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INVESTMENT IN WOMEN, ECONOMIC DEVELOPMENT, AND IMPROVEMENTS IN HEALTH IN LOW-INCOME COUNTRIES

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ABSTRACT

Rates of return on human capital are inferred by studies of the productivity of workers who differ in their human capital. Although there are many controversial issues on how to control statistically for extraneous factors that might affect the productivity of workers and be associated with their observed human capital investments, the general patterns of private and social returns are widely recognized. The secular growth in investments in education in low-income countries is commonly interpreted as an economically efficient response of poor people and their governments to these high internal rates of return on additional schooling. The rates of return to public and private investments in health are more difficult to assess. Studies suggest a substantial payoff from new technologies that have been developed for high-income societies and then can be distributed at low marginal costs in low-income countries. Both education and health investments, however, are not provided equally to women and to men in many low-income countries, despite evidence suggesting returns are not dissimilar. This asymmetry is particularly evident in South and West Asia and North and subSaharan Africa. This imbalance in human capital investments in women and men is the problem explored in this paper.

Investments in Women, Economic Development, and Improvements in Health in Low Income Countries*

Introduction

The rate of economic development depends on the mix of investments undertaken by a country and its people. Human capital investments are a large and increasing fraction of total investments in most countries (Schultz, 1988b). The rates of return on these investments in people are inferred by studies of the productivity of workers who differ in their human capital. These productive benefits of human capital are discounted back to the time when they were undertaken to assess whether they are worthwhile investments. Comparative studies of worker productivity cannot, in most cases, be based on experimentally induced or randomized variation in human capital investments across a population. There are, consequently, many controversial issues on how to control statistically for extraneous factors that might affect the productivity of workers and also be associated with their human capital investments. With all the limitations that such investigations entail, there are now a large number of studies based on a wide variety of working assumptions that find private and social returns to primary and secondary schooling are relatively high, between 5 and 40 percent, compared to returns on physical capital investments. These private rates of returns to basic schooling are also believed to be higher in low income countries than they are in high income industrially advanced countries (Psacharopoulos and Woodhall,

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1985). The secular increase in investments in education in low income countries is therefore often interpreted as an economically efficient response of poor people and their governments to the competitively attractive returns they can expect to earn on investments in additional schooling.

It is more difficult to estimate rates of return to public and private health investments and related research and development of new health inputs and technologies. The substantial reduction in mortality achieved in the last thirty years strengthens the impression that these health investments have paid off handsomely, at least in the low income countries. But there are few studies that isolate the role of specific programs or policy interventions in bringing about a major improvement in public health and labor productivity based on data representing the entire population. Even in the most dramatic cases of malaria control in the 1940s and 1950s, the origins of these improvements in health are hard to establish with confidence, because broadly based economic advances involving improvements in trade, nutrition, and income occurred at about the same time as the new malaria control measures were implemented.

There are many reasons why the task of evaluating public health programs in low income countries are fraught with uncertainty. Many types of human capital investment, such as prenatal health care, child nutrition supplements, and child health care yield immediate consumption benefits to the family as well as delayed gains in productivity that accrue over the individual's later adult lifetime. As with education, one can conservatively neglect the consumption benefits of health investments, understating their real value, but there still remains the problem of forecasting future gains in productivity and discounting them appropriately. Despite the limitations of our health evaluation methods, evidence is accumulating that advances in health are

responsible for a substantial, if imprecisely measured, part of the unprecedented world economic growth achieved in the period since the Second World War.

A convergence is evident among nations both in years of school investments and in health, proxied by longevity, with the poorer nations closing the relative gap that separates them from the richer industrially advanced nations. This catching up has been widely noted in life expectancy (e.g. United Nations, 1982) and is equally dramatic if age-specific enrollment rates are summed to provide an analogous single measure of expected years of schooling (Schultz, 1987).

Regional Patterns of Investment in Schooling of Women and Men

There are marked differences across countries in the human capital investment that are made in women relative to men. Some of these intercountry differences can be rationalized in terms of the economic constraints applicable to these countries. As will be shown, those countries of the world that are poorest tend to be those in which women receive, on average, the smallest share of these human capital investments. The most important human capital investments are, of course, in the two areas already discussed: schooling and health.

In the industrially advanced high income countries women receive today nearly the same number of years of schooling as do men, and women often report higher enrollment rates than men through secondary school. Latin America and East Asia are quite similar to the developed countries in this regard. At the other extreme are most of the countries of South and West Asia and North and subSaharan Africa in which women receive about half to three fourths the years of schooling as do men. This regional pattern is illustrated in Column 1 of

Table 1 using estimates of years of completed schooling from a recent Census, and in Columns 3 and 4 based on official enrollment rates aggregated across school levels. Although both sources of data on education have their respective shortcomings and probably overstate the real human capital women receive relative to men, the patterns across countries in these two measures are broadly coincident.1/ Enrollment rates are slowly converging between women and men from 1960 to 1980, as development has proceeded. Are the differences in female and male educational investments that remain explained by the diverse economic conditions in these countries?

An analysis of educational systems from 80 countries for the period between 1960 and 1980 sought to account for differences in public expenditures on education and enrollment rates in terms of real incomes per adult, the relative cost of teachers, and the share and urban composition of the school-aged population. More than 90 percent of the intercountry variation in public school expenditures per school aged child and 40 to 70 percent of the variation in primary and secondary school enrollment rates are explained in this fashion. The proportionate increase in enrollment rates for girls associated with a proportionate increase in income is significantly larger than the analogous income elasticity of enrollment for boys. Price elasticities are also larger in absolute value (negative) for female enrollment rates than for male. With economic growth and long run expansion of the educational system that tends to cause the relative price of teachers to decline, educational investments in women appear to increase relative to those in men. But within countries over time this gap between the educational attainment of women and men has narrowed more slowly than would have been expected on the basis of the relationship observed across countries at different levels of development (Schultz, 1987). These findings also suggest that unless special measures are

Table 1
Years of Schooling Completed and Expected Years of Enrollment Ratios by Sex, for Regions from 1960 and 1980: Selected Available Countries

Region (number of countries observed)	Years of Schooling Completed Age 20-24 1960-1980			Expected Years of Enrollment			
	Female to Male Ratio	Male Level in Years		Female to Male Ratio		Male Level in Years	
	(1)	(2)		1960 (3)	1980 (4)	1960 (5)	1980 (6)
1. High income industrially advanced countries (including Japan, Israel, and South Africa)	1.00 (24)	8.9 (24)		.94	1.00	10.8	12.6
2. Latin America	.94 (22)	5.5 (22)		.92	.97	5.6	9.8
3. East Asia (excluding Japan)	.83 (8)	6.4 (8)	Asia (excluding Arab)	.65	.75	7.5	9.4
4. South Asia	.45 (5)	3.8 (5)					
5. West Asia (excluding Israel)	.34 (2)	4.7 (2)	Arab States	.49	.73	5.0	9.0
6. North Africa	.39 (2)	3.5 (2)					
7. SubSaharan Africa (excluding S. Africa)	.44 (7)	3.3 (7)	Africa (excluding Arab)	.56	.73	3.5	7.0
World Total	n.a.	n.a.		.75	.82	7.7	9.8

Source: Columns 1 and 2 derived by averaging of the available sample of country estimates reported in Table A-1 by the author. Columns 3-6 derived from UNESCO estimates of enrollment rates by level, with different regional groupings. 1987 Statistical Yearbook, Table 2.10. See footnote 8 for definition of expected years of enrollment.

adopted, female enrollments may contract by a larger proportion than male enrollments in periods of economic decline, public sector retrenchment, and macroeconomic adjustment as may now be occurring in many countries of Africa and Latin America.

Holding constant for national income, price, and demographic structure the remaining unexplained variation in enrollment rates exhibit a regional clustering summarized in Table 2, but of a somewhat different form than seen in Table 1. Africa is an over achiever, given its low income and high cost of teachers, and these constraints account for the lower female to male enrollments in that continent. Latin America reports lower than expected enrollment rates, but the shortfall in this region is greater for males than for females. In the high income countries, there is a small positive deviation in enrollment rates and they tend to be slightly larger for women than for men at the secondary school level. South and West Asia, however, continue to evidence underinvestment in primary and secondary schools, and the shortfall is significantly larger for females than for males. Consequently, the low levels of income, the high cost of teachers, and demographic composition of the population do not account for the relatively low level of investment in the schooling of women in the South and West Asian and North African regions.

Regional Patterns of Mortality for Males and Females

Life expectancy also favors women relative to men in the same countries where schooling is more equally distributed by gender, as illustrated in Table 3. Biological evidence suggests that women are genetically more viable than men. Given similar consumption opportunities, women experience lower mortality rates at all ages, except perhaps during the childbearing years in countries where women have not been widely enrolled in primary schools. Death

Table 2

Proportional Deviation of Enrollment Rates and Public School Expenditures on Schools from Those Predicted for a Sample of 80 Countries on the Basis of Income, Teacher Prices, Urbanization and Age Composition: 1960-1980

Region (number of year-country-observations)	Primary Enrollments Rates for Female	Primary Enrollments Rates for Male	Primary School Expenditures Per Child	Secondary School Enrollment Rates Female	Secondary School Enrollment Rates Male	Secondary School Expenditures Per Child
	(1)	(2)	(3)	(4)	(5)	(6)
Europe, Oceania and North America	.06 (36)	.06 (36)	-.06 (36)	.03 (21)	.07 (21)	-.06 (21)
Latin America	-.11 (43)	-.16 (43)	-.05 (43)	-.36 (35)	-.50 (35)	-.18 (35)
East Asia	.20 (21)	.11 (21)	.09 (21)	.24 (18)	.17 (18)	.02 (18)
South and West Asia	-.66 (24)	-.28 (24)	-.24 (24)	-.62 (16)	-.07 (16)	- 04 (16)
Africa	.23 (62)	.15 (62)	.14 (62)	.36 (49)	.29 (49)	.16 (49)

Dependent variables are (1) the logarithm of the number of children enrolled in primary schools divided by the number of children age 6 to 11, and (2) the logarithm of the secondary enrollment divided by the number of children age 12 to 17; and the local public expenditures on the school level divided by the children in the respective benefiting age class expressed in real 1970 local currency and converted to 1970 U.S. dollars on the basis of IMF exchange rates prevailing on average for 1969 to 1971. See source for more detail.

Source: T. P. Schultz (1987: Table 13)

Table 3

Life Expectancy at Birth and Infant Mortality, Ratio by Sex and Maternal Mortality, for Regions in 1960 and 1980

	Life Expectancy at Birth				Infant Mortality		Maternal Mortality per
	Female to Male		Male Level		Female to Male	Male Level	100,000 Live Births
	1960-65	1980-85	1960-	1980	ca 1980	ca 1980	ca 1983
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
High Income	1.09	1.11	66.6	68.8	.80	17.4	30
Europe	1.05	1.09	67.0	69.7	(22)[a]	(22)	30
Oceania	1.07	1.06	61.7	64.8			
North America	1.10	1.12	66.9	69.4			
Japan	1.08	1.07	66.5	73.8			
Israel	1.04	1.05	68.1	71.0			
South Africa	1.07	1.05	52.1	60.9			
Latin America	1.06	1.07	54.9	62.1	.83	44.09	270
					(11)	(11)	
East Asia (excluding Japan)	1.06	1.05	51.0	64.5	.79	34.2	187
					(3)	(3)	
South East Asia	1.06	1.06	43.2	53.5			
Other East Asia (e.g. Hong Kong, Korea)	1.07	1.06	54.2	63.4			
China	1.06	1.04	53.4	68.5			
South Asia	.97	.98	43.3	50.7			
(middle)					.82	51.0	618
					(4)	(4)	
West Asia	1.05	1.06	48.2	58.2			
Africa	1.07	1.06	40.6	49.3	-	-	
North Africa	1.05	1.05	45.5	54.7	.98	58.1	500
					(2)	(2)	
SubSaharan Africa (excluding S. Africa)	1.08	1.07	39.1	47.7	.81	86.4	676
					(4)	(4)	
World	1.05	1.04	50.9	57.9	-	-	-

[a]Number of countries averaged in parentheses: Not necessarily representative of region because of data limitations.

Sources: First four columns weighted by populations. Estimates from United Nations, Demographic Indicators of Countries, New York, 1982; Columns 5 and 6 are unweighted averages of countries reporting in 1983 UN Demographic Yearbook, Table 16; Col. 7 are estimates weighted by population of regions from Ross, et al., 1988, Table 34. For country level estimates that are probably more reliable for Africa and Asia, see Appendix Table B.

due to bearing a child is twenty fold higher in South and West Asia and North and subSaharan Africa than in the developed countries, and women in these low income regions also bear twice as many children as do their high income counterparts (Table 2, col. 5). Nonetheless, infant and childhood mortality is quantitatively a larger factor in the low life expectancy of females in these regions. Estimates of differences in mortality by sex for children are, however, scarce and often unreliable; Table 2 illustratively averages official figures reported by the 1983 UN Demographic Yearbook to suggest regional patterns. Greater confidence can perhaps be placed on the infant and childhood mortality estimates derived from the recent World Fertility Surveys (Rutstein, 1983; Hobcraft, et al., 1985). Only two out of 29 surveys, those for Jordan and Syria, revealed greater female than male infant mortality, while three reported higher female than male child mortality between the ages of 2 and 5--Bangladesh, Pakistan, and Egypt. All of these countries fall in the South and West Asian or North African region.

More detailed analyses of mortality trends by sex (United Nations, 1982) confirm, as with education, that the prospects for survival are improving more rapidly for women than for men in most regions of the world. The world appears to be converging toward the sex differences in mortality observed in the industrially advanced countries, but the pace of progress differs markedly by regions. Women's education remains the best predictor of the level and sex differences in mortality; female enrollment rates are used by a recent World Bank study to forecast how national mortality schedules are likely to evolve in the next fifty years (Zachariah and Vu, 1988: xv). Until life expectancy at birth for women exceeds 60 years, the rate of increase in longevity is significantly greater in countries where more than 70 percent of girls are enrolled in primary school (as of 1965-69). In sum, women are especially poor

relative to men in their acquired capabilities, such as schooling, in the world's poorest countries, and their relative neglect is also reflected in their shorter lives. Equity calls for increasing the productive capabilities and consumption opportunities of women in these poorest countries. Are there also efficiency gains for a society that might motivate public interventions to equalize investments in women and men?

Consequences of Human Capital Investment on Economic Development

Narrow considerations of efficiency would justify investing in each family member's food, consumption, health, and long term skill formation, such as education, only so long as these investments repay the opportunity costs of capital to parents. Differences in private rates of return to individuals from investing in their human capital might help to explain why differences in the levels of investment in women and men are substantial across countries. If the allocation of an additional year's time to investment in human capital, such as schooling, raises subsequent lifetime average wage opportunities by a certain percent, then that percentage wage gain approximates the private rate of return to schooling (Becker, 1964; Mincer, 1974). Although the wage of the more educated woman may be lower than that of a comparably educated man, the opportunity cost of the time that the woman sacrifices to attend school rather than work is also less than a man. It is not the absolute level of wages, therefore, that signals the private efficiency returns to human capital investment, but the <u>relative</u> wage differences across groups with a different number of years of time invested in the acquisition of human capital.

Table 4 summarizes this proportionate wage shift associated with a year of completed schooling among workers in several Latin American countries. These separate estimates of the private returns to schooling for men and for

Estimates of the Private Rate of Returns to Years of Schooling from Logarithmic Wage Equations in Various Latin American Countries Without Selection Correction

Metropolitan or Urban Areas	Age 10-24		Age 25-44		Age 45+	
	Men	Women	Men	Women	Men	Women
Argentina, Buenos Aires 1980[a] (similar in 1976)						
Private return	.054	.12	.093	.066	.10	.11
t ratio	(3.82)	(6.14)	(8.21)	(4.91)	(6.6)	(3.85)
Sample size	112	72	209	99	88	21
Bolivia, LaPaz, 1980 (similar to 1976)						
Private return	.12	.17	.098	.11	.096	.067
t ratio	(7.51)	(10.1)	(13.9)	(9.46)	(11.9)	(3.91)
Sample size	225	107	541	211	235	66
Brazil, Sao Paulo, 1971 (higher in 1980)						
Private return	.041	.043	.054	.063	.060	.061
t ratio	(15.4)	(12.7)	(30.5)	(22.2)	(16.7)	(9.13)
Sample size	691	484	1276	518	533	169
Colombia, 1973 (lower in 1980)						
Private return	.19	.20	.18	.18	.16	.14
t ratio	(36.6)	(32.3)	(58.6)	(30.2)	(21.1)	(9.24)
Sample size	2405	1148	3478	1113	1171	225
Paraguay, Asuncion, 1979 (nearly the same in 1977)						
Private return	.12	.12	.11	.08	.10	.11
t ratio	(16.4)	(7.18)	(22.1)	(8.13)	(11.7)	(6.20)
Sample size	767	288	934	491	433	128
Peru, 1974						
Private return	.16	.15	.14	.14	.11	.19
t ratio	(17.0)	(6.6)	(27.7)	(14.9)	(13.6)	(7.0)
Sample size	841	318	1722	318	619	95

[a]Age groups in Argentina are 25-49 and over 49.

Sources: ECIEL (1980, 1982).

women are based on a common conceptual and statistical methodology and take account of variation in labor supply, but make no adjustment for the possibly unrepresentative character of the sample of wage earners (Schultz 1980). Similar evidence could be reported based on slightly different statistical methodologies from urban India, China, Taiwan, South Korea, Thailand, etc. It is evident that because the samples are often small, the estimates of the returns to schooling are sometimes imprecise, as in Table 4. Overall, however, there is no clear evidence that private returns to schooling systematically differ by sex, though they differ considerably in overall level across countries and years, depending on macro economic conditions in the country and the levels of past investments in schooling (Schultz, 1988b).

Relatively few studies have thus far sought to correct for the potentially unrepresentative nature of the samples of wage earners that are generally analyzed to understand the sources of individual productivity gains. Education could be more (or less) productive in wage employment than it is in self-employment or family work. Farm profits, after payment for the market value of all farm inputs including family labor, tend to be positively associated with the farmer's level of education. This was originally documented in several studies of U.S. farmers and then replicated in a variety of low income countries (Jamison and Lau, 1982). The private rates of return to schooling among farmers estimated in these studies are comparable to the estimated private returns to schooling among wage earners. But these comparisons may also include a sample selection bias. First, more educated individuals are more likely to leave farming for an urban job than the less educated rural resident. The remaining sample of farmers that have not left agriculture, as well as the sample of largely urban wage earners are both not precisely representative of the entire cohort of persons who could have

benefited from various amounts of schooling. A few studies have attempted to isolate the bias from rural out-migration and they conclude that private returns to rural schooling are downward biased unless the returns to schooling collected by leaving agriculture are included in the rural born cohort's lifetime income gains (Schultz, 1988b). The second more intractable problem with studies of farmer education and productivity is that the labor productivity of male and female family farm workers are not separately estimated. Consequently, the increased profits collected by the more educated farmer are attributed to his (or her) management ability, and the enhanced productivity of the spouse's or unpaid family worker's labor, which is also probably better educated, is not distinguished or deducted. Separate calculations of the returns to education for men and women in farming are occasionally available, as for example in Africa, when men and women manage different plots or crops (Moock, 1976).

A few recent studies have used appropriate statistical methods to correct for the sample selection bias that might arise because the productive effects of schooling are commonly estimated from an analysis of only wage earners. The tentative findings from these investigations of Thailand, Peru, and Colombia are that the uncorrected private returns to primary schooling inferred from wage earners underestimate the returns received by the representative individual in these low income countries. But at the level of college or university education, the private returns to schooling estimated from wage earners may overstate the returns for the representative individual.2/ Refinements in the construction of the wage comparisons between education groups can thus modify the measured private returns to schooling, but these alternative estimation methods have not tended to change systematically the pattern of approximate equality in private returns to schooling to men and women working in the same labor market.

Consequently, there is no statistical basis from many studies of wage earners or farmers to conclude that the efficiency returns to the private individual are lower from educating girls than boys. Moreover, there are several reasons for the social benefits that spill over beyond the individual from educating women to exceed those that are generated from educating men. To the extent that taxation on earnings recoups some of the public outlays on education, the differential labor supply response of women and men should reduce the net social costs of providing education to women and increase it for educating men. This occurs because women tend to work more hours in taxable work as their human capital increases in virtually all populations where labor supply behavior of women has been studied, whereas women and men tend to work fewer hours in taxable activities as the human capital of men increases. The net public cost of extending schooling to women is thus defrayed by the labor supply response of women, and the tax base is eroded and the social costs of schooling increased when men receive more schooling.

Beyond the private productivity return to schooling and the taxes the more productive worker pays, education can have additional consequences on other societal goals that are traditionally subsidized by the public sector. The human capital of parents has distinctive effects on their lifetime fertility, and the health, nutrition, and schooling of their children. Moreover, these linkages tend to be more positive for the mother's education than for the father's education, as discussed below. These social external benefits of women's schooling strengthen the efficiency argument for subsidizing more heavily women's schooling than men's.

Available data thus indicate that private returns earned by investing family resources in schooling are as large for sending girls to school as they are for boys. But the evidence from many countries of Asia and Africa suggests

that families are not as willing to sacrifice their resources to provide girls and boys with the same number of years of schooling. To infer why parents value the housework of their daughters more highly than they do the returns from educating their daughters, we need more studies of the general determinants of resource allocations within the family. Why do particular forms of consumption and human capital investments differ for boys and girls? Perhaps family arrangements in some cultures assign the gains from the increased productivity of women only to the family of the woman's husband. It is not clear why the woman's parents are not sufficiently compensated for their daughters' education, but some form of economic "market failure" must be present and warrants corrective measures. If private markets fail to induce individuals to invest socially optimal amounts in the education of certain groups, society is justified on efficiency grounds in subsidizing the schooling of such groups. Women would appear to be such a group in many countries.

The most frequently encountered explanation for the lower level of human capital investment in women than in men is that women participate less in the labor force, on average, and therefore the returns they receive when they work in the labor force should be deflated by the probability that they will assume a job in market labor force (Becker, 1964). Although women in high income countries are rapidly catching up to men in their labor force participation rates (Layard and Mincer, 1985), the differences between the sexes in many low income countries remain substantial. But this interpretation of the market returns to schooling implies that the productivity of people working outside of the labor force is not affected by their education. This assumption has recently been challenged by a large number of empirical studies that find education increases the productivity of a worker's time in many nonmarket production processes, particularly those performed by women in the home

(Michael, 1982; Haveman and Wolfe, 1984). The practical problem is that there is no metric available to sum up these gains in home productivity.

Productivity in the Market and Home

Because of the difficulty of measuring and valuing nonmarket production, economists have tended to focus on the marketable component of income of families and individuals. In principle, the market value of home produced and consumed goods, such as the production and preparation of food, fuel, the fetching of water, and maintenance of housing, for which there are sometimes market priced equivalents, should be included in personal and national income. But in practice the complexity of imputations leads to their omission, with no attention to untradeable home production activities such as child rearing. All of these forms of home production have become neglected because they are relatively unimportant in high income countries where economic accounting conventions tend to be first elaborated and refined. But when this omission is replicated in low income countries, a more serious distortion is introduced that systematically affects one's perception of women's contribution to the economy and transforms the entire quantitative record of modern economic growth. By omitting these nonmarket components of personal income, economists understate sources of income that are larger for poor families, and within families these conventions understate women's economic contribution relative to men's (Kusnic and DaVanzo 1980; Evenson, 1983). National income appears to grow more rapidly than it should as women allocate progressively more of their time to the market labor force, and no offsetting deduction to national income is made for the time women retract from nonmarket production that would otherwise benefit their families.

Technical change is fostered if it boosts the productivity of workers in the labor force but may be overlooked if it promises only to raise the productivity of workers engaged in undocumented home production. Public health measures are evaluated with little attention to the critical input of women's time in health care, as though the opportunity value of women's time is insignificant in comparisons to public sector resources and health inputs privately purchased in the market. It is widely suspected that public investments in agricultural research and development were originally biased toward export crops in many low income countries because commercial interests are concentrated in these crops and governments view them as a convenient source of tax revenue. Yet these export crops are often managed by males while the family food staples are more often produced by female agricultural workers, particularly in Africa. The gains from technical change in agriculture have thus been shifted toward market workers relative to nonmarket workers or, correspondingly, toward men relative to women (Boserup 1965, 1970; Judd et al. 1986; Evenson 1987). This intellectual oversight and resulting distortion in policy will only be corrected when the quantitative importance of nonmarket and in-kind income is estimated and its bearing on public sector priorities explicitly evaluated. In the area of disease control, morbidity reduction, extension of life, and fertility, the importance of women as productive and innovative agents is insufficiently emphasized (Binswanger et al. 1980; Evenson 1983).

Child Health and Mortality

The distinctive role of women in managing consumption of and investment in children within the family is a major reason for social intervention to increase specifically her capabilities and control over resources. Improving

the productivity of women through human capital investments is a social objective to accelerate economic development, but also to channel that development and new streams of income toward socially desired investments in the food, medical care, and schooling of children. A third set of consequences is associated with raising women's productivity; it involves the reduction of child mortality and the parallel reduction in fertility. Together these two demographic developments constitute the demographic transition that eventually diminishes the rate of population growth and increases the proportion of the population in the more productive labor force ages. Quantitative confirmation of these linkages, however, requires much study and replication at the household level to establish sound generalizations from country-specific empirical regularities. These studies will also help to identify the special features in many societies that modify the magnitudes of these behavioral tendencies.

Studies in the 1970s and 1980s in demography, economics, anthropology, and sociology came to a common conclusion; there was a strong, probably causal, relationship between mother's schooling and decreases in the incidence of mortality among her children. These patterns are widely replicated in dozens of surveys from countries in every region of the world. An added year of mother's education is associated with a 5 to 10 percent reduction in child mortality. Although the level of mortality tends to be higher in rural than in urban populations of low income countries, the proportionate reduction in child mortality associated with an additional year of mother's schooling is of a similar magnitude in both urban and rural areas of the same country (Cochrane, et al., 1980). On the other hand, the smaller impact of father's schooling on his children's mortality is greatly attenuated in rural populations (Mensch, et al., 1986). Studies in Latin America also found that child mortality

differentials associated with maternal education were smaller in Costa Rica and Cuba, and it was hypothesized that the strong public health programs in these two countries had helped even the least educated mothers obtain effective health care for their children (Behm, 1980). This and other economic hypotheses for the differences in the relative magnitude of the mother's schooling effects on child health and mortality have been analyzed with data from Colombia and Philippines (Schultz, 1980a, 1984; Barrera, 1988). It has been observed in several studies that public health outreach programs have their greatest benefit for the children of the least educated mothers. In economic terms, the management and innovational skills that an educated mother brings to the health cafe of her family appear to be economic "substitutes" for the preventive health care and extension activities provided by the local health system. Consequently, health outreach activities have their largest payoff among the least educated portions of the population.

Is education simply associated with having more resources to spend on health inputs or does education provide a mother with the capacity to cope more efficiently with health risks and better manage her child's environment? In Colombia and Brazil it appears that controlling for household income or husband's education or the marital status of the mother does not eliminate or even greatly reduce the independent partial explanatory role of the mother's education on her children's survival rate (Schultz 1980a; Thomas et al., 1987). Other studies confirmed that it was possible to control for a comprehensive series of life cycle events and current socioeconomic status variables in a regression equation explaining child mortality rates and still find a strong effect of maternal education (Farah and Preston 1982).

Demographers were initially confident in the capacity of biomedical and public health technologies to control infectious and parasitic diseases in low

income countries, irrespective of the country's comprehensive socioeconomic development (Stolnitz, 1975). A major factor in reassessing this conclusion is the quantitative evidence that maternal education is a more important determinant of cross sectional variation in child mortality than access to low cost health services and modern biomedical technologies. Another factor in this reassessment has been the growing evidence that the rate of decline in mortality in low income countries has slowed down since 1970, while it may have recently accelerated in high income countries (United Nations, 1982). One conclusion is clear, however, that unless the complex roles of mother's education in family health are better understood and properly controlled, evaluation of the cost-effectiveness of a multitude of other health oriented programs will be extremely imprecise and possibly misleading. One area in which family behavior relevant to child health is strongly affected by the human capital capabilities of women and men is fertility.

Fertility--Changing Reproductive Goals and Reducing Unwanted Births

In most societies the level of fertility responds sensitively to women's wage rates. Higher wages for women, that are associated with their human capital, increase their income but also increase what they must give up for them to bear and rear an additional child. The latter price effect invariably outweighs the former income effect, and the statistical tendency is for fertility to decline as women's market wage opportunities rise. Increases in the labor productivity and wage rates of men, on the other hand, can enhance the attractiveness of a large family and are often associated with higher levels of fertility, at least in low income agricultural countries (Schultz, 1981).

Because most children work as unpaid family workers, it is difficult to observe in the labor market the productive value of the time of children. But where regional wage rates for children are observed to vary, they are positively related to fertility, as in Egypt, where irrigation opportunities determine what crops are grown and these crops use different amounts of child labor (Levy, 1985). Nonearned income from land and physical wealth is also generally associated with larger families, because these sources of income are not necessarily related to what it costs to have another child. Nonearned income, therefore, permits parents to have more children, if other things are equal, and empirically we generally observe this pattern, holding constant for the separate education or wage opportunities of the mother and the father (Mueller, 1984). But nonearned income also may be dependent on past savings and work behavior of the parents that could increase the opportunity cost of children and mask in nonagricultural societies the expected positive relationship between exogenous sources of nonhuman capital and fertility.

As noted above, major credit for reducing infant and child mortality in low income countries was initially given to the international transfer of modern public health technologies, such as vaccines, antibiotics, and pesticides, along with institutions to manage their dissemination. By the 1970s, it was also noted that fertility declines were closely associated with the declining incidence of infant and child mortality, both when examined in cross sectional household surveys at the level of the individual woman and when studied across aggregates such as regions or countries (Schultz, 1981). If the association between child mortality and fertility were causal, and child mortality declined in this period only because of the importation of new public health technologies that left economic conditions essentially unchanged, then these data suggested that parents were responding to the increasing rates of

child survival by having fewer births. In other words, human fertility exhibited a homeostatic replacement response pattern and could be expected to compensate for child mortality. According to this interpretation of the data, health measures that were successful in reducing child mortality would elicit a compensating reduction in fertility, that would dampen any acceleration in population growth caused over the short run by improvements in health conditions in low income countries.

With more study, however, this explanation of the facts had to be elaborated. Because it is now clear that women's education, among other household endowments, governs a substantial part of the variation in child mortality, it is not accurate to attribute the widespread reduction in child mortality to an exogenously imposed change in public health technology. The association between a mother's education and lower fertility may reflect that more educated women decide to have fewer children because they can effectively shelter their children from many health risks (Barrera, 1988). Even though much of the variation in child mortality appears to be attributable to household socioeconomic resources and the education of parents, fertility appears to respond also to variation in child mortality that is beyond the control of the family household. Thus, fertility continues to compensate for the exogenous variation in child mortality, such as might be altered by vaccine availability or disease eradication programs. But the task of statistically separating the replacement response becomes more difficult because both fertility and child mortality are behaviorally modified by the same class of household variables.

The schooling of women may therefore exert effects on child health and mortality at several levels. Education of mothers is responsible for first reducing child mortality and thereby contributing to a decline in replacement

fertility. Mother's education also increases women's wage opportunities that reduce desired reproductive goals to facilitate competing objectives of providing each of their children with more health care and schooling. At a third level schooling of women improves contraceptive practice and is associated with a reduction in unwanted conceptions and births. Mother's education and her family's socioeconomic constraints affect fertility and child mortality in these and other synergistic ways. Evaluating the consequences of public health program activities, including family planning, can proceed with greater confidence as these behavioral adjustments of families to their developing opportunities and endowments are explicitly included in the assessment of policy interventions.

Conclusion

Women play a central role in determining the health of family members, and the education of women is a powerful, if not yet fully understood, factor affecting child mortality, nutrition, health, and school achievement. The local availability of medical care and public health interventions can be evaluated as independent determinants of health only after the effects of household resources and maternal education are held constant. Analogously, local community expenditures per woman on family planning activities can be assessed as a means for reducing fertility only after the same family socioeconomic constraints are taken into account (Rosenzweig and Schultz, 1982). Unequal investments in the human capital of women and men may have much to do with the differential progress made in various countries in reducing mortality and fertility. Father's education and wage opportunities reduce child mortality modestly and then mostly in urban areas, whereas they are conducive to higher fertility in rural areas. Modern curative health programs,

such as clinics and hospitals, appear to confer few health benefits beyond urban populations in many low income countries. In contrast, mother's education and increased market wage opportunities are associated with reductions in her fertility and in the mortality of her children, whether she resides in an urban or rural area of the low income world. Those countries that were identified initially in this paper as having invested relatively little in the education and health of women may have paid a high price for this allocation of their resources, both in terms of inefficient slower economic growth in labor productivity and also in terms of slower advances in health.

Unless health policy interventions and pilot programs are implemented according to a randomized design, evaluation of their effectiveness will require a model of the socioeconomic determinants of household behavior. Among health determinants, the education of women and their productive opportunities appear to be important for understanding the family's demand for health inputs and related behavior such as fertility. The integration of social science models of household behavior and quantitative methods to evaluate public health programs can be of immediate value today in low income countries. Perhaps in the not too distant future, these methodologies will also help to set national and international priorities in biomedical research that promise to develop new cost effective medical technologies that extend the length of human life and raise the productivity of women and men in the low income world.

Notes

1. Expenditures per year on schooling of boys and girls is frequently not equal, particularly where the schooling system is not coeducational, but also where women are predominantly enrolled in different courses of study. A common arrangement is for women in higher education to be heavily concentrated in teacher training (normal) schools, while men are in academic university-based programs, or women tend to train as nurses while men as doctors, lawyers, and engineers. The public costs and private returns to these courses of study are likely to differ, often substantially. There is also much scattered evidence that females enrolled in school perform more work at home than do males of the same age (Evenson, 1983), and girls are more readily withdrawn from school as temporary requirements for labor in the home increase. Enrollment rates collected at the start of the school year undoubtedly overstate the annual average attendance rates, and the overstatement is probably larger for girls than for boys. Consequently, the census figures on years of schooling completed reported in the first two columns of Table 1 are probably a more precise indicator of differences in human capital investment in men and women than the "expected years" measure derived from enrollment rates provided by school systems that are shown in the last four columns of Table 1.

Finally, interpersonal or intercountry comparisons based on the <u>ratio</u> of years of schooling of women and men may exaggerate gender inequality at low income levels and understate it at high income levels. For example, if rates of returns to schooling are constant at, say, 20%, a difference in schooling between women and men may be two years and be then associated with a wage

difference of 40% between women and men. As the national level of schooling increases, but the two year gap remains between men and women, the increase in the relative schooling of women and men will not be associated with an increase in the relative wage of women to men, unless of course the return on schooling decreases.

2. To measure the productive returns to investing in the capabilities of either women or men, the special factors underlying the individual's allocation of time to wage employment must be identified, preferably by economic theory. The resulting sample selection correction procedure then permits one to infer the private rate of return to schooling for the entire population from observing labor productivity for only wage earners. The variables that modify the individual's reservation wage or the value of time in nonwage work will depend on how broadly the relevant resource-pooling family is defined, and how flexibly family labor supply behavior is modeled. Existing studies for low income countries provide only the beginnings of a basis on which to draw empirical generalization about the magnitude of sample selection bias in the estimates of school returns, and how they differ for men and women. See for example work by Mohan (1986) on Colombia, King on Peru (1988), and Schultz (1988c) on Thailand. Though even these three studies employ different rules for model identification, they are moving toward a consensus on appropriate estimation methodology. Replication of this approach is now urgently needed.

REFERENCES

Barrera, A. (1988) "The Role of Maternal Schooling and Its Interaction with Public Health Programs in Child Health Production," Economic Growth Center Discussion Paper No. 551, Yale University, forthcoming in Journal of Development Economics.

Becker, G.S. (1964) Human Capital, New York: Columbia University Press.

Behm, H. (1980) "Socioeconomic Determinants of Mortality in Latin America" in Socioeconomic Determinants and Consequences of Mortality, WHO, Geneva.

Binswanger, H. P., R. E. Evenson, C. A. Florencio and B. N. F. White (eds.) (1980) Rural Household Studies in Asia, Singapore: Singapore University Press.

Boserup, E. (1965) The Conditions of Agricultural Growth, Chicago: Aldine Publishing Co., Chicago.

_____ (1970) Women's Role in Economic Development, New York: St. Martin's Press.

Cochrane, S.H., J. Leslie, D. J. O'Hara (1980) "The Effects of Education on Health," The World Bank Staff Working Paper 405, Washington, DC.

Evenson, R.E. (1983) "The Allocation of Women's Time: An International Comparison," Behavioral Science Research 17:3-4 (Spring-Summer) 196-218.

_____ (1987) The International Agricultural Research Centers, CGIAR Study Paper No. 22, The World Bank, Washington, D.C. (April).

Farah, A. A. and S. H. Preston (1982) "Child Mortality Differentials in Sudan," Population and Development Review, 8:365-383, (June).

Griliches, Z. (1977) "Estimating the Returns to Schooling," Econometrica 45:13, 1-22, (January).

Haveman, R. and B. Wolfe (1984) "Education and Economic Well Being: The Role of Nonmarket Effects," Journal of Human Resources 19:377-407.

Hobcraft, J.N., J.M. McDonald, and S.O. Rutstein (1984) "Socioeconomic Factors in Infant and Child Mortality" Population Studies 38(2):363-385.

Jamison, D.T. and L.I. Lau, (1982) Farmer Education and Farm Efficiency, Baltimore, MD: Johns Hopkins University Press.

Judd, M.A., J.K. Boyce, and R.E. Evenson (1986) "Investing in Agricultural Supply," Economic Development and Cultural Change 35(1) 77-114 (October).

King, E.M. (1988) "Does Education Pay in the Labor Force," Population and Human Resource Department, The World Bank, Washington, D.C.

Kusnic, M.W. and J. DaVanzo (1980) Income Inequality and the Definition of Income: The Case of Malaysia, R-2416-AID, Santa Monica, CA: The Rand Corp. (June).

Layard, R. and J. Mincer (eds.) (1985) "Trends in Women's Work, Education, and Family Building," Journal of Labor Economics 3:1, pt. 2 (January).

Levy, V. (1985) "Cropping Pattern, Mechanization, Child Labor and Fertility in a Farming Economy: Rural Egypt," Economic Development and Cultural Change 33(4) 777-792 (July).

Mensch, B., H. Lentzner and S. Preston (1986) Socioeconomic Differentials in Child Mortality in Developing Countries. New York: United Nations.

Michael , R.T. (1982) "Measuring Nonmonetary Benefits of Education," in W.W. McMahon and T.G. Geske (eds.) Financing Education, Urbana, IL: University of Illinois Press.

Mincer, J. (1974) Schooling Experience and Earnings New York: Columbia University Press.

Mohan, R. (1986) Work, Wages, and Welfare in a Developing Metropolis, Baltimore, MD: Johns Hopkins University Press.

Moock, P.J. (1976) "The Efficiency of Women as Farm Managers: Kenya," American Journal of Agricultural Economics (December) 831-835.

Mueller, E. (1984) "Income Aspirations and Fertility in Rural Areas of Less Developed Countries," in W.A. Schutjer and C.S. Stokes (eds.) Rural Development and Human Fertility, New York: Macmillan Publishing Company.

Psacharopoulos, G. and M. Woodhall (1985) Education for Development, New York: Oxford University Press.

Rosenzweig, M. and T. P. Schultz (1982) "Child Mortality and Fertility in Colombia: Individual and Community Effects," Health Policy and Education, 2: 305-348, Amsterdam: Elsevier Scientific Publishing Co.

Rutstein, S.O. (1983) "Infant and Child Mortality: Levels, Trends, and Demographic Differentials," WFS Comparative Studies No. 24.

Schultz, T.P. (1980a) "Interpretation of the Relations among Mortality, Economics of the Household, and the Health Environment, in Socioeconomic Determinants and Consequences of Mortality Differences, Geneva: WHO.

_____ (1980b) "Estimating Labor Supply Functions for Married Women" in J.P. Smith (ed.) Female Labor Supply, Princeton, NJ: Princeton University Press.

_____ (1981) Economics of Population, Reading, MA: Addison-Wesley.

_____ (1984) "Studying the Impact of Household Economics and Community Variables on Child Mortality," in Child Survival (eds.) W.H. Mosley and L.C. Chen, Population and Development Review, Supplement to volume 10.

_____ (1987) "School Expenditures and Enrollments, 1960-1980," in National Academy of Sciences background papers (eds.) D.G. Johnson and R. Lee, Population Growth and Economic Development, Madison, WI: University of Wisconsin Press.

_____ (1988a) "Women's Changing Participation in the Labor Force: A World Perspective," forthcoming Economic Development and Cultural Change.

_____ (1988b) "Educational Investment and Returns. In Handbook of Development Economics: 1 (eds.) H. Chenery and T.N. Srinivasan, Amsterdam: North Holland.

_____ (1988c) "Women and Development: Objectives, Framework and Policy," draft Women in Development Division, Population and Human Resources Department, The World Bank, Washington, D.C. (November).

Stolnitz, G.J. (1975) "International Mortality Trends," in Population Debate, Vol. I, New York: United Nations.

Thomas, D., J. Strauss and M.H. Henriques, (1987) "Child Survival, Nutritional Status, and Household Characteristics," Economic Growth Center paper No. 542, Yale University.

United Nations (1982) Levels and Trends of Mortality Since 1950, Department of International Economic and Social Affairs (ST/ESA/SER.A/74) New York.

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Appendix Table A

Estimates of Life Expectancy at Birth and Mortality for Women and Men from Africa and Asia

Country	Years	Life Expectation at Birth in Years		Ratio of Female to Male Life Expectation	Ratio of Age Specific Mortality Rates of Males to Fem				
		Male	Female		Less Than One Year (infant)	Age 1 to 5	Age 5 to 10	Age 10 to 15	Age 15 to 35[a]
Africa									
Algeria	1948-51	44	49	1.11					
	1954-56	39	45	1.15					
	1969-70	50	54	1.08	1.00	.90	.52	.74	.89
	1970	53	54	1.02					
Egypt	1948-52	40	41	1.03	1.01				
	1958-62	48	49	1.02	.97				
	1963-67	49	50	1.02	.97	.99	1.06	1.04	1.16
Libya	1964-74	51	54	1.06	1.07				
	1968-73	52	55	1.06	1.07				
Morocco	1970	48	49	1.02	1.25				
Sudan	1968-73	43	44	1.02					
Tunisia	1968	52	50	.96	1.00				
	1968-69	54	55	1.02	1.02	.85	1.14	1.14	.82
Burundi	1965	39	42	1.08					
	1970-71	43	46	1.07					
Kenya	1969				.99	.90	.94	1.08	1.22
Madagascar	1966				1.40	1.18	1.19	1.21	1.06
Mauritius	1951-53	50	52	1.04					
	1961-63	59	62	1.05					
	1970-72	61	65	1.07	1.26	.88	.90	1.50	.81
Tanzania (mainland)	1967	39	42	1.08					
Central Africa Republic	1959-60	35	36	1.03					
Chad	1963-64	34	35	1.03					
Congo	1960-61	36	39	1.08					
Gabon	1960-61	40	42	1.05					
Botswana	1971	51	55	1.08					
Lesotho	1966	49	50	1.02					
Benin	1961	34	36	1.06					
Ghana	1968-69	46	48	1.04					
	1975	47	50	1.06					
Liberia	1962	36	39	1.08					
Mali	1960-61	31	33	1.06					
Niger	1960	36	37	1.03					
Sierra Leone	1973	31	35	1.13					
Togo	1961	37	39	1.05					
Asia									
China	1978	67	69	1.03					
Hong Kong	1961	64	71	1.11					
	1971	67	75	1.12					
Malaysia	1956	56	58	1.04					
(Peninsular)	1972	63	68	1.08	1.32	1.05			
Philippines	1948	49	53	1.08					
	1969-71	59	64	1.08					
South Korea	1961	54	61	1.13					
	1971-75	59	66	1.12	1.08	.85			
Singapore	1956-58	61	67	1.10					
	1969-71	66	72	1.09	1.21				
Indonesia	1971	45	48	1.07	1.12	1.13			
Malaysia Sabah	1970	49	45	.92					
Sarawak	1970	52	53	1.02					
Thailand	1947	49	51	1.04	1.19				
	1969-71	59	61	1.04	1.23	.95			
Taiwan	1956	60	65	1.08	1.10	.93	1.22	1.38	
	1975	67	73	1.09	1.36	1.21	1.55	1.56	2.01
Kuwait	1974-76	66	70	1.06	1.15				
Lebanon	1970	62	66	1.06					
Sri Lanka	1945-47	45	43	.96	1.09				
	1962-64	62	63	1.02					
	1970-72	64	67	1.05		.85			
Burma	1954	41	44	1.07					
(urban)	1974	56	60	1.07		.91			
Iran	1973-76	57	57	1.00	.91	.80			
Iraq	1974-75	57	59	1.04		.96			
Afghanistan	1972-73	34	36	1.06					
Bangladesh	1974	46	47	1.02	1.10	1.04			
Dem. Yeman	1973	41	43	1.05					
India	1941-50	33	32	.97	1.09				
	1951-60	42	41	.98	1.11				
	1970-72	49	46	.94	1.01	.76			
Nepal	1952-54	32	29	.91					
	1974-76	45	42	.93	1.04				
Pakistan	1962-65	47	45	.96		.66			
Yeman	1975	38	39	1.03					

Note: [a]Unweighted sum of age specific mortality rates from age 15 to 35, during which most childbearing occurs and thus of maternal mortality may be apparent.