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Household Production and Health*

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Abstract. This paper highlights the influence of the new home economics in general and Jacob Mincer's work in particular on the field of health economics. I begin by considering the value of time as a determinant of adult health and medical care utilization. I then turn to a similar treatment in the case of children's health and medical care utilization. I conclude with alternative explanations of the positive relationship between years of formal schooling completed and health, a topic that deals with complementary relationships between the two most important components of the stock of human capital.

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I took Jacob Mincer's two-semester labor economics course at Columbia University during the academic year 1965–66. Two of the first items that I read for the course during the first semester were his papers entitled "Labor Force Participation of Married Women: A Study of Labor Supply" (Jacob Mincer, 1962) and "Market Prices, Opportunity Costs, and Income Effects" (Jacob Mincer, 1963). Jacob devoted much of the second semester of the course to material that he eventually would publish in a book entitled *Schooling, Experience, and Earnings* (Jacob Mincer, 1974). The two papers and the book are in my view three of the most important contributions to labor economics in the last half of the 20th century.

Given the identity of the author, it is not surprising that I learned a striking empirical fact from each of the three items that I have just mentioned. From the first, I learned that an increase in the wage rate of married women leads to an increase in their labor-force participation rate, if their husband's income is held constant. From the second, I learned that an increase in the wage rate of married women leads to a reduction in the number of children to which they will give birth, again if their husband's income is held constant. From the third, I learned that higher levels of schooling and on-the-job training are the major cause of higher wage rates.

As opposed to their distinct empirical contributions, the three items share a common theoretical theme: namely, the dichotomy between work and leisure is

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much too simple. This theme highlights that the labor/leisure decision is complicated by the presence of other uses of time. Individuals allocate time to many activities including food preparation, child care, other types of production of goods and services for the home and the family, and the acquisition of knowledge and skills or human capital via formal schooling and on-the-job training. Since "time is money," women with higher wage rates simultaneously allocate more time to work in the market and less time to child care by having fewer children. But since time sacrificed from the market now can raise market productivity in the future, there are powerful incentives to forego current earnings in favor of investments in human capital. Thus, these three papers have a dual message. On the one hand, an increase in the value of time elicits a variety of responses by consumers. On the other hand, increases in the value of time result from human capital investment decisions made by consumers.

In addition to taking Jacob's courses in labor economics, I witnessed much of his collaboration with Gary S. Becker at the now famous Columbia University labor economics workshop during the decade of the 1960s. Although they never published research together, their interaction with each other and with students at the workshop and the publications that emerged from those interactions (especially the three by Jacob mentioned above and Gary S. Becker, 1964, 1965, 1981) resulted in the new home economics.

For three reasons, the new home economics has had profound impacts on the field of health economics. First, time is required to produce health and to obtain medical care. Second, health, like knowledge, is a durable capital stock; and both may be viewed as components of the stock of human capital. With one modification, insights from human capital theory developed by Jacob and others can be applied to this stock. The modification pertains to the nature of the returns. Investments in knowledge raise productivity in the market sector, where money earnings are produced, and may also raise productivity in the nonmarket or household sector, where commodities that enter the utility function are produced (Robert T. Michael, 1973). By contrast, investments in health by reducing morbidity and prolonging life increase the amount of time available to produce money earnings and commodities (Michael Grossman, 1972a,b).

The third impact of the new home economics on health economics is a direct offshoot of Jacob's work on fertility. The finding that women with higher wage rates have fewer children suggests that they may have a smaller number of higher quality children, especially if part of the wage differential is due to schooling (Robert J. Willis, 1973; Becker, 1981). Since children's health is one aspect of their quality, theoretical and empirical work in this area owes much to Jacob's insights on the determinants of optimal family size.

In the remainder of this paper, I highlight the influence of the new home economics in general and Jacob's work in particular on the field of health economics. I begin by considering the value of time as a determinant of adult health and medical care utilization. I then turn to a similar treatment in the case of children's health and medical care utilization. I conclude with a discussion of alternative explanations of the positive relationship between years of formal schooling completed and health.

It is natural to discuss the last topic in a paper of this nature because it deals with complementary relationships between the two most important components of the stock of human capital.

1. The value of time, adult health, and medical care utilization

Jacob Mincer's emphasis on decision making based on the value of time is especially relevant to investments in health because both the benefits and the costs of these investments are positively related to the consumer's wage rate. Benefits rise because these investments reduce morbidity and mortality and thus increase the amount of time available to engage in a variety of productive activities. The greater the monetary value of this expanded amount of time, the greater is the wage rate. Costs rise because the consumer's time is an input into the production of health investments and also may be required to obtain medical care and other market inputs. As long as some of the market goods in the health production function have positive money prices, the marginal monetary return on an investment in health is positively related to the wage rate. Hence, in a pure investment model of the demand for health—one in which health does not enter the utility function directly—the optimal quantity of health is a positive function of the wage rate or value of time (Grossman, 1972a,b, 2000). This prediction becomes ambiguous in a pure consumption model in which health is demanded solely because it enters the utility function. In the latter model the relative price of health would rise with the wage if time costs were relatively more important in the production of health than in the production of other commodities (Grossman, 1972b, 2000).

In both models, higher-wage individuals have incentives to substitute medical care for their own time in the production of a given amount of health. In a pure investment model this substitution in production effect is reinforced by an output effect. In a pure consumption model the output effect may go in the opposite direction. Both models, however, point to the wage rate as an argument in the demand function for health and in the demand function for medical care. Both models also contain the prediction that an increase in the amount of time required to travel to the physician's office or to wait in the office before receiving services will lower the quantity of medical care demanded. Finally, under some circumstances, persons with high wage rates will be less responsive to variations in the money price of medical care than those with lower wage rates since a given percentage change in money price represents a smaller percentage change in the total or "full" price of health or medical care.[1]

Considerable empirical support for the above propositions has accumulated during the past three decades. In my work on the demand for health, I find positive effects of the wage rate on self-rated health and negative effects on work-loss and restricted-activity days due to illness or injury in two micro data sets (Grossman, 1972b, 1975). I also find that an increase in the wage lowers mortality in an analysis of variations in age-adjusted death rates across states of the United States

(Grossman, 1972b). These results control for schooling, family income, and a number of other variables. Adam Wagstaff (1986) replicates them using a survey conducted in Denmark and health indicators based on non-chronic health conditions that reflect physical mobility, mental health, respiratory health, and presence of pain. Manfred Erbsland, Walter Ried, and Volker Ulrich (1995) report a similar finding in a West German survey in which health is measured by degree of handicap, self-rated health status, sick leave, and chronic complaints.

The studies just cited support a pure investment model of the demand for health. On the other hand, Christopher J. Ruhm (2000b) provides evidence in favor of a consumption model. Using a time series of states of the United States for the period from 1972 through 1991, he shows that total mortality and eight of ten sources of fatality are inversely related to state unemployment rates. His interpretation of this procycle behavior of mortality is that the value of time and the relative price of health are negatively related to the unemployment rate. His accompanying analysis of micro data indicates that obesity increases and physical activity declines during business cycle expansions.

Most estimates of the demand for medical care that focus on the value of time do so in data in which travel time to the source of medical care and waiting time at the source are available. These variables either are multiplied by the wage rate or are entered as separate regressors. Jan P. Acton (1975, 1976) shows that travel and waiting time are important rationers of the demand for outpatient medical services in several samples of New York City residents. Thomas R. McCarthy (1985) reports an elasticity of the number of physician visits demanded with respect to in-office waiting time of approximately -1 in a national US sample. Avi Dor, Paul Gertler, and Jacques van der Gaag (1987) and Paul Gertler, Luis Locay, and Warren Sanderson (1987) show that increased travel time discourages demand for medical care services in the Ivory Coast and Peru, respectively. The latter study contains the finding that the money price elasticity of demand for medical care falls in absolute value as income rises, presumably because the indirect or time price component of care represents a larger fraction of the full price of care at higher income levels.

The role of the value of time in the demand for medical care provides an explanation of a somewhat puzzling phenomenon on the supply side of the market: "the availability effect." By this is meant the notion that physicians or dentists can directly influence the demand for their services. Evidence comes from studies showing that an increase in the per capita number of physicians or dentists in an area increases the per capita number of physicians' visits or dentists' visits made by the residents of the area, with income and the money price of a visit held constant. Additional evidence is that the relationship between money price and the number of providers is positive, with demand determinants held constant (see Thomas G. McGuire, 2000 and the references that he cites). Many studies that find a positive provider effect in the demand function fail to control for travel and waiting time. As pointed out above, these variables are demand rationers and are likely to be negatively related to provider availability.

Arthur S. De Vany, Donald R. House, and Thomas R. Saving (1983) show that the positive relationship between money price and provider availability disappears once office-waiting time is held constant in the market for dental services. Waiting time by patients is negatively related to the number of dentists in an area, and a reduction in waiting time is accompanied by an increase in fees. The last effect arises because more inputs are required to increase service capacity. De Vany, House, and Saving's results are consistent with a model in which consumers who value their time highly are willing to tradeoff a reduction in waiting time for an increase in money price and in which dentists make location decisions to accommodate this tradeoff. Curt D. Mueller (1985) provides additional evidence of this tradeoff in the market for physicians' services. In a national sample money price rises and waiting time falls as patient income rises.

2. The value of time, children's health, and medical care utilization

The pure investment model of the demand for health that I constructed using many elements of the new home economics facilitates relatively simple analyses of the determinants of adult health (Grossman, 1972a,b, 2000). Models of the demand for child health derived from the new home economics cannot be characterized in the same manner. One must confront a nonlinear budget constraint due to the nature of the child quality–quantity interaction, uncertainties as to whether the number of children and their quality are substitutes or complements, and the possible simultaneous determination of the number and quality of children and the wife's wage rate (Willis, 1973; Jacob Mincer and Solomon Polachek, 1974; Becker, 1981). For these reasons, especially the last, much of the literature dealing with child health has focused on female schooling levels rather than on female wage rates. While an increase in schooling raises the market wage rate, it may also increase efficiency in the production of child health. Hence, although the new home economics highlights the relevance of mother's schooling, the empirical effects of this variable are subject to more than one interpretation.

Michael Grossman and Robert Kaestner (1997) review many studies that document negative relationships between infant mortality and parents' schooling and positive relationships between various measures of child and adolescent health and parents' schooling. These studies suggest that the effect is causal because they control for genetic endowment in a variety of ways and because they report larger effects for mother's schooling than for father's schooling. The latter finding is important because equal effects would be expected if the schooling variables were simply proxies for unmeasured genetic endowments. On the other hand, if the effect of schooling is primarily environmental, one would expect the impact of mother's schooling to be larger because she was the family member most involved with children's health during the periods in which the studies were conducted.

Hope Corman and Michael Grossman (1985) provide estimates of the quantitative importance of mother's schooling by using cross-sectional regression results to

explain US trends in race-specific neonatal mortality (deaths of infants within the first 27 days of life per thousand live births) mortality between 1964 and 1977. In addition to schooling, they consider poverty; abortion; neonatal intensive care, family planning, and maternal and infant care project availability; and variables pertaining to the Medicaid and WIC programs. The increase in White female schooling makes the largest contribution to the 46 percent decline in White neonatal mortality and the increase in Black female schooling makes the second largest contribution to the 42 percent decline in Black neonatal mortality. Schooling explains 7 percent of the White reduction and 6 percent of the Black reduction.

Ann D. Colle and Michael Grossman (1978), Fred Goldman and Michael Grossman (1978), and Rosanna Coffey (1983) provide direct evidence that the value of mother's time rations physicians services related to infants and children. The first two studies include the time price of a pediatric care physician visit—travel time multiplied by the mother's potential market wage rate—as a regressor in demand functions for these visits. Both find negative coefficients. In addition Goldman and Grossman point out that the time price is a fixed cost since it does not depend on the number of services received per visit. They show that mothers with large fixed costs obtain more services per visit by using more highly trained physicians, as reflected by their specialty, board certification status, age, and other characteristics. Coffey (1983) reports that the time price of care rations demand in the market for prenatal care and family planning services.

Ruhm (2000a) provides empirical evidence that a reduction in the opportunity cost of time allocated to the production of infant health, with little or no change in income, increases the quantity of health demanded. Using aggregate data for nine European countries for almost three decades, he shows that entitlements to parental leave following delivery lower postneonatal mortality (deaths between 28 days and 1 year) and child mortality (deaths between 1 and 5 years of age). Presumably, the presence of a paid leave and an increase in its length lower the relative price of infant and child health because its production is a time-intensive activity.

3. Health and schooling

An extensive review of the literature conducted by Grossman and Kaestner (1997) suggests that years of formal schooling completed is the most important correlate of good health. This finding emerges whether health levels are measured by mortality rates, morbidity rates, self-evaluation of health status, or physiological indicators of health, and whether the units of observation are individuals or groups. In a broad sense, this correlation between health and schooling may be explained in one of three ways. The first argues that there is a causal relationship that runs from increases in schooling to increases in health. The second holds that the direction of causality runs from better health to more schooling. The third argues that no causal relationship is implied by the correlation; instead, differences in one or more "third variables," such

as physical and mental ability and parental characteristics, affect both health and schooling in the same direction.

Causality from schooling to health results when more educated persons are more efficient producers of health. This efficiency effect can take two forms. Productive efficiency pertains to a situation in which the more educated obtain a larger health output from given amounts of endogenous (choice) inputs. This is the effect that I have emphasized in my research. Allocative efficiency, discussed in detail by Donald S. Kenkel (2000), pertains to a situation in which schooling increases information about the true effects of the inputs on health. For example, the more educated may have more knowledge about the harmful effects of cigarette smoking or about what constitutes an appropriate diet. Allocative efficiency will improve health to the extent that it leads to the selection of a better-input mix.

Alternatively, the direction of causality may run from better health to more schooling because healthier students may be more efficient producers of additions to the stock of knowledge (or human capital) via formal schooling. Furthermore, this causal path may have long-lasting effects if past health is an input into current health status. Thus, even for nonstudents, a positive relationship between health and schooling may reflect reverse causality in the absence of controls for past health. Health also may cause schooling because a reduction in mortality increases the number of periods over which the returns from investments in knowledge can be collected.

Kaestner and I (Grossman and Kaestner, 1997) conclude from our extensive review of the literature that schooling does in fact have a causal impact on good health. In drawing this conclusion, we are sensitive to the difficulties of establishing causality in the social sciences where natural experiments rarely can be performed. Our affirmative answer is based on the numerous studies in the United States and developing countries that we have summarized. These studies employ a variety of health measures, many different estimation techniques, and controls for a host of third variables.

In the remainder of this section, I want to address one challenge of the conclusion that the role of schooling is causal: the time preference hypothesis first proposed by Victor R. Fuchs (1982). Fuchs argues that persons who are more future-oriented (who have a high degree of time preference for the future) attend school for longer periods of time and make larger investments in health. Thus, the effect of schooling on health is biased if one fails to control for time preference.

The time preference hypothesis is analogous to the hypothesis that the positive effect of schooling on earnings, explored in detail by Mincer (1974), is biased upward by the omission of ability. In each case a well-established relationship between schooling and an outcome (earnings or health) is challenged because a hard-to-measure variable (ability or time preference) has been omitted. Much ink has been spilled on this issue in the human capital literature. Attempts to include proxies for ability in earnings functions have resulted in very modest reductions in the schooling coefficient (e.g., Zvi Griliches and William M. Mason, 1972; John C. Hause 1972). Proponents of the ability hypothesis have attributed the modest reductions to

measurement error in these proxies (e.g., Arthur S. Goldberger, 1974). More recent efforts have sought instruments that are correlated with schooling but not correlated with ability (e.g., Joshua D. Angrist and Alan B. Krueger, 1991). These efforts have produced the somewhat surprising finding that the schooling coefficient *increases* when the instrumental variables procedure is employed. A cynic might conclude that the way to destroy any empirical regularity is to attribute it to an unmeasured variable, especially if the theory with regard to the relevance of this variable is not well-developed.[2]

Nevertheless, the time preference hypothesis is important because it is related to recent and potentially very rich theoretical models in which preferences are endogenous (Gary S. Becker and Casey B. Mulligan, 1997). Differences in time preference among individuals will not generate differences in investments in human capital unless certain other conditions are met. One condition is that the ability to finance these investments by borrowing is limited, so that they must be funded to some extent by foregoing current consumption. Even if the capital market is perfect, the returns on an investment in schooling depend on hours of work if schooling raises market productivity by a larger percentage than it raises nonmarket productivity. Individuals who are more future-oriented desire relatively more leisure at older ages. Therefore, they work more at younger ages and have a higher discounted marginal benefit on a given investment than persons who are more present-oriented. If health enters the utility function, persons who discount the future less heavily will have higher health levels during most stages of the life cycle. Hence, a positive relationship between schooling and health does not necessarily imply causality.

Since the conditions that generate causal effects of time preference on schooling and health are plausible, attempts to control for time preference in estimating the schooling coefficient in a health outcome equation are valuable. Fuchs (1982) and J. Paul Leigh and Rachna Dhir (1997) find that indexes of time preference have insignificant effects on health status and little impact on schooling coefficients. These results must be regarded as preliminary because they are based on small samples and on exploratory measures of time preference.

Mark C. Berger and J. Paul Leigh (1989) and others employ instrumental variables (IV) to obtain consistent estimates of the causal effect of schooling on health (see Grossman, 2000 for a detailed discussion of these studies). In most cases the IV coefficients are larger than the ordinary least squares coefficients. These results are inconsistent with the time preference hypothesis and consistent with the hypothesis that schooling causes health. This conclusion rests on the assumption that the instruments used to predict schooling are uncorrelated with time preference and other unobserved determinants of health. The validity of this assumption may not be plausible with regard to certain instruments used in these studies such as parents' schooling and parents' income.

Very recent work by Jeremy Arkes (2001), Adriana Lleras-Muney (2002), Scott J. Adams (2002), Jacob N. Arendt (2002), and Janet Currie and Enrico Moretti (forthcoming) address the schooling-health controversy by using compulsory education laws, unemployment rates during a person's teenage years, or college

openings to obtain consistent estimates of the effect of schooling on health. Lleras-Muney (2002) employs compulsory education laws in effect from 1915 to 1939 to obtain consistent estimates of the effect of education on mortality in synthetic cohorts of successive US Censuses of Population for 1960, 1970, and 1980. This instrument is highly unlikely to be correlated with unobserved determinants of health, especially because she controls for state of birth and other state characteristics at age 14. Her ordinary least squares estimates suggest that an additional year of schooling lowers the probability of dying in the next 10 years by 1.3 percentage points. Her IV estimate is much larger: 3.6 percentage points.

Adams (2002) uses the same instrument as Lleras-Muney in the first wave of the Health and Retirement survey, conducted in 1992. He restricts his analysis to individuals between the ages of 51 and 61 and measures health by functional ability and self-rated health. He finds positive and significant effects of education on these positive correlates of good health and larger IV coefficients than the corresponding online library system (OLS) coefficients.

Arendt (2002) capitalizes on compulsory school reform in Denmark in 1958 and 1975 to study the impact of schooling on self-rated health in the 1990 and 1995 waves of the Danish National Work Environment Cohort Study. Respondents were between the ages of 18 and 59 in 1990. His results are similar to those of Adams.

Arkes (2001) focuses on White males aged 47–56 in the 1990 Census of Population. His instrument for schooling is the state unemployment rate during a person's teenage years. With state per capita income held constant, he argues that a higher unemployment rate should lead to greater educational attainment because it reduces the opportunity cost of attending school. From two-stage least squares probit models, he finds that an additional year of formal schooling lowers the probability of having a work-limiting condition by 2.6 percentage points and reduces the probability of requiring personal care by 0.7 percentage points. Both estimates exceed those that emerge from probit models that treat schooling as exogenous.

Currie and Moretti (forthcoming) examine the relationship between maternal education and birthweight among US White women with data from individual birth certificates from the Vital Statistics Natality files for 1970–2000. They use information on college openings between 1940 and 1990 to construct an availability measure of college in a woman's 17th year as an instrument for schooling. They find that the positive effect of maternal schooling on birthweight increases when it is estimated by instrumental variables.

The results of the five very recent studies just reviewed certainly suggest causality from more schooling to better health. The finding that the IV estimates exceed the OLS estimates may arise because the instruments are based on policy interventions that affect the educational choices of persons with low levels of education (David Card, 2001). If different individuals face different health returns to education, IV estimates reflect the marginal rate of return of the group affected by the policies (Joshua D. Angrist, Guido Imbens, and Donald B. Rubin, 1996). Whatever the interpretation of the findings, they do not support the hypothesis that the observed effect of schooling on health is due to time preference.

4. Conclusion

I conclude with an acknowledgment and a plea. My acknowledgment is to Jacob Mincer. His superb skills in research and teaching inspired me to select labor economics as my field of specialization at Columbia University in 1965. When I perhaps disappointed him by changing my specialization to health economics, I was only taking seriously something that he taught me. From my perspective, in 1967 an investment in health economics paid the best interest. As I hope this paper has demonstrated, I did not stray very far from Jacob and his flock because my research and related research in health owes a great debt to the new home economics.

My plea is for the development of comprehensive theoretical models in which the stocks of health and knowledge are determined simultaneously. The rich empirical literature treating interactions between schooling and health underscores the potential payoffs to this undertaking. A model in which both the stock of health and the stock of knowledge (schooling) are endogenous does not necessarily generate causality between the two. Individuals, however, typically stop investing in schooling at relatively young ages but rarely stop investing in health. I have a "hunch" that a dynamic model that takes account of these patterns will generate effects of an endogenously determined schooling variable on health in the health demand function if schooling has a causal impact on productive efficiency or time preference.

Notes

1. For a detailed treatment of the propositions developed in the first two paragraphs of section 2 and some necessary qualifications, see Grossman (2000).
2. See Grossman and Robert Kaestner (1997) for a model in which ability should be omitted from the reduced form earnings function even though it enters the structural production function and has a causal impact on schooling.

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