduation and college attendance rates among disadvantaged teens enrolled in them.

Higher Education

While public job training programs have very modest effects on labor market outcomes, a college education for a student of even average ability has a large effect. Encouraging students to attend college either through guaranteed loans or direct tuition subsidies is often proposed. However, it is not obvious what purposes these policies serve. Virtually all high school graduates have the opportunity to enroll in a local community college with

low tuition. If there are potentially large returns to be had from going to college, it is odd that many students are not taking advantage of the available opportunities for collecting them.

Advocates of college subsidy programs cite evidence that children from low-income families complete fewer years of schooling than other individuals even in the face of very high rates of return to schooling (Mortenson, 1988, and Kane, 1994). Figure 1 presents the evidence succinctly. This evidence suggests that credit market restrictions are important factors in generating schooling outcomes and that low-income individuals may not obtain more school in the face of large and rising returns because they do not have access to credit to pay for tuition. If this is true, relaxing these borrowing constraints may lead to a large increase in schooling for low income students. It may also reduce ethnic and racial schooling gaps. (See Figure 2, taken from Cameron and Heckman 1997,1998a,b). Existing subsidized federal student loans and need-based grants are a step in this direction. However, the evidence that credit constraints are important is far from clear.

Borrowing constraints may not be the cause for reported differences in schooling choices among children from high and low-income families. Family income as measured in those studies is a proxy for a wide range of background factors – not just short-term liquidity constraints that might be eased by more generous fellowship and loan policies. Persons from poor family backgrounds may attain fewer years of schooling because of diminished family motivation for child learning and because family background may affect the child's learning ability. The neighborhoods and quality of local public schools in which students mature will also typically be worse for students from low-income families.

At issue is what measured family income represents in the correlational studies cited by advocates of tuition subsidies. It is significant in this regard that Herrnstein and Murray (1994) and Cameron and Heckman (1997, 1998a,b) find that after they account for other background characteristics and scores on ability tests, measured family income plays only a minor role in explaining schooling attainment. When Cameron and Heckman (1997, 1998) account for Armed Forces Qualifying Test (AFQT) scores – often used as measures of scholastic achievement – in their analysis of schooling attainment, they find that the effect of family income on the probability that an individual continues on in school disappears. For instance, conditioning on ability and family background for white males the probability of attending college increases by only 0.002 for every thousand dollar increase in family income. Taking this number literally, if a student's probability of attending college were 0.50, increasing his family's income by $10.000 would only raise that probability to 0.52. Holding other family background and ability characteristics constant, large increases in family income lead to only modest changes in the probability of attending college. This lends support to the view that long term factors, like ability, family structure, neighborhood effects, and the quality of the primary and secondary schools an individual attends may be more important than short-term credit constraints in determining who goes to college. While all of these factors are likely to be correlated with family income levels, there is little evidence suggesting that improved loan programs and education subsidies can reverse or overturn years of disadvantage in increasing college enrollment. See Tables 6A and 6B and the discussion in Cameron and Heckman (1997, 1998a,b).

Along this same line, Cameron and Heckman (1997, 1998a,b) find that family income

does not have an important effect on whether an individual goes to college or not,once account is made of long term achievement scores and other family background measures. It does, however, determine the type of college (two-year or four-year) a person attends. Current loan and subsidy programs appear to allow most students who want to attend college to do so. Disadvantaged students may be forced to attend two-year public institutions rather than higher quality four-year private universities. Since Kane and Rouse (1995) find that community college credits command the same economic return as credits from four-year universities, such a substitution may have little effect on the future earnings of students.

The absence of any convincing evidence on liquidity constraints may be a consequence of the generosity of existing programs. Post-secondary education is already highly subsidized. As shown back in Tables 1A and 1B, more than 90% of instructional costs of public colleges are paid out of public funds. (See McPherson and Shapiro, 1994, and Winston 1997). About 20% of the costs of private post-secondary education are also paid for by some form of government. The evidence we have summarized suggests that further action does not need to be taken to alleviate borrowing constraints in the market for human capital investment.

A related question is whether tuition subsidies are likely to have much effect on college attendance. Cameron and Heckman (1997, 1998a,b) estimate that if tuition is raised by $1000 per year, the probability of attending college (on average) decreases by 0.045 for whites, 0.056 for blacks, and 0.071 for Hispanics. These responses are small since average community college tuition levels are under $1000. They demonstrate that tuition levels

explain little of the differential between minority and majority college attendance rates.

Many of the current schooling subsidies are not aimed solely at credit constrained families. Federal and state governments provide significant subsidies to public colleges, lowering the tuition rates paid by students substantially below the social cost of their education. These subsidies encourage many individuals to invest in education, and it is plausible that they are excessive. Unlike subsidies to job training programs, which tend to benefit only the poor, school subsidies and student aid programs tend to benefit persons from middle class and wealthier families, who are more likely to attend public colleges and universities.

Baily, Burtless, and Litan (1993) state that non-college bound youth receive an inadequate amount of post-secondary school training. They cite as evidence a relatively higher level of public spending per college attendee compared to high school graduates and high school dropouts. It is important to temper their conclusion by noting that a large part of public spending on college education is for community colleges, which provide both academic and vocational training. More than 40% of college students currently attend such schools, which receive substantial support from local, state, and federal sources. In 1991, 29% of the federal education budget was spent on community colleges (U.S. Bureau of the Census, 1992). Local governments devote considerable resources to these schools as well.

Federal student aid programs also support students in public and private vocational schools. Indeed, among students enrolled in the fall of 1989, the percentage of students enrolled in private vocational schools who received federal support (82% full-time, 60% part-time) exceeded the percentage of students in public 4-year colleges who received such

support (35% full-time, 18% part-time; U.S. Department of Education, 1993). Of the $5.7 billion given in Pell Grants, 24.3% went to students enrolled in community colleges and 20.7% went to students enrolled in proprietary schools (Hansen, 1994). State and local governments play an even larger role in supporting community colleges and vocational training.

While it might seem like the large federal expenditures on college education go to those seeking advanced formal education, a substantial portion of those funds provide aid to lesser-skilled individuals receiving vocational and job-specific training at community colleges. Substantial federal funds are also spent on public and private training programs that target the least skilled. This makes it difficult to determine who benefits the most from government post-secondary education and training subsidies.

Primary, Secondary, and Early Education

State and local governments also heavily subsidize primary and secondary education. Virtually all operating costs and goods inputs are completely subsidized through high school. Only the opportunity cost of the students time remains unsubsidized. Because the amounts spent per pupil are largely determined by some level of government, many have questioned whether those amounts are adequate. Should teachers be paid more? Should class sizes be reduced? These are just a few of the questions researchers have been struggling to answer for nearly thirty years.

While the results of studies vary, there is a growing consensus that, within current ranges, measured inputs such as class size and spending per pupil have little, if any, effect on the future earnings of students. (See Heckman, Layne-Farrar, and Todd, 1996, and Card

and Krueger, 1996.) The most optimistic estimates show a mere 1-2% rise in future earnings for every 10% increase in per-pupil spending; however, those estimates have been shown to depend crucially on analytical assumptions made by researchers. When those assumptions are relaxed, the effects of per pupil spending and class size are statistically insignificant (Heckman, Layne-Farrar, and Todd, 1996). Even if we take the highest estimates from the literature and combine them with the best case scenario for student costs, we find that increasing spending per pupil is not a wise investment. The evidence in Table 7 indicates that we may be spending too much on students.[14] Taking the higher estimate of a 2% increase in future earnings for a 10% rise in per pupil spending yields a negative net return for all schooling levels. For high school graduates, the net loss is about $3,800, and for college graduates the net loss is over $4,400. Unless a similar increase in spending raises future earnings by 5% or more per year, the financial costs of school quality far outweigh the returns. In order to justify additional spending on primary and secondary schools, we would need to appeal to other social benefits that are not captured by earnings.

This evidence does not prove that school quality does not matter. Surely, it must. But, there is little evidence that marginal improvements in current levels of schooling quality are likely to be effective. Pouring more funds into schools to lower class sizes by one or two pupils or to raise spending per pupil by a few hundred dollars will not solve the problems of our primary and secondary school system. While the effects of quality vary across environments and additional funding for some schools may be justified, more fundamental changes are required if we hope to see a significant improvement in our educational system.

One new area of research offers hope. Recent studies of early childhood investments

have shown remarkable success, though the number of studies is still limited and the sample sizes of most studies are small. Early childhood interventions of high quality appear to have lasting effects. Disadvantaged subnormal children randomly assigned to the Perry Preschool program have higher earnings and lower levels of criminal behavior in their late 20s than do comparable children randomized out of the program. Reported cost-benefit ratios are substantial. Measured through age 27, the program returns $5.70 for every dollar spent. When returns are projected for the remainder of the program participants lives, the return on the dollar rises to $8.70. See the evidence in Tables 8A and 8B.

As with the Job Corps, a substantial fraction (65% in this case) of the return to the program has been attributed to reductions in crime. (Schweinhart, Barnes and Weikart, 1993). The Syracuse Preschool program provided family development support for disadvantaged children from prenatal care through age five. Reductions in problems with probation and criminal offenses ten years later were as large as 70% among children randomly assigned to the program. Girls who participated in the program also showed greater school achievement (Lally, Mangione, and Honig, 1988). Studies of early intervention programs have found short-term increases in test scores, less grade retention, and higher high school graduation rates among enrolled children. Of those studies that examine pre-delinquent or criminal behavior, most have found lower rates of deviant behavior among program participants. See Table 9 for a summary of the effects of selected early intervention programs on student test scores, schooling, earnings, and delinquency.

Evidence on the more universal Head Start program is less clear, but the program is quite heterogeneous. Currie and Thomas (1995) found short-term gains in test scores for all

participating children; however, most of those gains decayed quickly for African-American children. They conclude that either differences in local program administration or in subsequent schooling quality are at the root of the differences between the outcomes for black and white children. It is important to note, however, that similar declines in test scores have been found for programs like the Perry Preschool, but their long-term evaluations are quite favorable. The psychometric literature is not clear about the relationship between early test scores and success in school, graduation rates, socialization, and labor market outcomes. The fade-out effects in test scores do not imply that long-term beneficial effects of Head Start do not exist. Head Start may improve the lifetime prospects of its participants, despite yielding only short-term gains in test scores.

There is some evidence that Head Start may have smaller long-term impacts than more intensive model programs. Haskins (1989) reports that studies of Head Start's impact on special education placement and grade retention have produced less dramatic results than smaller demonstration projects like the Perry Preschool, though these studies are typically of poor quality. This is not surprising given the much lower spending per child and quality of service provided by Head Start programs shown in Table 9. Unfortunately, there are no reliable long-term evaluations of Head Start.

There is much more to learn about how government policy can be most effective at improving the prospects of youth. Current studies focus on small intensive programs, and it is difficult to determine how such programs would perform on a larger (and less-intense) scale. After comparing the estimated school-age effects of the more comprehensive Head Start program with those of smaller model programs, Haskins (1989) cautions against the

presumption that expanded versions of model programs will yield the same long-term effects on children as programs like the Perry Preschool. However, proponents of early intervention programs argue that the weaknesses of Head Start can be attributed to its shorter period of intervention, lower intensity, and less qualified staff than is typical of more ideal programs (Zigler, 1994). In short, you get what you pay for. For example, children enrolled in the Perry Preschool program received high quality full-time preschool services for 1-2 years (most received two years), and their parents benefited from weekly home visits by their children's teachers. On the other hand, Head Start offers a much lower quality (and lower paid) staff, part-time classes for children, and limited parental involvement. Improvements in Head Start, proponents argue, are likely to produce effects closer to those observed in more successful small-scale programs. Given the potential for success (as exhibited by the Perry Preschool experiment), more studies of the long-term impacts of various types of small-scale and broad-based early intervention programs are certainly warranted.

As an alternative to increasing traditional school inputs or youth training programs, mentor programs that provide adolescents with developmental and educational help are being tried out. The Quantum Opportunity Program (QOP) enrolled 25 underprivileged incoming high school students in each of five cities. The students were assigned a mentor who provided them with counseling, as well as education, community, and development services for four years. Financial incentives were given for participation in different activities, ranging from tutoring to cultural events. For each hour of participation (up to a limit), individuals were given $1 with a matching $1 placed in an account that could only be used for post-high school training or college; bonuses were also given for meeting program partic-

ipation goals. By providing financial incentives as well as the support and encouragement needed to keep these teens active, the program increased high school graduation rates by 34% and cut lifetime conviction rates in half when compared to a control group (Taggart, 1995). Since the latest study only evaluates outcomes two years after the program finished, many students (particularly participants) are still in some form of schooling or training, understating program effects on income. The higher schooling attainment of participants makes it likely, however, that the program will yield substantial increases in earnings. The success of this pilot program has led to a new, expanded study of the program in five additional cities nationwide. If the results of the earlier study hold up, such a program may provide a tempting avenue for raising the skills of poor adolescents.

The evidence on other selected adolescent programs on schooling, earnings, and crime is mixed. Neither JTPA nor the Summer Training and Education Program (STEP) increase the schooling attainment or earnings of their participants. Both of these programs concentrate on the employment and training of disadvantaged adolescents, though the STEP program also offers academic remediation and courses in life skills. Both programs fail to improve the lifetime prospects of their participants. On the other hand, the Job Corps and QOP have shown that sustained intensive programs for adolescents can raise participants' schooling attainment levels and earnings, as well as reduce their criminal tendencies. While QOP provides mentors, education and development services, and financial incentives for high school students to help them succeed in their normal school environment, the Job Corps provides a comprehensive set of services (vocational training, basic education, health care, etc.) to disadvantaged out-of-school youth in program residential centers. The in-

tensity and long duration of these two programs appear to be important; however, the numerous differences between them make it difficult to identify one or two aspects that are essential for program success. (See Heckman, Lochner, Smith and Taber, 1997).

Early and adolescent intervention programs are designed to remedy the poor learning and social environments in many American families by providing motivation, guidance, and instruction for children and sometimes their parents. Creative and intensive programs targeted at the specific needs of disadvantaged children and adolescents appear to be more successful at improving skill levels among the worst-off than broad-based traditional solutions that focus on improving current schools or on training individuals who have dropped out of school. Earlier interventions are more effective than later ones. A shift in our whole approach to education is necessary. Intervening in the lives of youth appears to be a cost-effective strategy.

4. Tax Policy

The final type of policy we consider is tax policy. Aside from the progressivity of the current tax system, tax rules tend to promote human over physical capital formation (Quigley and Smolensky, 1990). There is some evidence that tax laws are more favorable towards investment by more skilled and wealthier workers, although there are elements in the tax code that favor low-skill workers as well. Tax rules also tend to encourage investments made on the job over investments through formal schooling, especially schooling that requires substantial out-of-pocket or tuition costs. While many of the effects of the current tax system on human capital investment may be unintended, those effects can be

substantial and favor certain workers as well as certain types of investment over others.

In order to understand how taxes influence human capital investment, it is helpful to understand its costs and returns. The costs of investment are foregone earnings net of taxes plus any additional tuition or out-of-pocket expenses. Higher proportional taxes reduce the costs of spending an hour in school by the amount they reduce the return of working an hour in the market.

The simplest case to consider is a regime with flat (proportional) taxes where the only investment cost is foregone income. In this case, changes in the level of the flat wage tax will have no effect on human capital accumulation. Increases in the tax rate reduce the return by the same proportion as they reduce the cost, so there is no change in the incentive to invest. The ratio of marginal returns to marginal costs remains unaffected. Hence, proportional taxes on labor income have no effect on investment in human capital. On the other hand, if there are tuition expenses which are not tax deductible, a higher tax rate discourages investment, because it lowers the returns to investment more than the costs. In the case of a 10% increase in the tax rate, the return to investment falls by 10%, the cost of foregone income declines by 10%, but the tuition cost remains unchanged if tuition cannot be deducted, as it cannot be in the U.S. tax system. Thus, the return declines by more than the costs, so human capital investment is discouraged.

The intuition behind the neutrality of flat labor income taxes on human capital investment arises from the fact that the cost of time inputs to investment are foregone earnings, which are tax deductible. If tax rates are 10% and you earn $10 less, you pay $1 less in taxes–the net loss is only $9. The costs of other inputs to on-the-job training can typically

be expensed by the worker's employer and can be financed through lower wages, thereby making them tax deductible as well. The only major cost of human capital investment that is not tax deductible is college tuition. While this cost is substantial for some, a majority of youth do not attend college, and a majority of those who do attend community colleges or state colleges where tuition costs are modest. Because most of the costs of investment are financed through foregone earnings and are tax deductible, changes in the rate of a flat tax on wages will have little effect on human capital accumulation. (Boskin, 1977 and Heckman 1976 analyze these issues).

However, the current U.S. tax system is not flat. The progressivity in the tax schedule will tend to discourage human capital investment. For some individuals, the gain in earnings resulting from human capital investment causes them to move up tax brackets. In this case, the returns from investment are taxed at a higher rate, but the cost is expensed at a lower rate. This discourages human capital accumulation. Consider a progressive tax system where the only cost of investment is foregone earnings. Suppose an individuals current marginal tax rate is 10%. If he chooses to invest, his increased earnings will cause him to switch to a marginal tax rate of 20%. In this case the returns are taxed at the 20% level, but the costs are deducted at the 10% level, and progressive taxes discourage human capital investment when compared to a flat tax regime.

Taxes on physical capital are another important component of the tax system that can affect human capital investment decisions. The level of human capital investment declines when the after-tax interest rate increases, because the discounted returns to investment are lower. Changing the tax rate on interest income may have a large effect on human

capital accumulation, at least in the short run (Heckman, 1976). However, in the long run, the after-tax interest rate remains unchanged by changes in income taxes, so a revenue-neutral change in the tax rate on interest income may have little effect on human capital investment levels, although it may have large effects on physical capital investment (Davies and Whalley, 1991).

The tax system favors public schooling investment at the primary and secondary level over private schooling and any type of post-secondary schooling. Any student can attend public elementary and high school for free and the costs of those public schools are financed primarily through local and state taxes, which are fully deductible. However both private school and college tuition is not deductible, so the current tax system is biased against college education and private education. Moreover, the level of tuition tends to increase with college quality, so the current tax system discourages students from attending higher quality universities. Since private school tuition is not tax deductible, but local taxes are, communities have incentives to set up good public schools rather than send their children to private schools.

The current tax system favors human capital accumulation on the job versus full-time schooling. Human capital investments can be separated into those undertaken while working (or paid for by the employer) and those taken elsewhere (and paid for by the individual). Current tax laws favor the former over the latter, encouraging individuals to seek training on the job. Virtually all investments made through an employer can be expensed and financed through foregone wages. The employee does not need to itemize deductions to realize this tax benefit.

Educational assistance programs exempt tuition paid for by employers from personal income tax, provided the schooling is job-related. Portable vocational or employer-based training can be sold to employees by firms and paid for by lower wages. The foregone earnings are essentially written-off on personal income taxes. Individuals seeking training are, therefore, encouraged to look to their employer rather than formal schools. In addition, training and schooling expenditures that are not job-related can be immediately written-off by firms up to $5,250 per year for each worker. However, tuition support is restricted to undergraduate level education (U.S. House of Representatives, Joint Committee on Taxation, 1992). Again, this shifts schooling and training to the workplace environment.

Relative to physical capital, some types of human capital investment are favored by the tax system, while others are not. To the extent that many human capital investments are immediately tax-deductible while physical capital investments must be amortized, the current tax system encourages human over physical capital investment. In cases where schooling or training costs cannot be deducted – primarily tuition costs for formal schooling – investment in physical capital is favored. While it is ambiguous as to who current tax provisions benefit most – the most or the least skilled – employer provided training is certainly favored over training undertaken away from the workplace. This asymmetry of tax treatment is often justified by the argument that there is a much larger consumption value of academic education than job-specific training and that this consumption value should be taxed.

Which individuals are encouraged to invest by the current tax system and what types of investment they are encouraged to undertake? Various features of the current tax code

are biased toward more skilled workers with higher earnings. For individuals who are employed, investment costs are typically financed through foregone earnings. To the extent that formal educational expenses are not paid for this way, they can be deducted from gross earnings provided that they are itemized and that itemizations from all sources exceed 2% of adjusted gross income. This feature of the tax code tends to favor high-skill individuals who are more likely to itemize expenses.

Since 1986, individuals have been unable to deduct interest paid on educational loans from their taxable income. The disincentive effects of this exclusion can be substantial. While individuals must pay taxes on interest from savings, they cannot deduct the interest they pay on educational loans. However, mortgage interest is still deductible. It is possible for families with home equity to take out mortgages to finance their children's education, and there is some evidence that post-1986 families have done so. Again, it is the more skilled and wealthy who are most likely to own homes, so they and their children are hurt less by a policy that only allows mortgage interest to be deducted.

Compared to a flat tax scheme that generates the same total revenue, a progressive tax system combined with the non-deductibility of some schooling and training costs also affects the various skill groups differently, encouraging investment by lesser skilled students while discouraging investment by the most skilled. Consider a simple example. Suppose that the tax system were to shift from a flat tax (T_f) to a two-bracket system where individuals in the low income bracket face a lower marginal tax rate ($T_l < T_f$) than before and those in the high income bracket face a higher marginal tax rate ($T_h > T_f$). The least skilled individuals who could never hope to reach the high income bracket would face a lower

marginal tax rate (T_l) throughout their lives. This is like facing a lower flat tax. If some costs of investment are not tax deductible, as is the case for tuition costs in the current tax system, these individuals would be encouraged to invest more than under the previous tax scheme where everyone was taxed at the higher rate.[15]

On the other hand, consider highly skilled individuals who would spend most of their working lives in the upper tax bracket. Because optimal human capital investment leads to rising earnings profiles, these individuals will face higher marginal tax rates later in life than in their early investment years. Consider an individual whose income places him at the point where the higher tax rate begins to apply. When comparing marginal investment costs and returns with those under a flat tax scheme, their costs of investment would be higher by the fraction $T_f - T_l$, and their returns lower by $T_h - T_f$ (assuming full deductibility of investment costs). With higher costs and lower returns, they will choose to invest less. Even without any deductibility of investment costs, a progressive tax schedule is likely to discourage investment in their skills.

While the current tax system is more complicated than this, it is strongly progressive over certain income ranges, and the logic of our simple example applies more broadly. Because most post-schooling investment is tax deductible through foregone earnings while a considerable fraction of schooling costs are not, the largest pro-investment effect of progressive taxes will be seen in the schooling attainment of relatively uneducated individuals. As far as post-school investment is concerned, most costs are deductible, so a progressive tax scheme tends to reduce investment during this phase of the life-cycle for all individuals. For the most skilled, both schooling and post-schooling investment are likely to be reduced

when taxes are progressive. Progressive taxes reduce wage inequality through two distinct channels: directly, through decreasing after-tax earnings more for high-skill persons who tend to earn more and, indirectly, through encouraging investment for the least skilled and discouraging investment for the most skilled.

In their general equilibrium analysis of the effect of tax reforms on human capital accumulation, Heckman, Lochner and Taber (1998b) drawing on their (1998a) model of heterogeneous human capital and endogenous skill formation estimate that a revenue-neutral switch to a flat consumption tax raises physical capital stocks by as much as 20% in the long run, while only raising the stock of skilled (college-educated) human capital by 2%. Switching from a progressive income tax to a flat consumption tax (thereby removing all taxes on physical capital) raises wages for both high school and college graduates. This rise in the return to college causes the fraction of people attending college to increase only slightly - by about .13%. Most of the increase comes from high ability increased enrollment people. Removing taxes on capital income raises the wages of all workers, and only slightly increases overall wage inequality as measured by the college-high school wage differential or as measured by the standard deviation of log wages. Flat tax reform will have a modest, but positive effect on skill formation, raising the wages of all workers by 5-7% but will have only small effects on wage inequality.

5. Conclusion: A Life-Cycle Perspective

The best available evidence suggests that learning begets learning. Early investments make subsequent investments effective. Much of the recent discussion about improving

post-secondary education is misplaced when the value of early schooling is put in context. In the long run, significant improvements in the skill levels of American workers, especially workers not attending college, are unlikely without substantial improvements in primary and secondary education as well as pre-school age investments. We cannot afford to postpone investing in children until they become adults. Learning is a continual process and must begin at a young age, continuing through adulthood. The role of the family is crucial to the formation of learning skills, and government interventions at an early age that mend the harm done by dysfunctional families have proven to be highly effective.

The returns to human capital investments are greatest for the young for two reasons: (a) younger persons have a longer horizon over which to recoup the fruits of their investments and (b) skill begets skill. Skill remediation programs for adults with severe educational disadvantages have negligible effects compared to early intervention programs, as do training programs for more mature displaced workers. The available evidence clearly suggests that adults past a certain age and below a certain skill level achieve poor returns to skill investment. A reallocation of funds from investment in the old and unskilled to the young and more trainable for whom a human capital strategy is more effective is likely to produce more favorable outcomes in the long run.

Current training policies need to be re-considered. Private training programs have two advantages that public training programs do not: they can train workers who are likely to benefit most, and they can tailor their training programs to market needs. While public training programs sometimes yield increases in participant earnings, those increases fall far short of those estimated in private training programs. Tax incentives and subsidies that

encourage private sector on-the-job training should be expanded, while ineffective public sector training programs should be re-evaluated and eliminated. Firms are likely to choose younger and more able workers to train, rather than expending resources on older and more difficult to train workers who will gain little from additional investments.

All levels of government subsidize higher education, and those subsidies benefit both unskilled and skilled workers. There is some evidence that tuition subsidies increase college enrollment rates. Many proponents of college subsidy and loan programs argue that credit constraints prevent students from low-income families from attending college. The evidence on credit constraints is ambiguous, however. Students from low-income families tend to have much lower college attendance rates for reasons other than liquidity constraints. Lower family income levels are associated with less productive family and neighborhood environments as well as lower child motivation and ability, which are not so easily remedied by student loans or fellowships. The available evidence does not suggest that additional loans or subsidies are necessary to alleviate credit constraints.

Public primary and secondary schools are fully subsidized by taxes. The available evidence suggests that additional spending on public school quality would be inefficient. Instead, specialized early intervention programs that attempt to compensate for poorly functioning family environments appear to have large positive impacts on future schooling attainment, earnings, and social behavior. Similarly, mentoring programs for disadvantaged adolescents show cost-effective improvements in high school graduation rates and criminal activity. While effective programs have been small and intense, the magnitude of their effects makes them promising alternatives to the more traditional initiatives such

as additional school spending and public training programs. The long-term effects of the more universal program, Head Start, have not been measured.

The effects of tax policy on human capital should not be neglected but moves to flat consumption taxes are unlikely to have dramatic effects on skill formation or output, although they will have modest postive effects on the wages of all skill levels. Making tuition costs tax deductible would reduce a disincentive to investment for individuals contemplating post-secondary education but Heckman, Lochner and Taber (1998b) find only modest effects of a move to deductibility on skill formation or aggregate investment. The tax code favors persons from wealthier families and more skilled workers over the least skilled and investments on the job over those made off the job. However, the overall effects of taxes on human capital investments are relatively small compared to their effects on physical capital. In an economy with flat taxes, full deductibility of all inputs, and little difference in the complementarity between human and physical capital, and a negligible elasticity of labor supply, human capital investment would be completely unaffected by the tax rate. In that environment, a human capital tax is a modern version of a Henry George tax.

Government policies affect human capital investment in many ways, often affecting different people differently. Policies designed to encourage investment by the majority may turn out to discourage investment by the most disadvantaged. On the other hand, training programs aimed at improving the conditions of the least skilled can be prohibitively costly. In evaluating a human capital investment strategy, it is crucial to consider the entire policy portfolio together – training programs, school-based policies, and tax policy – rather than focusing on one policy in isolation from the others. The interaction among policies makes

such a narrow focus unwise.

We argue for a comprehensive life-cycle perspective in designing policies that promote skill formation. Learning is a dynamic, cumulative process, and early investment stimulates later investment. Early interventions are more effective than later interventions, which are largely ineffective. Dysfunctional families and environments create a legacy of skill and motivational impairment, which can be partly undone by intensive programs administered at an early age.

Firms and families are major producers of skills in the modern economy. Policies that focus on formal education to the exclusion of informal training ignore major sources of skill formation and misdirect policy. Poorly-functioning families retard skill formation, just as distorting taxes on capital reduce wages and skill formation in firms.

Our analysis suggests that more emphasis should be placed on investments in youth, who have many years to reap the benefits of those investments. Programs that intervene early in life can avoid the negative influences a bad family environment can impose on a child. Intensive interventions during adolescence can sometimes rectify damage that has already been done. Even training on the job can be an effective means of producing skills for young adults. However, subsidizing training and additional schooling for mature adults is inefficient, unless there are positive social externalities to human capital or unless credit constraints are prevalent. There is little evidence for either.

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Heckman is Henry Schultz Distinguished Service Professor of Economics, Director of the Center for Social Program Evaluation at the University of Chicago, and Senior Research Fellow at the American Bar Foundation. Klenow is Associate Professor of Economics, Graduate School of Business, University of Chicago, and NBER Faculty Research Fellow. Some of this material is also discussed in Heckman, Lochner, Smith and Todd (1997). We thank Ed Lazear for helpful comments and Wei Jiang for research assistance. This research was funded by grants from the Russell Sage Foundation and NSF 93-21048.

Notes

[1]Like schooling, R&D is already subsidized (through direct funding and through the tax code) in the U.S. and other countries. Proof of the existence of positive externalities to R&D is not proof that it is underfunded.

[2]In 1993, less than 8% of all persons arrested were over age 45, according to the Statistical Abstract (U.S. Bureau of the Census, 1995).

[3]Since these regressions are in levels, we are considering a static externality *a la* Lucas (1988). In contrast, many have proposed dynamic externalities, such as individuals learning from others (and the more human capital others have, the more there is to learn) or gaining from the ideas created in the past by others (e.g. Advanced Micro Devices imitating the microprocessor technologies developed by Intel).

[4]Each year of primary schooling may mean more human capital in South Korea than in the U.S. in light of differences in international test scores. See the evidence in Hanushek and Kim, 1995.

[5]The required externality could be much larger because, for each year of education *induced* by government subsidies, the government may pay for more than one year. The social cost of these inframarginal subsidies depends on the distortions created by government financing.

[6]Mark 5.6, series RGDPCH, or the chain-weight real GDP per capita at 1985 international prices.

[7]The results are quite similar when we restrict out attention to the 25 and over population or the male population.

[8]This corrects for aggregation bias.

[9]This presumes that ability bias is less important in the cross-country regressions than in the within-country regressions, say because average ability is the same across countries. This seems reasonable if ability is genetically determined, but not if it is affected by family upbringing.

[10]Below we note that there are only weak effects of schooling quality on earnings.

[11]Lucas (1988) noted that human capital externalities could explain the desire of workers of all skill levels to migrate to richer countries. But this fact could also be explained by differences in technology that complement labor of all skill types.

[12]To the extent that workers finding employment as a result of job search assistance displace other workers, the private returns of these programs will overstate the net social returns.

[13]Orr, et al. (1995) found no impact of JTPA on AFDC disbursements.

[14]We thank Sam Peltzman for suggesting these calculations in private correspondence.

[15]Remember, however, that if all costs are deductible, their investment would not be affected.

Table 1a

Need-Based & Merit Aid, Costs, Prices, and Subsidies
Average Per FTE Student

	Average Enrollment (FTE)	Costs: Instructional E&G&K	Price: Net Tuition & Fees	Subsidy: Cost-Price	General Aid	Non-Need Aid	Need-Based Aid
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
All Institutions	3,462	10,653	$3,101	7,551	6,063	$357	$1,131
Public	5,128	8,760	$921	7,839	7,099	$415	$326
Private	1,688	12,669	$5,424	7,224	4,960	$480	$1,805

The Distribution of Costs

	Net Price/Cost	Subsidy/Cost	General Cost	Non-Need-/Cost	Need-Based/Cost
	(1)	(2)	(3)	(4)	(5)
All Institutions	29.1%	70.9%	56.9%	3.4%	10.6%
Public Institutions	10.5%	89.5%	81.0%	4.7%	3.7%
Private Institutions	42.8%	57.2%	39.2%	3.8%	14.2%

The Distribution of Subsidies

	General Aid/Subsidy	Non-Need Aid/Subsidy	Need-Based Aid/Subsidy	Non-Need Aid/ Targeted Aid	Need-Base Aid/ Targeted Aid
	(1)	(2)	(3)	(4)	(5)
All Institutions	80.3%	4.7%	15.0%	24.0%	76.0%
Public Institutions	90.6%	5.3%	4.2%	56.0%	44.0%
Private Institutions	68.5%	6.6%	24.9%	21.0%	79.0%

Source: McPherson and Shapiro, Merit Aid: Students, Institutions, and Society, WPEHE, DP-28 (1994).

Table 1b

Costs, Prices, Subsidies, Aid and Enrollment

by Control and Subsidy Decile
1987 and 1994 Academic Years

	Number of Observations	Enrollment		Subsidy		Educational Spending		Net Tuition and Fees		Sticker Price		General Subsidy		Individual Student Aid	
		1987	1994	1987	1994	1987	1994	1987	1994	1987	1994	1987	1994	1987	1994
	N	(1)		(2)		(3)		(4)		(5)		(6)		(7)	
All Institutions															
Public Institutions	2,269	3,274	3,736	8,308	8,002	11,338	11,647	3,030	3,645	4,433	5,749	6,905	5,898	1,403	2,104
Private Institutions	1,197	4,649	5,365	8,143	7,618	9,013	8,768	870	1,149	1,555	2,139	7,458	6,629	685	989
	1,072	1,740	1,917	8,492	8,432	13,933	14,863	5,441	6,431	7,646	9,780	6,287	5,083	2,205	3,348
Public Institutions															
Research	72	20,343	21,074	10,710	10,162	12,719	13,087	2,009	2,925	2,922	4,228	9,797	8,859	913	1,303
Doctoral	54	10,086	11,338	9,386	8,478	11,190	10,913	1,804	2,435	2,553	3,496	8,636	7,417	749	1,061
Comprehensive	254	5,724	6,606	8,776	7,839	9,966	9,581	1,190	1,741	2,003	2,768	7,963	6,812	813	1,027
Liberal Arts	75	1,992	2,507	9,039	7,850	9,926	9,287	887	1,438	1,898	2,688	8,028	6,599	1,011	1,251
Two-Year	722	2,652	3,305	7,222	6,936	7,779	7,555	557	618	1,132	1,524	6,647	6,030	575	906
Specialized	20	1,868	2,040	17,375	17,072	18,818	18,934	1,444	1,862	2,240	3,081	16,579	15,853	796	1,219
Private Institutions															
Research	38	11,068	11,722	17,372	20,190	26,804	31,246	9,431	11,056	12,936	16,047	13,868	15,199	3,505	4,991
Doctoral	40	5,390	5,645	7,152	8,091	16,177	18,308	9,024	10,217	11,100	13,265	5,076	5,043	2,076	3,048
Comprehenive	235	2,096	2,424	6,645	5,734	12,274	12,657	5,829	6,923	7,592	9,788	4,881	2,869	1,763	2,865
Liberal/Arts	505	1,060	1,216	9,449	9,586	14,639	15,635	5,190	6,049	7,758	9,944	6,881	5,692	2,568	3,894
Two-Year	131	652	633	5,966	6,178	9,667	10,731	3,701	4,553	5,425	7,108	4,242	3,623	1,724	2,555
Specialized	123	939	957	8,478	7,723	13,663	14,123	5,185	6,400	6,895	8,865	6,767	5,258	1,711	2,466

Table 2

GDP Per Capita and Schooling Across Countries

Dependent Variable: ln(GDP per capita)

Year	E(s)	Var(s)	Exper.	Life E.	#	$\bar{R}^2$
1990	.338 (.021)				92	.74
1985	.322 (.020)				106	.71
1960	.266 (.024)				92	.58
1990	.315 (.030)	.011 (.010)			92	.74
1985	.264 (.026)	.030 (.009)			106	.74
1960	.310 (.042)	-.019 (.015)			92	.58
1985	.230 (.030)	.029 (.009)	.067 (.018)		97	.80
1960	.257 (.046)	-.009 (.015)	.059 (.024)		92	.61
1985	.106 (.030)	.006 (.008)	.056 (.015)	.068 (.010)	93	.87
1960	.070 (.050)	.002 (.013)	.045 (.021)	.053 (.009)	89	.72

Sources: Summers and Heston (1991) Mark 5.6 for GDP per capita. Barro and Lee (1996) for schooling attainment. Barro and Lee (1993) and U.N. (1994) for experience. Barro and Lee (1993) for life expectancy.

Notes: The dependent variable is RGDPCH, Summers-Heston chain-weight GDP per capita (1985 international prices). Regressors are years of schooling attained by the 15+ population. E(s) is the sum of average primary, secondary, and tertiary years of schooling attained. Regression samples include all countries with necessary data. Standard errors are in parentheses. Var(s) is the variance of schooling attainment across 7 groups (no schooling, some primary, primary, some secondary, secondary, some higher, higher).

Table 3

Estimated Impacts of Federal Job Training Programs on Annual Post-Program Earnings

	JTPA[a]		CETA[b]		MDTA[c]		NSW[d]		GAIN[e]	
	Level	Percent	Level	Percent	Level	Percent	Level	Percent	Level	Percent
Adult Men										
White	$417	4.8%	$431	4%	$942***	6.6%				
Non-white	347	4.5	440	5	1374***	14.2				
Adult Women										
White	482**	9.0	1079***	19	1693***	24				
Non-white	146	3.2	1294***	25	1893***	38.1				
Male Youth							$72	1.1%		
White	-888**	-10.6	-1010							
Non-White	-232	-4.0	-1330							
Female Youth										
White	-81	-1.7	80							
Non-white	-182	-5.0	260							
AFDC Men									$371***	11.7
AFDC Women							460**	11.7	512***	23.2

Notes: All earnings figures are expressed in 1990 dollars.
Estimates for JTPA, NOW, and GAIN are experimental. Estimates for MDTA and CETA are non-experimental.
*Statistically significance at the .10 level, ** at the .05 level, *** at the .01 level (two-tailed test).
[a]Job Training Partnership Act (JTPA) estimates are from Bloom, et al. (1993).
[b]Comprehensive Employment and Training Act (CETA) estimates for adults are from Westat (1981); estimates for youth are from Bassi (1984).
[c]Manpower Development and Training Act (MDTA) estimates are from Ashenfelter (1978).
[d]National Supported Work Demonstration Program (NSW) estimates are from Hollister, et al. (1984) and LaLonde (1995).
[e]GAIN etimates are from Riccio, et al. (1994). Figures from AFDC men are from AFDC-U, which consisted of approx. 91% men, and figures for AFDC women from AFDC-FG, which was approx. 86% women.

Source: Heckman, Lochner, Smith and Taber (1997).

Table 4

Estimated Annual Impacts and Costs for Major U.S. Displaced Worker Programs

Demonstration Project	Net Impact		
	Earnings[a]	UI Benefits[b]	Cost[c]
Texas WAD: Houston	$688	-$302	TierI: $1,837-2,606 TierI/II: $3,750-4,253
El Paso	Men: $969 Women: $1444	-$244 -$286	TierI: $510-883 Tier I/II: $912-1382
New Jersey UI			
Job search assistance	$1,210	-$400	CT: $3,133
Job search assistance/training	$474	-$373	OJT: $2,255
Job search assistance/bonus	$1,279	-$782	
TAA			
Pre-1988	-$228		
Post-1988	$372		

[a]New Jersey estimates are measured for the second quarter after initial UI claim.
[b]Measured over 30 weeks for Texas WAD and over the benefit year for New Jersey.
[c]Cost estimates are per worker who received services.
Note: All figures in the table are in 1990 dollars.
Source: Bloom (1990), Corson, et al. (1989), and Decker and Corson (1995).
Previously published in Heckman, Lochner, Smith and Taber (1997)

Table 5

Rates of return on investments in job training

Data set	Corrected r	Average Tenure Years
PSID, all males	23.5	8
EOPP, young new hires	8.7	3
NLS	16.0	3
NLS (Old NLS)	26.0	4

Source: Mincer (1993)

Table 6a

How Much Do Schooling Attainment Probabilities Rise or Decline when the Minority Distribution of Various Factors are Assigned the Value of the White Mean?

A. High School Completion (High School Graduation and GED Attainment Combined

	Without AFQT Score		With AFQT Score	
	Blacks	*Hispanics*	*Blacks*	*Hispanics*
1. Equating Family Background Only	.054	.047	.038	-.029
Effect of Individual Components:				
Number of Siblings	.013	.033	.005	.013
Highest Grade Completed Father	.008	.029	.002	.019
Highest Grade Completed Mother	.039	.009	.030	-.059
Broken Home	-.001	-.005	.003	-.002
2. Family Income Only	.063	.095	.040	.040
3. Equating Average Wages	.012	.020	.010	.010
4. Equating Tuition and College Proximity	-.002	-.003	-.002	-.002
5. Equating AFQT Scores	na	na	.130	.111
6. Equating 1-2	.101	.125	.072	.015
7. Equating 1-4	.108	.137	.079	.022
8. Equating 1-5	na	na	.159	.122
PREDICTED GAP between Whites-Minorities (Note: The predicted gap is equal to the actual gap computed from the raw data)	.06	.14	.06	.14

Source: Cameron and Heckman (1998).

Table 6b

Change in College Entry Probabilities
(Unconditional on High School Graduation)

	Without AFQT Score		With AFQT Score	
	(1) *Blacks*	(2) *Hispanics*	(3) *Blacks*	(4) *Hispanics*
(1) Equating Family Background Only	.112	.119	.071	.029
Individual Component Effects:				
(1a) Number of Siblings	.038	.046	.016	.013
(1b) Highest Grade of Father	.017	.050	.002	.019
(1c) Highest Grade of Mother	.064	.025	.057	.004
(1d) Broken Home	-.011	-.003	-.005	-.004
(2) Family Income Only	.063	.054	.023	.010
(3) Equating Average Wages	.005	.012	.000	.008
(4) Equating Tuition and College Proximity	-.005	-.019	-.003	-.018
(5) Equating AFQT Scores	na	na	.210	.161
(6) Equating 1-2	.161	.170	.072	.040
(7) Equating 1-4	.161	.168	.095	.032
(8) Equating 1-5	na	na	.289	.175
(9) PREDICTED GAP between Whites and Minorities*	.13	.13	.13	.13

*The predicted gap is computed from the econometric model and equals the actual gap computed from the raw data up to three significant digits.

Note.- Predictions are based on models estimated with the heterogeneity correction discussed in the text. These simulations were calculated by adding a scalar each of the minority covariate distributions so that the mean of the minority and majority distributions would equate. For example, to simulated the effect of equating family income, schooling probabilities were calculated for minorities using the full distribution of the data after adding the difference in mean family income between minorities and whites to the minority family income data.

Table 7: School Quality: Discounted Net Returns to Raising Spending Per Pupil by 10%

	Annual Rate of Return to Earnings			
Education	1%	1.50%	2%	5%
10 yrs	-3422	-2987	-2552	56
12 yrs	-3861	-3366	-2869	106
14 yrs	-4315	-3800	-3285	-196
16 yrs	-4523	-3898	-3273	476

Notes:

(1) All costs and returns are discounted at the annual rate of 7%.

(2) An annual of cost per pupil of $650 was assumed for each year of school. This is 10% of total expenditures, divided by average daily attendance in 1994. (Statistical Abstract of the U. S., 1995)

(3) Returns are based on average wage rates by age within schooling groups through age 65 and were taken from the 1989-91 CPS. 2000 hours worked per year were assumed.

(4) All figures are in 1990 dollars.

(5) We thank Sam Peltzman for suggesting these calculations.

Source: Heckman, Lochner, Smith and Taber (1997).

Table 8A

PRESCHOOL EFFECTS RELATED TO ECONOMIC BENEFITS[a]

OUTCOME VARIABLE	PRESCHOOL	(N)	NO-PRESCHOOL	(N)
Education Effects				
California Achievement Test at Age 9	172.8	(54)	145.5	(55)
California Achievement Test at Age 14	122.2	(49)	94.5	(46)
Classifed Mentally Retarded[b]	15%	(54)	35%	(58)
Graduated from High School	67%	(58)	49%	(63)
Employment Effects				
Employed at Age 19	50%	(58)	32%	(63)
Monthly Earnings at Age 28	$1,129	(54)	$766	(61)
Crime Effects				
Arrested by Age 19	31%	(58)	51%	(63)
5 or More Arrests By Age 28	7%	(58)	35%	(63)
Welfare Effects				
Received Welfare at Age 19	18%	(58)	32%	(63)
Received Welfare at Age 28	59%	(58)	80%	(63)

[a]All group differences statistically significant at .05 level.
[b]At least one year in a classroom for "educably mentally impaired" children.

Table 8B

PRESENT VALUE OF COSTS AND BENEFITS PER CHILD

COST OR BENEFIT	RECIPIENTS OF COSTS AND BENEFITS		
	WHOLE SOCIETY	PRESCHOOL PARTICIPANTS	GENERAL PUBLIC
Preschool Cost[a]	-$12,356	$0	-$12,356
Measured Benefits			
Child Care	738	738	0
K-12 Education	6,872	0	6,872
College[b]	-868	0	-868
Adult	283	0	283
Education	14,498	10,269	4,229
Employment[c]	49,044	0	49,044
Crime	219	-2,193	2,412
Welfare			
Benefit Subtotal	$70,876	$8,814	$61,972
Projected Benefits			
Earnings	15,833	11,215	4,618
Crime	21,337	0	21,337
Welfare	46	-460	506
Total Benefits	$108,002	$19,569	$88,433
Net Present Value	$95,646	$19,569	$76,077

[a]Costs and cost increases appear as negative numbers.
[b]Some small portion of college costs are likely to have been borne by the participants, but these could not be estimated from the available information.
[c]The benefits reported for employment include all costs paid by the employer to hire a participant. Allocation to participants and the general public assume that: a) the marginal tax rate is 25%, b) the value of fringe benefits received by the employee equals 10% of salary, and c) the value of other fringes paid by the employer (e.g., the employer's share of social security) equals 10% of salary.

Table 9: Effects of Early Intervention Programs

Program/Study	Costs*	Program Description	Test Scores	Schooling	Earnings	Pre-Delinquency/Crime
Abecedarian Project**		full-time year round classes for children from infancy through preschool	higher scores at ages 1-4	34% less grade retention by 2nd grade; better reading & math proficiency		
Early Training** (Gray et al., 1982)		part-time classes for children in summer; weekly home visits during school year	higher scores at ages 5-10	16% less grade retention; 21% higher HS grad. rates		
Harlem Study (Palmer, 1983)		individual teacher-child sessions twice-weekly for young males	higher scores at ages 3-5	21% less grade retention		
Houston PCDC**		home visits for parents for 2 yrs; child nursery care 4 days/wk in year 2 (Mexican Americans)	higher scores at age 3			rated less aggressive & hostile by mothers (ages 8-11)
Milwaukee Project** (Garber, 1988)		full-time year-round classes for children through 1st grade; job training for mothers	higher scores at ages 2-10	27% less grade retention		
Mother-Child Home Program (Levenstein, O'Hara, & Madden, 1983)		home visits with mothers and children twice weekly	higher scores at ages 3-4	6% less grade retention		
Perry Preschool Program** (Schweinhart, Barnes, & Weikart, 1993)	$13,400	weekly home visits with parents; intensive, high quality preschool services for 1-2 years	higher scores in all studied years (ages 5-27)	21% less grade retention or special services; 21% higher HS grad. rates	part. earned $453 more per month at age 27	2.3 vs. 4.6 lifetime arrests by age 27; 7% vs. 35% arrested 5 or more times
Rome Head Start (McDonald & Monroe, 1981)	$5,400 (2 yrs)	part-time classes for children; parent involvement		12% less grade retention; 17% higher HS grad. rates		
Syracuse University Family Development (Lally et al., 1988)	$38,100	weekly home visits for family; day care year round	higher scores at ages 3-4			6% vs. 22% had probation files; offenses were less severe
Yale Experiment	$23,300	family support; home visits and day care as needed for 30 months	better language development at 30 months	better school attendance & adjustment; fewer special school services (age 12 1/2)		rated less aggressive & pre-delinquent by teachers & parents (age 12 1/2)

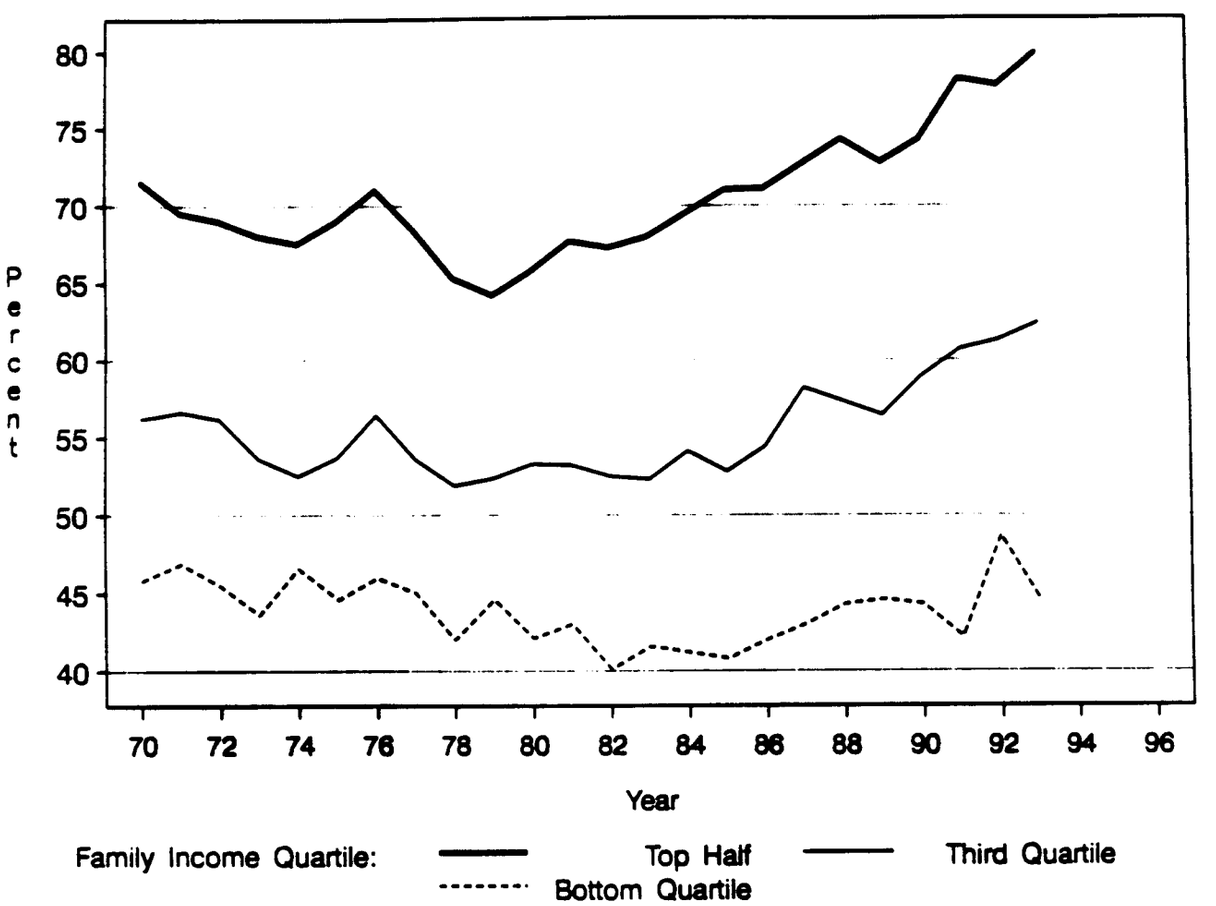
Notes: All comparisons are for program participants vs. non-participants.

* Costs valued in 1990 dollars.

** Studies used a random assignment experimental design to determine program impacts

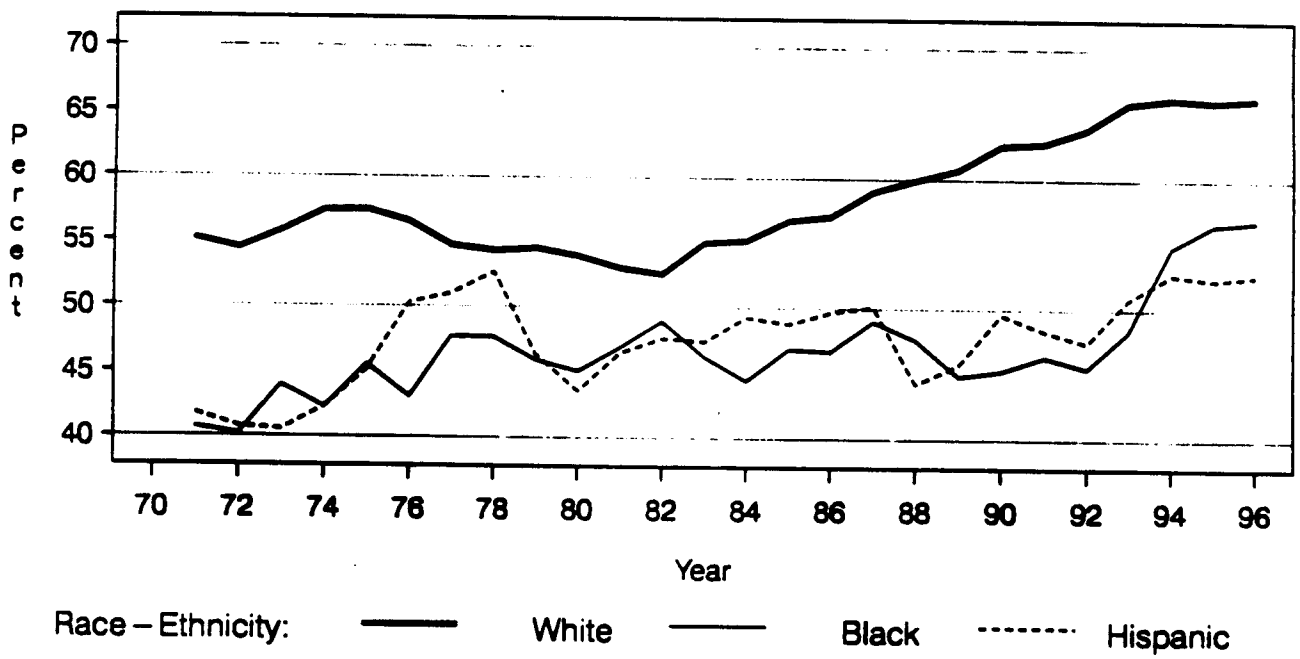
Sources: See Donohue & Siegelman (1996), Schweinhart, Barnes, & Weikart (1993), and Seitz (1990) for the impacts reported here

Figure 1. College Participation by 18 to 24 Year Old High School Graduates and Equivalency Degree Holders



Note.– These numbers were computed from 1971 to 1989 CPS P–20 School Reports and 1990–1993 October CPS data files. Racial–ethnic groups are defined mutually exclusively.

Figure 2. College Entry Proportions of 21 to 24 Year Olds Who Have Graduated High School or Obtained an Equivalency Degree



Notes.— The values represent three-year moving averages of March CPS data (two-year averages for 1971 and 1996). Racial-ethnic groups are defined mutually exclusively.

Source.— Heckman and Cameron (1998).