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Readings in DEVELOPMENT ECONOMICS

EMPIRICAL MICROECONOMICS

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Readings in Development Microeconomics

Volume 2: Empirical Microeconomics

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Introduction

In the past two decades, there has been a flowering of empirical research in development microeconomics. While household- and enterprise-level data have long been available in some developing countries (India, in particular, has been a world leader in the collection of household survey data), data availability has improved dramatically in recent years. Simultaneously, development economists have had access to much cheaper computing power and have contributed to and benefitted from rapid advances in econometric methods. As a consequence, development economists have been able to achieve a tighter integration between the economic theory underlying particular hypotheses and empirical research which tests those hypotheses. There has been a fruitful exchange of methodological tools and economic hypotheses between development economics and the rest of the discipline. Development economists have taken advantage of the broad diversity of economic institutions in poor countries to construct uniquely powerful tests of general economic hypotheses regarding, for example, imperfect information (chapters 5 and 6), household structure (chapters 3 and 4) and the evolution of institutions (chapter 12). Two particularly noteworthy recent trends in empirical development microeconomics, are not included in this volume. The first is work based on field research by development economists, of which there is a relatively small but rapidly growing collection of excellent papers. The second is research using firm-level data, which has received less attention than household survey data from development economists in the recent past. This, too, is changing, and we expect that in a few years a revised version of this collection would contain representatives of both types of research.

In chapter 1, Thomas and Strauss explore one of the key empirical relationships underlying the development process: the reciprocal

connection between wages and health. It is quite clear that richer individuals tend to be more healthy because they are better nourished, live in healthier environments and receive better medical care. Better health is a salutary consequence of economic development. Thomas and Strauss examine the reverse causation, running from better health to greater productivity and thus to higher wages. They use cross-sectional variation in food prices and non-labor income as instrumental variables for endogenous measures of health in wage regressions and find striking evidence that an individual's height, body mass index, and caloric and protein intakes are strongly positively related to wages in urban Brazil. They pay close attention to the important non-linearities in the relationship between these various measures of health and wage outcomes. This paper is one of several in the recent literature which provide strong evidence in support of the hypothesis that nutritional status and health are important determinants of productivity and thus earnings. The evidence, however, is not consistent with the strong requirements of the nutrition efficiency wage hypothesis.

Rosenzweig discusses a broader range of interrelationships between human capital, demographic change and economic development in chapter 2. He shows that there is a good deal of evidence that families respond to increases in the returns to education by reducing fertility and increasing investment in schooling per child. Very simple evidence on this score comes from variation across districts in India in the impact of the green revolution technologies in agriculture. Wages and schooling rose much faster, and fertility declined much faster in districts suitable for the green revolution technology than in districts in which the technology was not introduced. There is also some evidence that unanticipated births (twins) reduce human capital investment in children, suggesting that reductions in the cost of fertility control could be associated with increased human capital investments. Chapters 1 and 2 of this volume go some distance toward providing an empirical basis for theoretical arguments like that of chapter 5 in the first volume.

The next two chapters examine the internal structure of households. Much applied work in economics treats the household as an indivisible unit in which individual incomes are pooled and choices are guided by some sort of household preferences. In chapter 3, Thomas provides a simple test of this assumption. He finds that in Brazil, unearned income controlled by mothers has a much larger

effect on family health than unearned income of the father, contradicting the unitary model. The main caveat is that unearned income is (generally) interest on accumulated labor income and thus might depend on unobserved individual characteristics that affect both labor supply and commodity demand. Thomas also provides a test of the income-pooling hypothesis when unearned income is measured with error; this test turns out to be equivalent to a more general test that the intrahousehold allocation process is Pareto efficient.

Given the accumulating evidence against the assumption that the household can be modeled as an indivisible unit, Chiappori (see reference in chapter) has proposed the "collective" model as a generalization. The collective model makes only the assumption that the intrahousehold negotiating process results in a Pareto efficient allocation. In chapter 16, Udry tests this assumption in the context of households which engage in production. He provides evidence that factors of production are not allocated efficiently across the plots controlled by men and women in the same household in Burkina Faso, contradicting the assumption that household allocations are efficient.

Chapters 5 and 6 examine information imperfections in factor markets. Shaban examines land tenancy contracts in India and finds evidence in support of the Marshallian hypothesis that sharecropping is associated with inefficiently low intensity of cultivation. He shows that individuals cultivate their own land more intensively than they cultivate land that they sharecrop, even after controlling for a rich set of plot characteristics. This paper provides empirical support for some of the information problems which underlie the theoretical models of sharecropping discussed in chapter 2 of volume 1. In chapter 6, Foster and Rosenzweig provide remarkable evidence of moral hazard in rural labor markets in the Philippines. They show that workers engaged in piece rate labor or work on their own farm lose weight more rapidly (conditional on calorie consumption) than workers engaged in work on sharecropped plots or for time rate wages. If accepted, these estimates imply that workers supply less effort when working under contracts which are susceptible to moral hazard. Conversely, it is shown that caloric intake (which is not likely observed by the employer) has a significantly stronger positive effect on piece rate than time rate wages. The main econometric difficulty faced in this procedure is the endogeneity of consumption and labor activities; the instruments include a variety of household

demographic, human capital and asset variables. The paper is not definitive because this identification problem is quite difficult, but the method is innovative and useful and the results strongly suggestive.

The following four chapters investigate different dimensions of financial markets in developing countries. Imperfections in credit and insurance markets are central to much of the theoretical work in development economics (see chapters 1, 2, 3, 4, 5, 6, and 8 in volume 1). The permanent income hypothesis is examined in chapters 7 and 10. In chapter 7, Paxson provides a method that has since been used by a number of authors to examine savings behavior. Fluctuations in rainfall identify an exogenous component of transitory income.[1] This permits the consistent estimation of the marginal propensity to save transitory income. The marginal propensity to save transitory income in Thailand is quite high: households do save to smooth annual fluctuations in income. The PIH, however, is rejected because the marginal propensity to save out of permanent income is found to be larger than zero.

A structural dynamic model of consumption smoothing and investment when insurance is imperfect, asset rental markets absent and borrowing constrained is constructed and estimated in chapter 8. Rosenzweig and Wolpin find that in a subset of the ICRISAT Indian villages, productive assets—in particular, bullocks—are sold when households are subject to adverse weather shocks. The use of a productive asset to smooth consumption is striking evidence of the importance of risk aversion along with binding credit constraints and incomplete insurance markets.

In chapter 9, Townsend tests the audacious hypothesis that there is a Pareto efficient allocation of risk in the ICRISAT India villages. The most striking results he presents are a variety of regressions that indicate that after controlling for average village consumption, household income, crop output and other household level shocks have little or no effect on movements in household consumption. Townsend concludes that a fully Pareto efficient allocation of risk is not achieved in these villages, but that the rejection is weak. The simple model of Pareto efficiency provides a remarkably good approximation to the allocation of risk in these villages. Chapters 8 and 9, therefore, suggest very different models of the financial environment in the same villages. The differing emphasis of the papers may reflect the different impacts of idiosyncratic and aggregate risk on

household behavior; they may as well reflect the different methods of the authors.

Chapter 10 examines the evolution of the distribution of consumption over 14 years within cohorts in (among other countries) Taiwan. Many models of consumption including the PIH imply that the spread of the distribution widens over time, as the accumulation of shocks increases the dispersion of permanent income. Full consumption insurance, on the other hand, implies no such increase in dispersion. Deaton and Paxson find that within-cohort consumption inequality does increase with age, casting further doubt on the applicability of models of full insurance of the long term.

Externalities associated with technological innovation are often viewed as a source of long-run growth (for example, chapter 9 in volume 1). Chapter 11 contributes to the small empirical microeconomic foundation for this literature. Foster and Rosenzweig provide a model of a learning externality associated with the adoption of green revolution technology in India. They suppose that there was uncertainty about how the new technology could best be used, and test the hypothesis that farmers learn from the experiments of other farmers, as well as from their own experience. They provide evidence that the learning externality is not internalized, so that there is under investment in experimentation with the new technology.

Finally, chapter 12 examines the relationship between property rights and investment decisions. It has often been argued that investment behavior is strongly conditioned by property rights, and that insecure rights can inhibit investment in, for example, land improvements. Besley shows that in Ghana there is another dynamic as well. Investment in land improvements (including tree crops and various techniques of fertility maintenance) can increase the security of a cultivator's rights to a plot of land. These conclusions are in accord with the relevant ethnographic literature.

Note

1. This method is the converse of an idea introduced earlier by Wolpin (see reference in chapter). Wolpin uses cross-sectional variation across India in long-run weather patterns as an instrument to identify variation in permanent income.

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1 Health and Wages: Evidence on Men and Women in Urban Brazil

Duncan Thomas and
John Strauss

1 Introduction

An extensive literature demonstrates there are substantial returns in labor markets to investments in human capital, as measured by education. In contrast, comparatively few studies have examined the returns to other dimensions of human capital, such as health, particularly for developing economies. Yet, the link between productivity and health, especially those dimensions related to nutrition, has long played a key role in theories of economic development, through the idea of efficiency wages, and has also taken a central place in the study of economic history.[1] However, until very recently, development economists have typically concluded there is little reliable empirical evidence indicating health has an important impact on labor productivity.[2]

This skeptical view stems, in part, from the paucity of studies on the subject, which reflects the fact that health indicators have seldom been collected in surveys that contain measures of wages or productivity. The skepticism also reflects questions over the proper interpretation of correlations between health and labor outcomes presented in many early studies which paid little or no attention to the direction of causality. Those studies ignored the fact that any component of income, such as wages or labor supply, may affect current behavior which, in turn, affects health, such as consuming a healthier diet, and *vice versa*.

A number of recent studies have begun to grapple with the issue of the potential endogeneity of health status, and a body of evidence is now developing that suggests there are causal relationships between health and labor productivity in low-income countries.[3] These studies have focused on rural populations, mostly male workers, and have

seldom examined more than one or two health measures. But, if knowledge is to be advanced in this area and if it is to be potentially relevant for policy, then it is necessary to be more precise and to identify the types of individuals and activities for which the returns to investments in health are the highest. Furthermore, just as education has different dimensions such as its quantity and quality, so too does health. Which dimensions of health have labor market impacts and for whom? Do investments in health as an adult reap returns, or is it only health investments during childhood that matter? And, does the impact of health vary across the income distribution; in particular, does it especially matter among the poor?

In this chapter, we contribute to the literature in several ways, using a large and very rich cross-sectional household survey conducted in Brazil. Given income, the country's investment levels in human capital are low in Brazil, and a high fraction of people are in poor health. We investigate the impact of four indicators of health on wages of urban workers: these indicators are height, body mass index (weight divided by height squared), *per capita* calorie intake, and *per capita* protein intake. These indicators do not fully capture "health," but they do measure different dimensions of it. For example, height is a cumulative measure reflecting both investments in nutrition during one's life (mostly as a child) and also, possibly, nonhealth human capital investments. Nutrient intakes, in contrast, are inputs into the production function for current health. The effects of the four indicators are examined individually and all together, with body mass index and nutrient intakes being treated as endogenous (or measured with error). Special attention is paid to nonlinearities in the effects of health, guided in our interpretation by the biomedical evidence. Noting that the effects may vary with the nature of the activity, comparisons are drawn between those who work in the market sector and those who are self-employed, treating sectoral choice as endogenous. As a different cut on the same issue, we examine whether returns differ by educational group, which we adopt as a proxy for energy expenditure required for the job. These comparisons also shed light on differences in the returns to health across the income distribution. Finally, contrasts between men and women provide further evidence to support interpretation of the patterns we observe.

Our findings indicate that health, as measured in this paper, yields a substantial return in urban Brazil, at least in the market wage sector.

Among men and women who participate in that sector, all four measures of health significantly affect wages even after accounting for endogeneity. Height has a particularly large impact: taller men and women earn more even after controlling for education and other dimensions of health. Body mass index has a positive effect on the wages of men but not of women. This, along with the fact that the effect of height is larger for men, is likely to reflect, in part, a return to strength. Further corroborating evidence along these lines is suggested by the fact that body mass index has a larger (and usually significant) effect on the wages of those with little education (including women). Nutrient intakes are also important among workers in the market sector. More calories are associated with higher wages, but only at very low intake levels. Conditional on calorie intake, mass, and height, additional protein has the greatest return at high levels of intakes, suggesting there is a return to higher quality diets. The evidence among the self-employed is less clear. Height remains a powerful predictor of wages for men, but not for women, and body mass index affects the wages of only those men who have little or no education. Neither of the nutrient intakes appears to significantly affect wages of the self-employed.

The next section outlines a model of wages and health, which guides the empirical analysis. This is followed by a discussion of measurement issues and then a description of the data sources. The regression results follow in Section 5.

2 Model

In order to draw inferences about the effect of health on labor market outcomes, at least two key issues need to be addressed. The first is measurement: health status is multi-dimensional (Ware, 1987) and difficult to capture in survey data. It is discussed in the next subsection.

The second issue is the direction of causality between measures of health and wages or productivity. While better health may result in a worker being more productive, higher income may be spent on improving one's health. In addition, unobserved factors related to human capital or tastes may affect both current health and productivity. Thus, OLS estimates of the effect of health on wages are likely to be contaminated by both simultaneity and unobserved heterogeneity bias. We first describe a model of health, productivity, and labor force participation, in which all three outcomes are treated as

endogenous. The model is then used to identify the effects of health on productivity and wages.

Begin with an unconditional (reduced form) latent labor supply function, h^*, which depends on a vector of observable exogenous individual characteristics, X_i, a vector of community-level characteristics, X_c, such as prices, local demand and infrastructure, and a productivity-related individual-specific unobservable. An individual will choose to work if a wage offer is greater than the shadow wage, in which case, $h^* > 0$.

To examine the influence of health on productivity, consider a standard ln(wage) function, which is conditional on both health, X_h, and labor force participation, $h^* > 0$:

$$\ln w = \omega(X_i, X_h, \bar{X}_c, \mu_i), \qquad h^* > 0, \tag{1}$$

where $\bar{X}_c$ is a subset of community characteristics X_c.

In an attempt to purge correlations between health, X_h, and unobservables, μ_i, we adopt an instrumental variables estimator.[4] Assuming wages do not depend on labor supply, individual and community characteristics which affect health, but not wages, are valid instruments.[5] Examples might include community-level characteristics such as the disease environment, health infrastructure, and prices of health inputs. Since the measures of health used below are all related to food and nutrition, we use as instruments relative food prices, which vary across regions in Brazil.[6] In a static model of wage determination, wealth or nonlabor income and, possibly, characteristics of other household members may be potential instruments. We use measures of nonlabor income (of the individual and other household members). These nonlabor income and price characteristics also serve to identify selection into the labor force.

Modeling sectoral choice decisions is, in principle, analogous to the participation decision with polychotomous choices, and so sector-specific wage functions might be estimated with the same identification strategy. However, identification of health effects is slightly more difficult for the self-employed than for those working for market wages. Productive, quasi-fixed household assets belong in the net self-employment wages function, as do characteristics of all household members who work in the enterprise. Provided that, conditional on health, the household self-employment production decisions and its consumption decisions can be modeled recursively (Singh, Squire, and Strauss, 1986), health infrastructure and price variables (unre-

lated to the self-employment enterprise) are still legitimate instruments for the self-employment wage function when it is conditioned on health (Pitt and Rosenzweig, 1986).

3 Dimensions of Health, Productivity, and Labor Supply

The next key issue is measurement, which has spawned a large literature of its own. At a conceptual level, it is not clear how to measure health and, more practically, different dimensions of health are likely to have different effects on wages. These effects may also differ depending on the nature of work: a laborer, for example, may suffer a larger decline in income because of physical injury than a more sedentary worker.

Measures of morbidity incidence among adults appear to have fairly small effects on incomes and wages (Pitt and Rosenzweig, 1986; Schultz and Tansel, 1992). Clearly, incidence of ill health is a short-term measure (unless the illness is chronic), and for many bouts of illness, incomes are likely to be little affected in the longer run (say, over a year). Moreover, illness is rather hard to measure in surveys, and most studies have relied on self-reported morbidities, which are prone to both random and systematic reporting error.[7]

Anthropometric measurements, in particular height and weight, have been suggested as less subjective indicators of health status, although they measure different dimensions of health. Height may be directly related to productivity, but it also reflects previous health investments, primarily early in life, and it is possibly correlated with nonhealth human capital investments made during childhood. Long-term increases in heights in the United States and Europe have been related to increases in national incomes and declines in mortality rates (Fogel, 1994). Weight is also potentially related to productivity, at least among those who are very light or very heavy, through such mechanisms as metabolic efficiency and maximum physical capacity. But a light person may also be small, and so not underweight given height (and, conversely, heavy, tall people may not be overweight). Thus nutritionists have found it convenient to analyze weight given height. While different ways of expressing this ratio are possible, one that is often used is the body mass index or BMI.[8] BMI has been shown to be related to maximum physical capacity independent of energy intake (Spurr, 1983; Martorell and Arroyave, 1988). Furthermore, energy can be stored in the body and expended when needed.

Thus, BMI is likely to vary in the short run and may be affected by contemporaneous movements in income or prices. Nevertheless, it is important to note that BMI, as well as height, may partly reflect previous health investments, and these may be correlated with other past human capital investments that directly affect productivity and labor supply.

A third set of health-related factors are nutrient intakes, which are likely to vary over both the short and long run. We will focus on calories and protein. Current intakes of energy may enhance productivity in some jobs, for example by increasing maximum oxygen uptake, which is also related to maximum work capacity. On the other hand, many jobs do not require maximum physical effort, so it is not obvious that energy, or other nutrient intakes, should be correlated with either productivity or labor supply. If, as some claim, the body adapts to changes in energy intakes so that functioning is kept intact, then it is only at extremely low levels of nutrient intakes that productivity or labor supply should suffer;[9] this suggests the relationship between intakes and wages may be very nonlinear.

An important contribution of this study is the simultaneous examination of four different dimensions of health. There are biomedical reasons to expect that these measures will not all affect wages in the same way. For example, current weight or BMI is likely to have a different effect than current calorie intake, even if the body is being drawn upon as a source of energy expenditure. This is because the conversion of body fat into calories may not be an equally efficient source of energy as current calorie intake. Furthermore, conditional on calorie intake, BMI may serve as a source of strength which may be important for some jobs. It is also likely that current calorie intake will operate differently from protein intakes, and these effects may differ across the intake distribution. Furthermore, Foster and Rosenzweig (1992, 1994) point out there may be economic reasons for labor market rewards to vary with health measures in the event that productivity is not costlessly observable, because some health measures are more readily observed (such as BMI) by an employer than others (such as nutrient intakes). To speak to this issue, in part, separate analyses are presented for workers in the market sector and the self-employed.

Whether the four health measures do have different effects on wages is fundamentally an empirical issue; to the extent they do, then examining them in combination permits testing several more

subtle hypotheses. For example, holding calories constant, higher protein diets will be more expensive and thus of higher quality (in terms of not only proteins but also other nutrients); it will thus be possible to assess whether higher-quality diets are rewarded in the labor market. Similarly, holding nutrient intakes constant, the effects of weight and height on wages can be interpreted as reflecting the effect of factors such as strength. Further evidence regarding these issues will be provided by the comparisons below of men and women, as well as comparisons of the effects of health across the education distribution.

4 Data

The data are drawn from a broad-purpose household budget survey, *Estudo Nacional da Despesa Familiar* (ENDEF), collected from August 1974 through August 1975 in Brazil. The survey gathered detailed information from about 53,000 households on incomes, expenditures, and sociodemographic characteristics of household members.

Every respondent (over 14 years of age) reported labor supply and income for the previous year. In addition to annual earnings in each job, the respondent reported the number of hours worked during the previous month and whether or not the person was working in that job for each month of the previous year. An implied wage for each respondent aged 25 to 50 is calculated, assuming the hours reported for the previous month reflect the average for the year. We distinguish wages earned in the market and self-employed sectors because returns to health may differ between the sectors, because wages may not be fully comparable across the sectors, and because labor markets may be segmented.

Self-employment income is notoriously difficult to measure; in ENDEF, the enumerators sought to obtain income net of business expenses. Our measure of self-employment earnings may, however, reflect returns on capital used in that enterprise. It is not entirely clear how to attribute income from family enterprises in which more than one household member is working. Since this is a significant problem in the rural sector, where many households operate farms, we focus only on the urban sector in this paper and use data on 16,169 men and 17,925 women from the South and Northeast of Brazil.[10]

In addition to expenditures on food and nonfood items, the survey gathered very detailed information on quantities of foods purchased