6 PETER MUENNIG

Consequences in Health Status and Costs

People with more education typically live longer and healthier lives. High school graduates, for example, live about six to nine years longer than high school dropouts.[1] They also are less likely to suffer from illness or disability in a variety of forms. In this chapter I seek to measure these benefits in dollar terms. I focus on the association between educational attainment and (1) reductions in morbidity and mortality and (2) reductions in government spending on health care. I examine these effects using a large, comprehensive health data set, the Medical Expenditure Panel Survey, covering the non-institutionalized civilian population in the United States. On the basis of conservative assumptions, I conclude that each additional high school graduate represents a health-related gain to the government of at least $39,000 in discounted lifetime medical expenditures. Monetized gains in health and longevity amount to an additional $183,000. I also discuss the limitations of this analysis.

Education-related gains in health and longevity have obvious benefits for the people who reap those gains. These benefits can be measured in quality-adjusted life years (QALYs), as I describe later, and monetized by applying

1. Link and Phelan (1995); Wong and others (2002). There is evidence that much of this difference in life expectancy can be attributed to educational attainment itself. Cutler and Lleras-Muney (2006); Groot and van den Brink (2004); Lleras-Muney (2004). It is possible that improving either educational attainment or educational quality leads to improvements in health, but here I focus on educational attainment alone because it is the best-studied outcome.

economists' estimates of the value of a statistical life. In addition, such gains can deliver savings in government health care programs such as Medicaid and Medicare.

Medicaid expenditures are the largest and fastest-growing state expense in an era of state budget shortfalls. Increasing educational attainment could reduce these expenses in two ways. First, because eligibility for Medicaid is based mostly on means-tested formulas, improving educational attainment is likely to reduce the number of people who are eligible for Medicaid.[2] Successful education interventions are thought to be causally associated with improvements in earnings, so education interventions would likely lower Medicaid enrollment regardless of the effect of educational attainment on health.[3]

Second, evidence suggests that improvements in educational attainment directly improve health outcomes.[4] Public-sector expenditures may therefore be further reduced if successful education interventions reduce the total amount of disability and disease among people who graduate from high school but nonetheless qualify for public programs.

This second pathway could also lead to reductions in Medicare spending. Although Medicare is best known as a program for retirees, it also covers low-income persons under the age of 65 who have qualifying disabilities, such as kidney disease.[5] Therefore, to the extent that education reduces the probability of disability, it should reduce Medicare enrollment and thereby further reduce public-sector costs. The financial effect could be significant, because persons with disabilities have per enrollee costs that are threefold those of nondisabled enrollees.[6]

Three countervailing effects, however, may limit the net public-sector savings attributable to increased education. First, people with more education are more likely to seek care than those with less education.[7] Second, less educated people may be more likely to die young, and the dead do not consume health care.[8] Therefore, even if improving educational attainment results in improvements in health, it may not greatly reduce expenditures among those who remain enrolled in Medicaid despite having graduated from high school.

2. Iglehart (1999a).

3. Carniero and Heckman (2003).

4. Groot and van den Brink (2004); Lleras-Muney (2004).

5. Iglehart (1999b).

6. Iglehart (1999b); Keehan and others (2004). See also "A Profile of Medicaid," Centers for Medicare and Medicaid Services, Chartbook 2000.

7. Newhouse and Insurance Experiment Group (1993).

8. Rogot, Sorlie, and Johnson (1992); Sorlie, Backlund, and Keller (1995).

Third, more educated people are more likely to have jobs that offer private health insurance. As a result, they are less likely to fall into the category of the uninsured ill—a group whose care costs upward of $14 billion in tax revenue each year.[9] Employer expenditures on private health insurance plans, however, are tax deductible. In 1999 these deductions reduced federal tax revenues by approximately $76 billion.[10] Therefore, the net effect of increasing private insurance enrollment is to shift the burden of paying health costs from the states (which pay some of the costs associated with caring for the uninsured) to the federal government.

In sum, successful education interventions will almost certainly produce public-sector savings, but considerable uncertainty surrounds their extent. The most conservative approach to estimating the effects of education interventions on public expenditures is to calculate the associated reductions in expenditures on Medicaid, a means-tested program. A more complete estimate would also include potential reductions in Medicare and other public-sector program costs. This approach still omits some savings, such as those associated with reduced spending on the uninsured. But from the government perspective, savings associated with reducing the total number of uninsured persons are probably offset by tax deductions for employers.

Mechanisms through which Education Improves Health

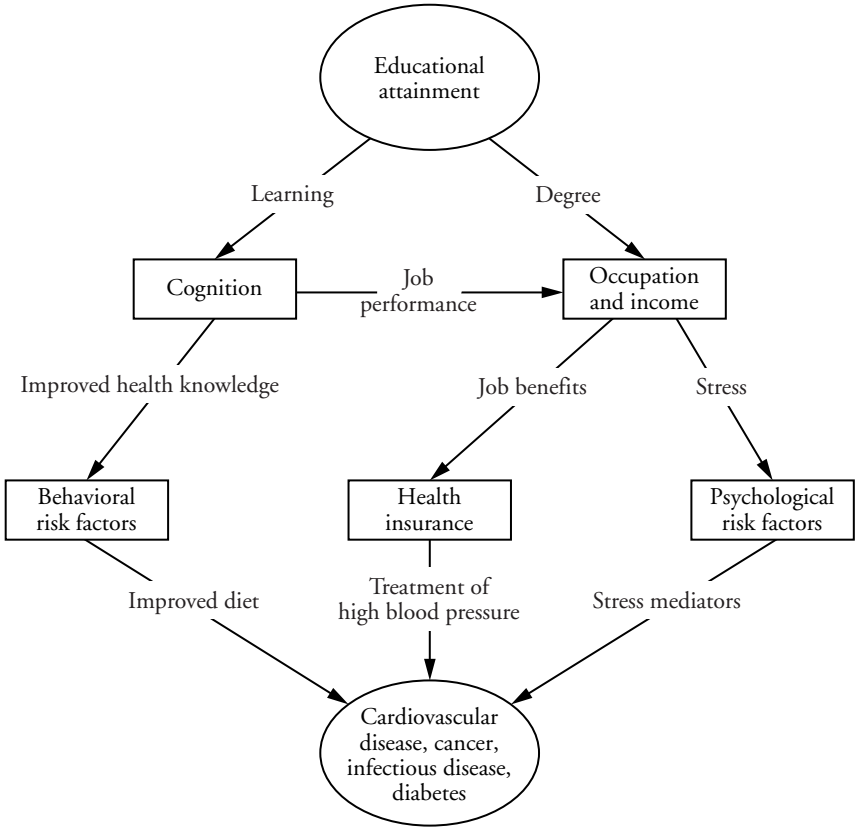
Relative to people with high school diplomas, adults who do not graduate from high school are more likely to die prematurely from cardiovascular disease (35 percent of all deaths among high school dropouts), cancer (27 percent), infection (9 percent), injury (5 percent), lung disease (5 percent), and diabetes (4 percent).[11] The underlying risk factors for all these causes of death except injury are similar, and many are plausibly related to educational attainment. As figure 6-1 shows, cognitive ability, social standing, other psychological or emotional factors, behavioral risk factors, and health insurance form the core putative causal connections between educational attainment and many diseases, including cardiovascular disease, cancer, infection, and diabetes mellitus. Nonetheless, identifying the causal pathways linking education to health

9. Thorpe (2005).

10. Executive Office of the President, "Budget of the United States Government: Analytical Perspectives of the United States: Fiscal 1999."

11. Link and Phelan (1995); Wong and others (2002).

Figure 6-1. Selected Plausible Pathways through which Education Works to Improve Health



is not straightforward. In figure 6-1 I have eliminated many interconnections and examples for the sake of simplicity.

Effects of Improved Income and Occupation

One such pathway may lead from higher educational attainment through higher job quality and income, two factors that may reduce stress and thereby improve health outcomes. This pathway has not always been well understood. Early associations between "Type A" lifestyles and heart disease led to the popular misperception that affluence and education naturally led to stressful

lifestyles.[12] Wealthier, more educated persons certainly have some stress in their lives, but this stress surrounds having "too many things to do." In contrast, those with less education report higher levels of stress associated with "too little money," "health problems," "little leisure time," a large amount of "environmental noise," and "problems with children."[13]

Although the evidence is not definitive, stress conceivably increases the risk of heart disease, infectious disease, diabetes mellitus, and possibly cancer, by profoundly altering the body's biochemical makeup. When faced with a predator, the body releases a cascade of chemicals associated with the "fight or flight" response system. These stress mediators are helpful when one is about to be attacked: they raise blood pressure to perfuse organs, increase blood sugar to give cells energy, and release a host of chemicals that can mitigate damage if the body is injured. When stress becomes chronic, however, these chemical mediators may lead to premature cell aging, DNA damage, blockages in the arteries supplying the heart and brain, and immunosuppression.[14] For instance, certain cells show telltale signs of premature aging: when we compare such cells in the most stressed and least stressed subjects, the gap in biological age may be as great as ten years.[15] Similarly, when subjects are randomly allocated to receive live cold virus or a placebo, those with higher self-rated stress scores are more likely to become ill.[16]

Education may help mitigate the effects of stress by increasing access to social networks and other forms of support. Social networks may reduce loneliness and isolation as well as provide connections that can help people secure shelter or work when they are divorced or fired.[17] Higher levels of social support and lower levels of stress may also help reduce the initiation of risky health behaviors and foster their cessation.[18]

Conversely, social isolation or abuse may undermine both educational attainment and health. Studies on rodents, nonhuman primates, and humans all suggest that the social deprivations associated with poverty contribute to the incidence of adult social pathology and self-destructive behaviors, including those that raise the risk of injury or illness, such as smoking.[19] Depression,

12. Haynes and others (1978).
13. Taylor (2002).
14. McEwen (1998).
15. Epel and others (2004); Irie and others (2001).
16. Cohen and others (2003).
17. Cassel (1976).
18. Ibid.; Ross and Van Willigen (1997).
19. Clarke and Schneider (1997); Clarke and others (1994); Harlow and Suomi (1971); Higley and others (1993); Schneider, Coe, and Lubach (1992); Schneider and others (1999); Schneider and others (2002).

anger, and weak social networks also have strong associations with lower educational attainment and greater vulnerability to disease. These factors all fall under the heading "psychological risk factors" in figure 6-1.[20]

Education may also promote healthy behaviors and health outcomes by improving material living conditions. For example, people with little education are often forced to live in low-income neighborhoods that offer few opportunities for eating healthfully or exercising.[21] Studies based on the random assignment of housing vouchers have shown that the rate of obesity drops among subjects who move from such neighborhoods to more affluent areas.[22] To the extent that higher income removes people from poor neighborhoods, it also reduces their exposure to crime, poor housing conditions, and other environmental hazards, such as proximity to polluting industry. In addition, a better job translates directly into a higher probability of having a safe work environment.[23]

A final consideration is that by increasing income, successful educational interventions are likely to improve subjects' chances of enrollment in health insurance programs. Access to health insurance is widely believed to reduce the risk of premature death from cardiovascular disease (via cholesterol-lowering medications, anti-hypertensive medications, and blood sugar control in diabetics), infectious disease (via prompt treatment of life-threatening illness and the provision of anti-retroviral medications), and cancer (via early detection).[24] This relationship is depicted in the center of figure 6-1.

In short, by improving income and occupation, effective educational interventions may attenuate life stressors, improve social networks, reduce behavioral risk factors, and increase the likelihood of possessing health insurance. Other pathways exist as well. For instance, merely attending school can build self-esteem and promote healthier behavior.[25]

Effects of Greater Cognitive Ability

In addition to improving health by increasing income, education may also exert direct effects on health by improving cognitive ability.[26] People with greater cognitive ability are more likely to engage in healthy behavior (exercis-

20. Cohen and others (2003); Kubzansky and others (2001); Wilkinson (1999); Yan and others (2003).

21. Morland and others (2002).

22. Kling and others (2004).

23. DeNavas-Walt, Proctor, and Lee (2005).

24. Hadley (2003).

25. Link and Phelan (1995).

26. Adler and Ostrove (1999); Baker and others (2002); Barton and others (2003); Gottfredson (2004); Kiecolt-Glaser and others (2002); Mechanic (2002).

ing, for example); comprehend and comply with doctors' instructions (notably regarding medication); have the ability to negotiate complex bureaucracies such as health systems; develop effective coping mechanisms for dealing with stressors; meaningfully participate in health-promoting social activities; and, broadly, make good decisions. For example, better educated people may be better equipped to parse and resist harmful messages from industries that promote unhealthy products, such as cigarettes and junk food. People with more education and greater cognitive ability may also place more weight on the future, although in this case the causality is difficult to sort out because forward-looking persons are more likely to invest in education.[27]

Limits to the Effects of Education

There are limits, however, to what a "successful" education intervention can do for one's health. Often, when researchers speak of successful education interventions, they refer to improvements in schooling (for example, prekindergarten programs) that raise the high school graduation rate of a disadvantaged population. But even the most successful interventions are unlikely to produce new high school graduates who will be as prosperous and healthy as those who would have graduated without additional help. An effective educational intervention will increase the graduate's future income, occupational status, prestige, and access to social networks, all of which generate health.[28] Yet those who are born into relative affluence are not only born with many of these advantages in place but may also be exposed to consistently higher educational quality than can reasonably be realized through most educational interventions.

In addition, people born into relative affluence are also born into relative health. High-income children are less likely to have been exposed to tobacco and alcohol in utero, less likely to be exposed to toxins such as lead, and less likely to be victims of trauma through adolescence.[29] Abuse and toxic exposures not only affect physical health but also adversely affect cognitive development.[30] Finally, environmental stressors set off a harmful cascade of biochemical events related to psychological stress that begins in childhood.[31] For these reasons, disadvantaged children who later achieve economic success as a result of an educational intervention may, to varying degrees, be more likely to

27. Fuchs (2004).
28. Link and Phelan (1995).
29. Chen, Matthews, and Boyce (2002); Wilkinson (1999).
30. Canfield and others (2003); De Bellis and others (1999).
31. Brunner and others (1996).

have poor health and die prematurely in adulthood than others in their newly acquired social class.[32]

It is also important to keep in mind that children who do manage to overcome poor schooling, abuse, and other harsh environmental exposures and nonetheless respond to an educational intervention are either the most intellectually gifted or have been exposed to the least adverse circumstances. In other words, if ten students are exposed to an education intervention and one responds by graduating from high school, that student is probably better positioned to take full advantage of his or her high school diploma than the nine students who failed to respond.

Whereas poor children face many environmental obstacles, wealthy children who are coached, tutored, and pushed toward academic success face the fewest obstacles. Their success may therefore be more determined by genetic factors. Supporting this hypothesis, one twin study found that environmental factors primarily determined the IQs of poor children but genetic factors were the primary determinants of IQ among wealthy children.[33] This might explain why poor children assigned to small classes respond more vigorously to such interventions than nonpoor children.[34] If so, we would expect genetic factors to be less likely to confound the education-health association when measured among children raised in low-income families. Because the vast majority of high school dropouts come from this latter group, one would expect the measured health benefits of induced high school graduation to be less affected by genetic confounding.

Methods

In order to measure the health benefits associated with education interventions that increase the rate of high school graduation, I drew on the 2003 Medical Expenditure Panel Survey (MEPS). This survey, conducted by the Agency for Health Research and Quality, covers a nationally representative sample of more than 40,000 non-institutionalized civilian subjects. The 2003 MEPS oversampled African Americans and Hispanics. In addition to collecting detailed sociodemographic characteristics and medical expenditures, the MEPS contains an instrument capable of producing health-related quality of life scores.

32. Marmot and others (2001); Poulton and others (2002).
33. Turkheimer and others (2003).
34. Finn, Gerber, and Boyd-Zaharias (2005); Robinson (1990).

I used these scores to estimate health gains associated with increases in educational attainment. After I eliminated non-U.S.-born subjects, those younger than 25 and older than 65, subjects who required a proxy to answer questions, and subjects with missing values, 12,229 subjects remained in the analysis.

I used these data to estimate regression models identifying the relationship between educational attainment, on the one hand, and health-related quality of life scores and the probability of enrolling in public or private insurance, on the other. Each model included controls for age, race, ethnicity, and gender. Only nonmodifiable covariates (for example, race) were selected, because virtually all other demographic characteristics vary by educational attainment. For instance, income, employment status, marital status, family size, and most other predictors of insurance enrollment or health status vary by number of years of schooling completed. Because work and marriage often come after the completion of primary and secondary schooling, including these characteristics would artificially alter the effect size. Even effects associated with "fixed" characteristics may vary by educational attainment (for example, the racism experienced by a black professional will be different from that experienced by a black high school dropout).

To account for the fact that effective education interventions increase not only the number of high school graduates but also the number of students who go on to higher education, I built a Markov model that calculates outcomes for four groups: high school dropouts, high school graduates, those with some college, and college graduates.[35] In constructing this model I assumed that two-thirds of high school graduates receive no further education, one-sixth receive some college education, and one-sixth graduate from college. To obtain mortality rates for the four education categories, I multiplied the age-specific mortality rates by an education-specific, age-adjusted risk ratio.[36]

All analyses present data in constant 2005 U.S. dollars. Past public medical costs were inflated at a rate of 8 percent.[37] Future costs were discounted at a rate of 3.5 percent. Sensitivity analyses were conducted on the baseline discount rate, estimates of data error, and assumptions surrounding the effect of education on mortality rates. In addition, sensitivity analyses were conducted on the time before graduation that the intervention was administered.

35. High school dropouts are defined as persons with at least nine and fewer than twelve years of education. People in this group were assigned age-specific mortality rates for persons in the general U.S. population with less than a high school education. Kochanek and others (2004).

36. Backlund, Sorlie, and Johnson (1999).

37. Centers for Medicare and Medicaid Services, "Medicare: A Brief Summary" (cms.hhs.gov/publications/overview-medicare-medicaid/default3.asp [March 4, 2004]).

Reductions in Morbidity and Mortality

In health economics, changes in morbidity and mortality are measured in terms of a single outcome called the "quality-adjusted life year," or QALY. One QALY is a year of life lived in perfect health. The QALY comprises two components, health-related quality of life and years of life. Health-related quality of life is a measure of morbidity that varies from zero to one, with zero equal to a state of death and one equal to perfect health.[38] The health-related quality of life score is used to adjust life expectancy to reflect years of life in perfect health. For instance, a population with an average health-related quality of life of 0.8 and a life expectancy of 80 years would have a quality-adjusted life expectancy of 0.8×80 years = 64 QALYs.

For this analysis, I regressed health-related quality of life scores on relevant covariates and then predicted changes in health-related quality of life, measured in QALYs, by educational attainment. To assign an economic value to these changes, I multiplied them by a commonly used estimate for the dollar value of a statistical life.

Reductions in Government Spending on Health Care

To estimate the relationship between educational attainment and the probability of being enrolled in Medicaid, I used logistic regression. This approach requires two assumptions: first, that education produces an increase in wages, and second, that the magnitude of this increase in wages is similar to that predicted using logistic regression. To the extent that these assumptions hold, regression can be used to predict the percentage change in Medicaid enrollment by years of education completed. I then estimated overall program costs to the federal government and to each state by multiplying enrollment rates by per enrollee costs. The product of the probability of being insured by a public plan and the mean per enrollee cost is referred to as the per capita cost.

I performed a similar analysis for Medicare enrollment, using the assumptions that education reduces the incidence of conditions for which adults become eligible for Medicare and that regression produces a reasonable estimate of the magnitude of the effect of education on those conditions. Evidence from one very small randomized controlled trial and various instrumental variable analyses suggests that regression underestimates the extent to which education produces health, but these studies are far from conclusive.[39]

38. Gold and others (1996).

39. Lleras-Muney (2004); Schweinhart (2004).

Moreover, there is considerable variability in the association between educational attainment and the prevalence of specific diseases or conditions; a small number of conditions have a higher prevalence among the more educated.[40] None of these conditions, however, is related to the types of disability for which most Medicare recipients qualify. Therefore, the assumptions of the model seem reasonably likely to hold.

I obtained per enrollee costs for Medicaid and for all government health insurance programs together from the 2003 MEPS and inflated them to 2005 dollars. Because the MEPS does not capture all public investments, mean per enrollee costs were adjusted to account for costs out of range in MEPS. Foremost, MEPS excludes Medicaid payments to hospitals that serve a disproportionate share of the Medicaid population. These payments totaled $15.5 billion, or 11 percent of total Medicaid program costs, in 2001. Second, the in-range MEPS figures tend to be about 7 percent lower than similar costs from the National Health Accounts.[41] After adjusting for these two factors, the 2005 mean cost for all Medicaid adult (ages 25–64) enrollees was $7,696, and the mean cost for all public-sector users was $11,049.

Results

The health-related quality of life scores used in this study measure mobility, ability to perform usual activities, ability to take care of self, pain or discomfort, and anxiety or depression. By these measures, the health of the average 20-year-old high school dropout is comparable to that of the average 40-year-old college graduate.

Once one takes this difference and differences in life expectancy into account, each additional high school graduate produced by an education intervention is expected to gain a discounted 1.7 years of perfect health over his or her lifetime. This is a very conservative estimate; most models predict that high school graduation will produce six to nine years of additional (non-quality-adjusted) life expectancy.[42] Some, but not all, of the difference between the results of my analysis and those of previous studies is accounted for by discounting. The remainder is due to conservative assumptions surrounding the actual benefits realized by a high school graduate produced by an education intervention. In other words, the real world benefits realized by present-day

40. Cutler and Lleras-Muney (2006).
41. Selden and others (2001).
42. Wong and others (2002).

high school graduates relative to present-day high school dropouts are much greater than the numbers I present here.

Valuing this additional life conservatively at $110,000 per QALY gained measures the benefit of high school graduation at approximately $183,000 per person. The figure of $110,000 per QALY represents one of the lowest estimates in the medical literature and was used to ensure a conservative estimate. Some estimates exceed $350,000 per QALY gained.[43]

In addition, government health care costs drop with each additional high school graduate, because graduates are significantly less likely to be enrolled in Medicaid or Medicare (when considering only enrollees under the age of 65). Approximately 8 percent of high school graduates are enrolled in Medicaid, in comparison with 25 percent of high school dropouts and 1 percent of college graduates, when controlling for age, gender, race, and ethnicity. Similarly, whereas nearly 8 percent of adult high school dropouts are enrolled in Medicare before the age of 65, fewer than 4 percent of adult high school graduates and fewer than 1 percent of adult college graduates are enrolled in this program.

These differences in enrollment rates translate into large differences in annual public costs. The average high school dropout consumes $2,700 in public health insurance costs per year, the average high school graduate, $1,000, and the average college graduate, just $170. Over a lifetime, these annual costs add up. The average high school dropout consumes $59,000 in discounted public health insurance costs by the time he or she reaches age 65. In contrast, the average high school graduate with no further education consumes $23,000 in public health insurance costs over a lifetime, and the average college graduate, less than $4,000, I calculate that each additional high school graduate yields $39,000 of savings in lifetime government health insurance costs.

Finally, while the benefits are partly included in the foregoing numbers, it is informative to understand how insurance coverage varies with respect to educational attainment. Whereas 28 percent of high school dropouts are uninsured, 16 percent of high school graduates go uninsured. Just 6 percent of college graduates go uninsured.

Conclusion

Examining the health-related benefits of effective education interventions, I find that each additional high school graduate will gain 1.7 years of perfect

43. Hirth and others (2000).

health, valued at approximately $183,000. In addition, each new graduate will save the government approximately $39,000 in health care costs.

Certainly, it is unrealistic to expect that most of the 600,000 students who currently fail to graduate from high school in the United States each year can be converted into high school graduates. Nonetheless, it is informative to consider the net present value of the nationwide losses associated with social and school failures leading up to these large numbers of dropouts. Each and every annual cohort of high school dropouts represents a cost of $23 billion in public funds and $110 billion in forfeited health and longevity.

This study has a number of limitations beyond the necessary assumption that education increases income and life expectancy. First, the magnitudes of the effects of education on predicted Medicaid-Medicare enrollment and health-related quality of life were derived using cross-sectional data. This gradient may be artificially reduced or inflated by endogeneity or reverse causality. However, there is substantial evidence that linear regression does a good job of predicting the income increases seen in experimental settings, and fair evidence that it is conservative with respect to predicting mortality by educational attainment.[44]

Second, the overall cost savings are highly dependent on the predicted transition rates from high school to college. Real world progression rates are much higher than the ones I used. However, if an effective education intervention provides an opportunity for students to graduate from high school but almost none goes on to college, the estimated savings will be somewhat smaller than I have calculated.

Third, I generated public health insurance enrollment rates using logistic regression analysis. Although regression has been shown to be very good at predicting income gains associated with additional years of education, it may not be equally successful at capturing the relationship between educational attainment and public health insurance enrollment rates. For instance, additional years of education may improve a person's ability to navigate public bureaucracies, so those who receive an education intervention but remain within means-tested enrollment limits may be more likely to enroll than if they had not received the additional education.

Fourth, although very few model inputs were subject to random error (and those that were had very little), there are a number of important sources of nonrandom error. One-way sensitivity analyses and Monte Carlo simulations, however, produced relatively small effects on overall projected savings.

44. Carniero and Heckman (2003); Lleras-Muney (2004).

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