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T. Paul Schultz

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EDUCATION INVESTMENTS AND RETURNS IN ECONOMIC DEVELOPMENT

T. Paul Schultz

Yale University

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Abstract

Education Investments and Returns in Economic Development

This paper reviews several themes in the economic literature on education and development: (1) intercountry evidence on how income, price, and demographic constraints govern public expenditures on schools, (2) alternative conceptual interpretations of the relationship between education, productivity, and income, (3) uncertainties underlying the micro econometric evidence on the private and social returns to schooling in the labor market, which can generally be classified as model misspecification arising because of either the omission of appropriate controls or the neglect of potential sources of sample selection bias, (4) indications of the returns to schooling in nonmarket production of child health, education, and fertility control, primarily associated with the education of women who perform most of these activities in the home, and finally (5) evidence on how the allocation and management of public educational resources influence the efficiency with which these services are produced and the distribution of resulting private benefits among persons. Many aspects of these relationships are poorly understood. Because in practice only a few of the many proposed complicating features of human capital models can be implemented simultaneously, assigning priorities for further research is imperative. Among the numerous gaps in knowledge surveyed in the paper some can be closed with focused microeconometric empirical research using existing methods, and are likely to occur with the increasing supply of household survey and census data for low income countries. Other questions remain unanswered for lack of a specification of the dynamic aggregate interplay between the supply of investments in the formation of human capital and the modern sources of the derived demand for the skills that education produces. Progress on this latter frontier of the field is equally important, but less certain.

I. Introduction and Preview

The record of sustained modern growth in real per capita income cannot be accounted for by the accumulation of conventional units of physical capital or by the increased application of hours of labor per capita (Kuznets, 1966).[1/] The sources of modern economic growth are sought instead in the changing quality of labor and capital, in the more comprehensive accounting of other inputs, and in change of organization, policy environment, or technology (Denison, 1962; T.W. Schultz, 1963; Kuznets, 1966). While the issues surrounding the accounting of aggregate economic growth are unresolved and research strategies in this field remain controversial (Griliches, 1970; Nelson, 1981), research on various aspects of the microeconomic relationship between education and development has expanded rapidly, forging a consensus on questions for study and appropriate methodologies to address these questions. Studies across persons, households, farms, and firms have documented, first generally in the United States and then in many low-income countries, strong empirical regularities between educational attainment of persons and their productivity and performance in both market and nonmarket (home) production activities. If these relationships are causal, and education enhances the productivity of labor, it is not surprising that governments have shown a willingness to expend a considerable fraction of national income on public education; neither is it difficult to understand why parents have set aside an increasing amount of their private income to school their children, foregoing also the productive contribution the children would have made to family income had the children not attended school. The expansion in world demand for education is, thus, broadly consistent with schooling investments that earn a

high social and private return. Empirical microeconomic studies have simultaneously refined and extended the base of evidence that the more educated do indeed receive more income and produce more output than the less educated in a wide range of activities. (Psacharopoulos, 1985; Jamison and Lau, 1982) This microeconomic perspective explains the motivation of public groups and private individuals to supply resources to produce schooling services on the expectation that the rates of return warrant the investment.

If the value of education is thus seen as primarily determined in the marketplace, and the recent expansion of education is attributed to an increase in returns to schooling, then the challenge remains to explain why the returns to schooling have recently been bid up. What accounts in the aggregate for the shift outward in the derived demand for educated labor? What particular recent developments have boosted the payoff to investing in education, not only for an elite, but increasingly for the rank and file of the population? Education is highly valued not only for males entering the labor force, but for females whether or not they are likely to work outside the home. Hypotheses have been advanced to explain this phenomenon, relating it to the dynamic economic conditions that create opportunities in the form of disequilibria that are exploited more effectively by an educated population (T.W. Schultz, 1975). But testing these hypotheses that explicate the initial cause for the spread of education is intrinsically difficult. Mass education may be at the very origins of modern economic growth, a process that has only in the last fifty years spread notably beyond Europe, areas of European settlement, and Japan. This essay surveys a small part of the extensive literature on the linkages between education, productivity, and development, and assesses several areas where concerted research might clarify important issues and potentially change policies.2/

An Overview

The expansion of public educational systems worldwide has provided the average child in every country with increased years of schooling during the period 1960 to 1983.3/ The gap between high and low income countries in educational opportunities has narrowed, relatively and absolutely; the wide gap between the educational attainment of women and men has also narrowed, on average. This chapter presents an economic interpretation of this educational explosion and what has governed the process. Most of the growth in public expenditures on education is attributed to increases in growth of real income per adult. The income elasticity of public expenditures on primary and secondary education are 1.4 and 1.5, respectively. The declining price of teacher salaries relative to average incomes is the second major engine of education growth, which lowers the unit costs of providing schooling to a growing fraction of the child population. These tendencies appear to have been partially frustrated by rapid population growth which increases the proportion of the population in school ages. This population growth effect does not appear to have restrained enrollments at the primary level but eroded the resources available per student at both the secondary and primary levels.

Certain regions have increased public expenditures on education more rapidly or more slowly than would have been expected, based on incomes, cost of teachers, and population distribution. East Asia and Africa are in this regard overachievers while South and West Asia and Latin America are investing less in education than is expected on the basis of this framework.

At the individual level the positive relationship between the education of a worker and his or her earnings helps to account for the noted expansion of national educational systems. Under certain conditions, the proportionate increase in average lifetime wages associated with a year's education

approximates an internal private rate of return to investing a year's time in that form of schooling. Many empirical studies confirm the nature of this relationship, and proceed to estimate the private returns to education in developing countries. They show that basic primary and secondary schooling yields private returns between ten and forty percent, and generally somewhat lower at university or college levels. No pronounced differences are noted between men and women. Much of the returns to schooling for women arise from their increased productivity in nonmarket production, as evidenced in their ability to improve the health of family members, produce a more nutritious diet for the same outlays, and control more effectively their reproduction.

Needless to say, this empirical regularity between schooling and wages can be approached using a variety of more complicated econometric methods. Although additional controls and the choice of model structure influence estimates of the partial association between schooling and wages, the evidence evaluated below supports the view that private returns to basic education are substantial.

Few countries charge fees to students for the full cost of providing them with educational services. Social returns to schooling after deducting the unreimbursed public expenditures on schools are, therefore, lower than the private rates of return. Particularly for higher education, where the public cost of providing a student with instruction may be 50 times larger than at the primary level, the social rates of return in some developing countries may be insufficient to warrant further expansion of subsidized public higher education. This is rarely the case at the primary and secondary level.

Management of the educational sector seeks to promote an efficient and equitable use of public and private resources. Beyond the broader generalizations that can be applied to the financing and expansion of the

education sector, there are many country-specifc issues that are not pursued here. Most of these issues can be analyzed with econometric methods where labor force survey and census data are available for estimating the relative benefits of various types of education, and school input and output data are available to evaluate the efficiency of school systems to produce what the labor market demands in the way of skills.

Problems: Conceptual and Empirical

The empirical evidence supporting education's effect on factor productivity must be approached critically, however. At one level, there is innate skepticism born of casual empiricism and nurtured on the richness of alternative theoretical models; economists can propose many models to accommodate the stylized fact that elites are often relatively well educated and relatively well paid. At another level, the statistical evidence on education's productive roles is never ideal, because data on the "consequences" of education are obtained from populations in which educational attainment is not randomized but is itself an economic choice variable. The social sciences are rarely able to perform social experiments. Therefore, statistical studies of how education affects individual behavior and performance can be biased or misleading, because of the nonrandom selection of comparisons groups, the omission of other factors, the simultaneity among outcomes variables, such as wages, and potential determinants of these outcomes, such as job tenure, and, of course, measurement error and flaws of functional form approximations that are assumed in statistically estimating group differences associated with education.

There are also palpable differences between the formation of concrete physical capital and the accumulation of productive skills in schools. In the former case, land is improved by drainage or irrigation, railways are built,

and factories are constructed, from which productive services are derived that can usually be priced in a competitive marketplace. In the latter case, people of different ability attend schools of varied quality, and then they perform diverse and often incomparable tasks. It is frequently difficult to infer the marginal productivity of workers, and the selection of those that report a wage may subtly bias comparisons. Other workers may be employed in production teams or families, or within large integrated firms where the productivity of the individual is not readily monitored. Markets for the services of labor may not be competitive in the sense of spot markets that clear in the short run; labor markets may be further linked to other imperfect factor markets, such as those for land and credit, in the case of agriculture. (See chapters by Bell and Rosenzweig in this Handbook.) Although similar problems exist in the evaluation of the services of heterogeneous physical capital, many comparisons of labor market behavior and outcomes can be misleading unless care is used to explicitly deal with the heterogeneity of labor. Four distinctive features of human capital warrant brief discussion here.

Differences in property rights between human and physical capital imply that empirical studies must rely largely on rental market transactions in the case of human capital, i.e., wage rates, rather than on both rental and asset prices in the case of physical capital (Rosen, 1985). Given the durable lifetime nature of human capital, this constraint on available data is a serious limitation for testing theory, particularly when market lifetime equilibrium theories of investment are the basis for several influential frameworks for analyzing human capital (Becker, 1964; Mincer, 1962, 1974). Long-term contracts between firms and workers, or between landlords and laborers, may add additional dynamic incentive problems to the labor market

when information regarding the effort and productivity of labor is notably imperfect and costly to monitor. How do these convenient micro equilibrium investment approaches of the human capital tradition mislead researchers in a world where disequilibrium rents are the rule and not the exception?

Preferences of workers are likely to intrude on human capital models of individual behavior, while they are conveniently set aside by economists in their analyses of the production of market goods and services. An individual's decision on how much time to work in the labor market is dependent on his or her preferences for nonmarket time or leisure versus preferences for the goods that can be purchased with market income. Consequently, preferences may influence human capital investment decisions, unless human capital is assumed to be specifically neutral in its productive effect on market and nonmarket activities, including the formation of additional human capital (Ben-Porath, 1967; Michael, 1982).

Commodities that are produced for consumption within the household and are not readily traded across households will be produced in response to variations in consumer preferences of household members (Rosenzweig and Schultz, 1985). To avoid these complications, it is common to assume that farm-households produce for the marketplace as well as for their own consumption, and view the labor of family members as equivalent to labor hired from or supplied to the market; this homogeneity of output and labor input permits production and consumption decisions within the household to be sequentially optimized, and greatly simplifies empirical analysis of the behavior of farm-households (Singh, Squire and Strauss, 1986). Hired and family labor may not be perfect substitutes for each other in all tasks, because the ease of monitoring and therefore decentralizing work may differ for these two types of labor (Deolalikar and Vijverberg, 1983). While the family production-consumption model is attractive

for the study of farm production of food staples, it seems less appropriate for the study of the production of untraded goods, such as children, the schooling of those children, and the health of family members (Rosenzweig and Schultz, 1983).

Any attempt to measure nonmarket benefits of schooling that accrue within the domestic spheres of household production is subject to worrisome error, because of the "social and emotional factors involved" (Kuznets, 1954; 432). This is one among many reasons that led Kuznets and those who followed him to exclude household nonmarket production and the housewife's nonmarket contribution to welfare from their reckoning of national income, valued, to the extent possible, at market prices. However, an important feature of development is the tendency for the market to take over progressively more of the productive activities carried out initially within the household. Thus, to ignore nonmarket production and human capital's contribution to these forms of production is perhaps a more serious omission in the study of low income countries, and in the characterization of the process of economic development in general, than it is in the analysis of growth in today's industrially advanced countries.

These several differences between physical and human capital, and the different context of household and market production are real, and are responsible for some of the indirect estimation methods used in this field that rely on difficult to test assumptions of functional form and other identification restrictions. In situations where many economic and demographic choices of the household are viewed as jointly and simultaneously determined over a lifetime, including possibly the human capital investments of both the parents and children, it is difficult to specify exogenous constraints on which to base consistent estimates of behavioral relationships or household

production functions. Community programs, local prices, and regional characteristics derived from outside of the household decisionmaking unit are, therefore, increasingly used to identify household choice models (T.P.Schultz, 1984). This estimation strategy depends critically, however, on the assumption that migration does not sort persons according to their preferences for these regional services, activities, and amenities (Tiebout, 1965; T.P. Schultz, 1983; Rosenzweig and Wolpin, 1984). This assumption concerning the independence of migration may not always be defensible in developing countries, where local health and education programs may differ greatly today, particularly between rural and urban areas. Alternatively, the location of the public sector programs may also represent a calculated response to unobserved local environmental conditions or average population characteristics that the programs are themselves designed to change. Examples might be public health facilities and specific disease control programs that are established to serve communities with particularly severe health problems. Yet turning to community level constraints to help identify the determinants of household behavior is an attractive means to escape the vicious circle of simultaneity among closely related forms of household economic and demographic behavior.

In sum, the problems of measurement of productivity are serious in the nonmarket sector. Relevant statistical comparisons across persons or households tend to be subject to many sources of selection bias, that cannot always be persuasively corrected by available econometric techniques, theory, and data. Consequently, the evidence of education's market and nonmarket productive roles is sometimes fragile, and the working assumptions and statistical procedures that underlie this evidence need to be closely scrutinized and affirmed from a variety of methodological perspectives.

The outline of the chapter is as follows: Section II describes the expansion of the world's educational system both in terms of its inputs of public and private resources and its output of students, and then estimates how income, price, and population constraints appear to govern this process. Section III contrasts causal frameworks proposed to explain the relationship between education and productivity, and discusses sources of data to measure the relationship and discriminate among causal interpretations. Section IV reviews evidence on the market returns to schooling measured for both entrepreneurs and employees, men and women, and migrants and nonmigrants. Section IV considers the evidence of schooling's effects on nonmarket production. Section V considers the policy issues for development that arise from the apparent effects of education on economic productivity and the mechanisms used to finance and manage the educational system. In the concluding section VI, questions for further research are reiterated.

II. National Educational Systems: Interpretation of Aggregate Patterns[4]/

A distinctive development of the last 25 years is the rapid expansion of school systems in all parts of the world. Despite the unprecedented rate of growth in the population reaching school age, enrollment rates at these ages have increased in virtually every country. These developments are examined in this section to understand their origins and how economic and demographic factors may be governing this rapidly growing dimension of world investment. Incomes, relative factor prices, production technology, and demographic structure are interrelated in a production-demand framework as constraints and conditions affecting the costs of, and demands for, educational services. Data for 89 countries from 1960 to 1980 are then used to test quantitatively hypotheses within this framework. Differences in school enrollment between

males and females are also analyzed. Finally, regional deviations in educational expenditures and achievements are calculated, based on the fitted model, to document departures from international patterns.

World Trends

Figure 1 summarizes the level and increase in enrollment ratios at the primary, secondary and higher education level for countries grouped by income level, market/nonmarket economy, and oil exporter status. For summary comparison of overall levels of schooling, a synthetic cohort measure is constructed and called hereafter the 'expected years of schooling.' It is defined as the sum of six times the primary, six times the secondary, and five times the higher education enrollment ratios; where these weights, i.e., 6, 6 and 5, correspond to the average number of single-year age groups combined in the denominators of these three standardized enrollment ratios. This new synthetic cross-age measure of expected years of exposure to the educational system should not be confused with a cohort measure of completed years of schooling, which also excludes years that are repeated or not accredited.

Expected years of schooling increased 32 percent from 1960 to 1981 in the low income class of countries; 46 percent gains were achieved in the middle income countries who imported oil, and 50 percent gains occurred in the upper middle income class. The East European non-market countries increased their expected years of schooling by 35 percent, while the industrial market high income countries advanced 16 percent. Oil exporters in the middle income class achieved a doubling of expected schooling levels, while nearly a fourfold increase was reported in the high income oil exporters.

In general, the percentage gains in schooling were greater for those countries that started from a lower income level in 1960. The gap in expected years of schooling between the low and high income countries is therefore

Figure 1

Expected Years of School Enrollments, by School Level for Groups of Countries: 1960 and 1981
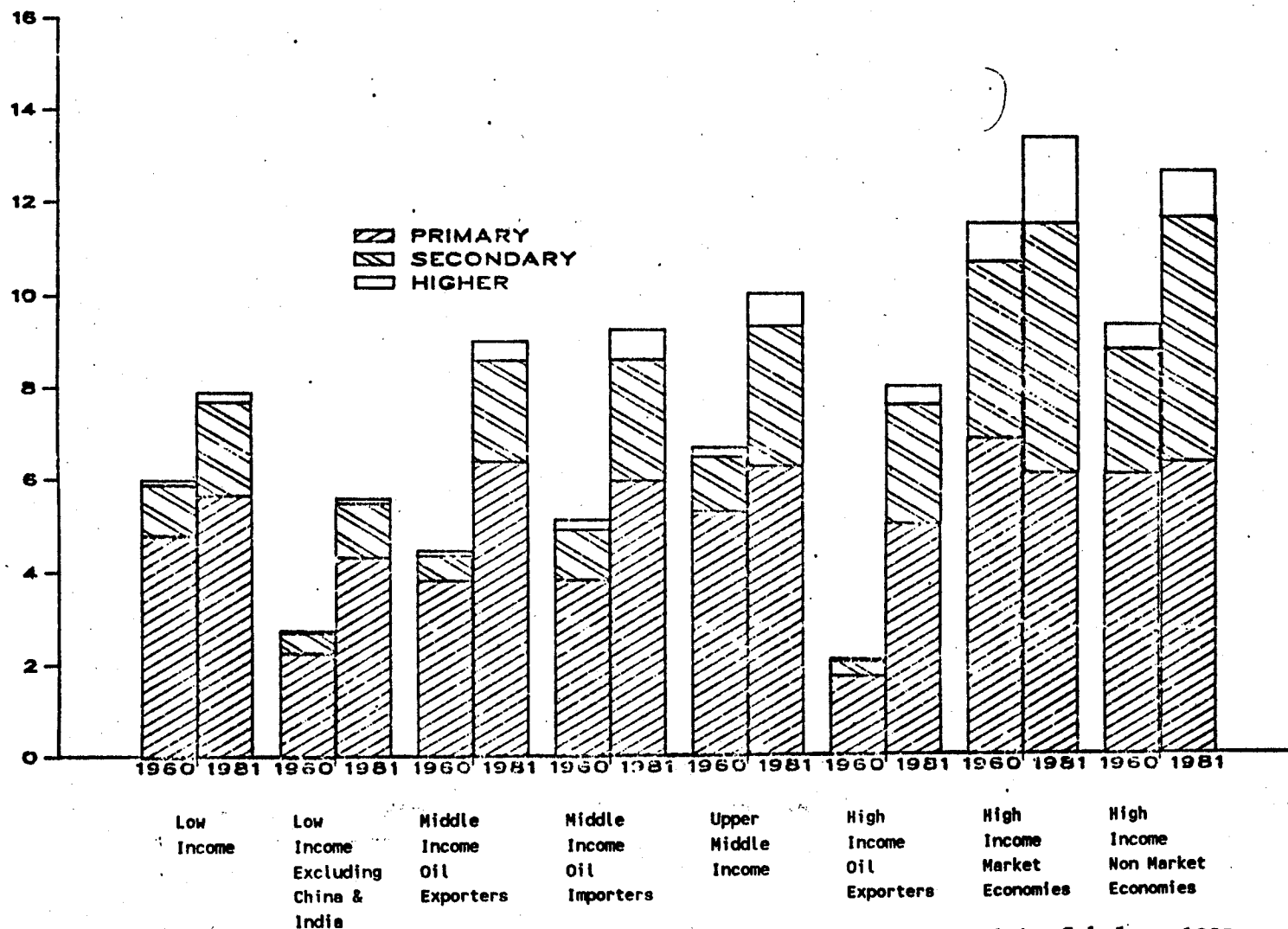
Source: Derived from World Development Report 1984. Definitions and data reported in Schultz, 1985.

closing, on average, whether expressed in relative terms or even as an absolute difference in years, which more adequately reflects the economic value of education. This closure in the absolute gap in education appears to be at least as rapid as that achieved in health, analogously summarized by life expectation at birth.[5]/ Figure 2 shows the corresponding figures for expected years of enrollments for males and females, summarized by cultural-regional areas; differences between enrollments of males and females have also decreased markedly and warrant an explanation.

The salient fact is that all classes of countries, and indeed every country for which overall comparisons can be drawn from 1960 to 1983, increased over these years the expected schooling that it provided to the 'average' child, despite the extraordinarily rapid growth in the number of school-aged children in many of the poorest countries.[6]/ The number of children between the ages of 6 and 17 more than doubled in the less developed regions from 1950 to 1980. The proportion of the population in these ages increased from 24.5 percent in 1950 to 29.1 percent in 1980. That the poorest countries and those that have suffered actual declines in their real income in this period were nonetheless able to expand their schooling systems rapidly enough to accommodate an increasing fraction of their children is remarkable.

However, a less sanguine picture of recent educational progress emerges from expenditure data assembled in Table 1 from World Bank sources. Central governmental expenditures on education, when expressed in constant GNP prices, have declined in many countries in the past decade. Resources allocated to education per capita by central governments appear to have declined markedly in real terms in the lowest income countries (including or excluding India and China) and increased by only 22 percent in the middle income oil importing countries. In contrast, oil exporting middle income and upper middle income countries were able to more than double their per capita real public

Figure 2

Expected Years of School Enrollment for Males and Females by Region: 1960 and 1980
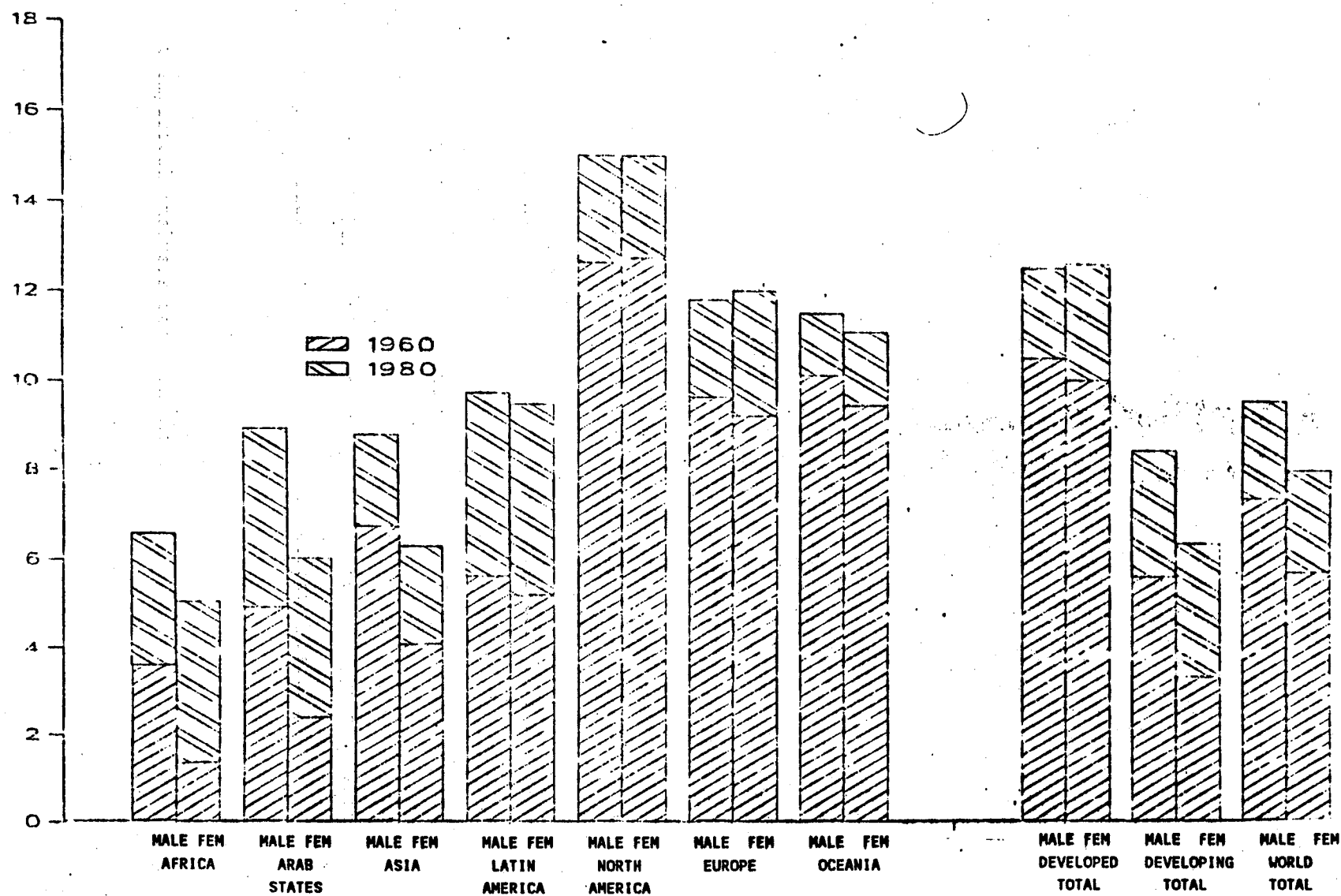
Source: Derived from UNESCO Yearbook. Definitions and data reported in Schultz, 1985.

Table 1
Central Government Expenditures: 1972, 1981

World Bank Country Class[a] (Number)	Percent of Government Expenditures on Education		Total Government Expenditures as Percent of GNP		Percent of Growth in Real per Capita GNP 1972-1981[b]	Percent of Growth in per Capita Real Expenditure on Education 1972-1981
	1972	1981	1972	1981		
	(1)	(2)	(3)	(4)	(5)	(6)
Low Income (34)[c]	16.4	5.9	21.0	15.4	26	-67
Excluding China and India[c]	16.4	11.5	21.0	17.6	7	-37
Middle Income (38)						
Oil Exporters	15.4	16.6	17.2	27.8	34	+133
Oil Importers	11.0	10.0	20.7	21.8	28	+22
Upper Middle Income (22)	10.8	14.3	15.0	20.6	32	+140
High Income – oil exporters (5)	13.5	9.2	36.6	26.3	0	-51
Industrial Market (18)	4.3	5.1	21.7	28.3	21	+87
East European Non-market (8)	NR	NR	NR	NR	NR	NR

Notes: a The low income class has an annual GNP per capita of less than US $410 in 1982 prices. The middle income class includes countries with GNP per capita between $410 and $1650, while the upper middle income class ranges from $1650 to about $6000.
   b Annual Growth. Rate on per capita real GNP derived for 1970 to 1982 from Bank Tables, and interpolated for the nine years corresponding to expenditure data, 1972-1981.
   c The lack of data for China or for India throughout this period makes the overall "Low Income" country class comparisons of limited value.

Source: 1984 World Development Report, World Bank Staff, Oxford University Press, New York, 1984. Appendix, Table 2, page 220; Table 19, page 254; and Table 26, page 268.

expenditures for education, while the high-income industrial countries raised their real outlays on education by 88 percent.

How have the poorer countries sustained increases in enrollments despite the evidence that central government outlays have not kept pace with population growth? One explanation for these divergent trends might be that local, state, and private expenditures on schooling expanded to replace central government outlays. Table 2 reports UNESCO estimates of public school expenditures at all governmental levels, confirming a decline in real public outlays on schools in Africa, Asia, and Latin America after 1980. I cannot assess how the data underlying Tables 1 and 2 might differ beyond the inclusion in Table 2 of noncentral government educational expenditures. Private school expenditures are not well documented, but the share of private school enrollments is generally modest and declining in most low income countries (World Bank, 1986a). Tuition and fees at public schools have also been eroded by inflation and public policy changes during the 1970s (Jimenez, 1984), though this trend may have reversed recently.

Another explanation could be that unit costs of producing educational services declined, as might occur if the school system realized economies of scale or incurred a decline in the price of educational inputs relative to the GNP deflator used here. Alternatively, the quality (or resource intensity) of schooling services may have deteriorated.

In sum, alternative factors could be behind the decline in government expenditures on education in some low income countries: (1) the actual quality of schooling per student may have declined; (2) the unit costs of production of educational services of a constant quality may have declined relative to the general price level (GNP deflator); and (3) the underlying data may be in error. The subsequent cross country empirical analysis of public educational

Table 2

Public Expenditures on Education Per Child of School Age, 1970-1982

Region:	Percent of World's Population age 6-17 in 1970	Public Expenditures on Education (billions of current U.S. dollars)				Public Expenditures per Child 6-17 (Constant 1970 U.S.Dollars)				Percentage Growth in Real Public Expenditures on Education 1970 to 1980
		1970	1975	1980	1982	1970	1975	1980	1982	
Africa, excluding Arab states	8.0	1.89	5.05	12.1	11.7	23.7	39.5	57.3	44.8	142
Arab states	3.8	1.80	8.44	17.7	22.1	49.0	144.	187.	187.	282
Asia, excluding Arab states	59.4	12.0	38.3	85.6	89.7	20.2	42.1	60.9	54.2	201
Latin America	8.5	5.54	14.3	32.8	36.5	65.3	108.	158.	147.	142
Northern America	5.3	71.8	113.	200.	232.	1350.	1570.	2170.	2280.	61
Europe, including USSR	14.7	64.5	146.	252.	224.	436.	714.	909.	703.	108
Oceania	.5	1.98	6.99	10.4	11.4	418.	996.	1010.	931.	142
Developed* Total	22.5	147.	295.	529.	536.	654.	956.	1260.	1120.	93
Developing Total	77.5	12.6	37.4	81.9	92.0	16.2	31.3	43.7	41.2	170
World Total	100.	160.	332.	611.	628.	160.	220.	266.	232.	66

*Europe, Oceania, North America, Japan, Israel and South Africa.
Sources: UNESCO Statistical Yearbook 1984, Table 2.12. GNP deflator for U.S. used to express current dollars (1975: 1.375; 1980: 1.950; 1982: 2.261): Statistical Abstract of the United States 1985, Table No. 715. Population Age 6 to 17 from U.N. Demographic Indicators of Countries, Estimates and Projections Assessed in 1980, for 1975, 1980 and interpolated to 1982 and extrapolated to 1970. For Arab States and Africa and Asia excluding Arab States, UNESCO Statistical Yearbook 1984, Table 1.2, uniformly interpolated from 5 to 19 age groups to 6 to 17.

systems is restricted to countries for which there are data on enrollments, teachers, expenditures on current and capital account, estimates of GNP in constant prices, urbanization, total fertility rates, and the population's age composition. The data from this restricted sample of countries are believed to be more reliable than the comprehensive figures reported above, but possibly less representative. Before considering intercountry patterns in these data, it is useful to have a framework within which to account for variation in the provision of educational services. The framework involves three parts: an interpretation of the political economy translating private demands into public expenditures, a production technology linking educational inputs to outputs, and the determinants of household demand for public educational services.

Adjustment of the Educational System to Demand and Supply

Education is demanded both as a consumer good that yields direct utility and as a producer good that is expected to enhance the future productivity of the educated individual (T.W. Schultz, 1961). Private demand of consumer goods depends on consumer income, relative prices, and tastes. As a produced means of production, economists have reasoned that the private and social demand for education should be an increasing function of its private and social rates of return (Becker, 1964). However, the relationship across countries between the level of returns and the average quantity of schooling represents intersections of the presumably upward sloping private/public supply function of investment in education and the downward sloping aggregate derived demand function for more educated workers. Unless variables can be specified a priori that shift one and not the other side of this market for more educated labor, it is not generally possible to identify statistically the individual's investment supply response function from the aggregate derived demand function for educated labor. Most empirical analysis based on consumer demand theory or the human

capital framework studies the behavioral response of individuals or families to aggregate market-determined wage rates, prices, initial endowments, etc. The latter are exogenous constraints that are expected to partially explain the individual response. At the aggregate level, derived demands for labor of various types and the aggregated responses of individuals to invest in human capital and supply labor to the market cannot be as readily disentangled or statistically identified. In the course of economic development both the aggregate demand and supply schedules are likely to shift. It would be useful for our purposes if we could specify exogenous endowments to the economy, such as original natural resource stocks, or exogenous technological dimensions to the development process that differ over time and across countries, that affect the derived demands for relatively better educated labor and hence raise (or lower) the producer returns to education. However, there is as yet no agreement on what these identifying variables might be.

In the subsequent empirical analysis of aggregate school systems, national income per adult, relative prices, and other technological and demographic constraints are tentatively interpreted as influencing the individual and family's investment supply function of education, or, in other words, the private and public sector demand for schooling services. But the same income, price, and technology factors may also shift aggregate derived demands for educated labor and thereby vary the rate of return to education as a producer good.1/ The relationships estimated below to explain school expenditures and outputs are consequently reduced-form equations that may embody the underlying investment supply and aggregate demand parameters. Identifying these underlying structural supply and demand parameters is not attempted here.

Actual estimates of the social rates of return for secondary schooling for some 40 countries are plotted in figure 3 against lagged secondary school

Figure 3

Social Returns to Secondary Schooling and Lagged Enrollment
Rates: Plot of Available Country Observations

Percent of Children Enrolled in Secondary School (ten years earlier)
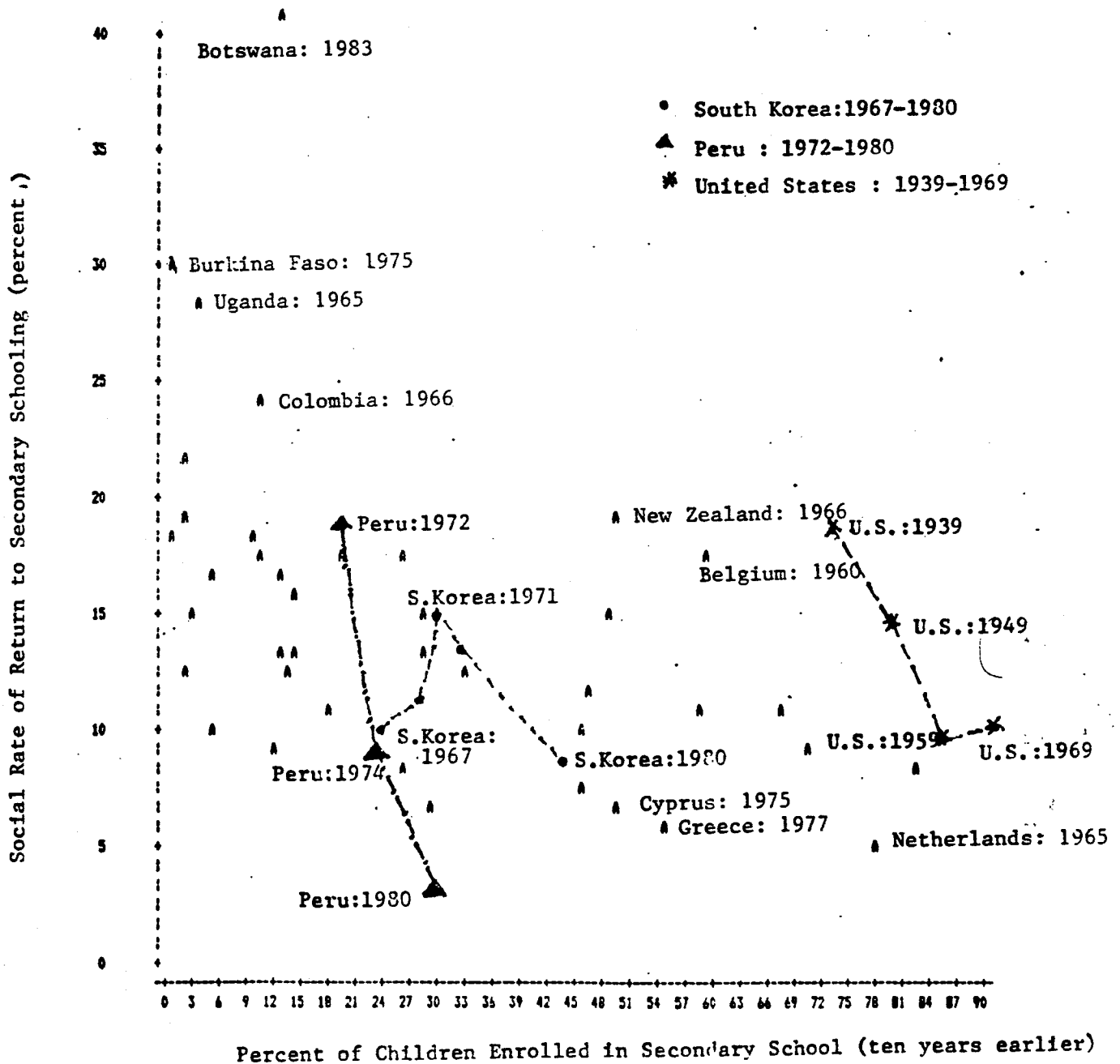
Source: Single most recent observation on secondary schools from each country
available in Psacharopoulos (1983, 1985). Repeated observations added
for the United States, South Korea, and Peru to indicate within country
variation.

enrollment ratios. The downward sloping scatter of observations suggests that the private/public supply of schooling is shifting to the right over time with development to trace out, approximately, the downward sloped (and probably also shifting) demand schedule. Some countries for which there are available repeated estimates of social returns confirm the same pattern within a country of falling social returns as the expansion of school systems overtakes expanding aggregate demands for more educated labor. But demand schedules may also shift more (or less) rapidly than supplies of educated labor, and this might explain the period of rising returns in South Korea from 1967 to 1971. The extreme drop in returns in Peru from 1972 to 1980 may signal the added impact of a cyclical decline in demand for better educated labor.

A second unusual feature of the educational system is that it produces its own main input, teachers. It thereby affects by its past production the current wage required to retain the services of teachers and consequently the unit cost of producing further education, other things being equal. This feedback effect of output on future unit costs suggests that choosing the best expansion path for education involves additional issues of intertemporal optimization and intergenerational equity, topics that implicitly arise in the educational planning literature, but which remain to be explicitly incorporated into many empirical analyses (Bowles, 1969; Freeman, 1971). For example, to expand a school system rapidly from a very limited national educational base involves inevitably bidding up temporarily the cost of teachers and may even require the costly importation of trained personnel. These high initial costs of expansion tend to decline as the pool of domestically trained secondary school graduates increases and these new graduates compete for available teacher posts. This decline in the relative price of teachers then encourages,

along with rising incomes, more private demand for public education as both a consumption and investment good. Figures 4 and 5 illustrate this downtrend in the relative price of primary and secondary school teachers, most clearly evident in a number of African countries which have recently expanded their national educational systems. In middle income countries, such as in Latin America, the downtrend in wages of at least primary school teachers relative to that of the average worker is more irregular. Some part of this decline in the relative price of teachers may reflect a substitution of women for men in teaching.

Although there is no established framework for dealing with these dynamic and recursive features of national educational systems, the current wage of teachers clearly depends on the current level of demand for schooling. Consequently, the price of teachers is endogenous to a model determining the demand for educational services. To estimate without simultaneous equation bias the effect of this price on current demand, instrumental variable methods are later adopted.

A Model of the Educational System

The technological possibilities for producing educational services are assumed to be identical across countries. This production function for educational services is also assumed in the long run to exhibit constant returns. This does not seem to be an unrealistic assumption for primary and secondary school systems. If the elasticity of substitution between labor and capital is one, the production function may be expressed in standard Cobb-Douglas form:

$$X = Z \, L^\alpha \, K^{1-\alpha} \qquad\qquad\qquad (1)$$

where X is the output of educational services, L is the labor input, K is the physical capital input, and α is the share of wages in output, and $1-\alpha$ is the

Figure 4

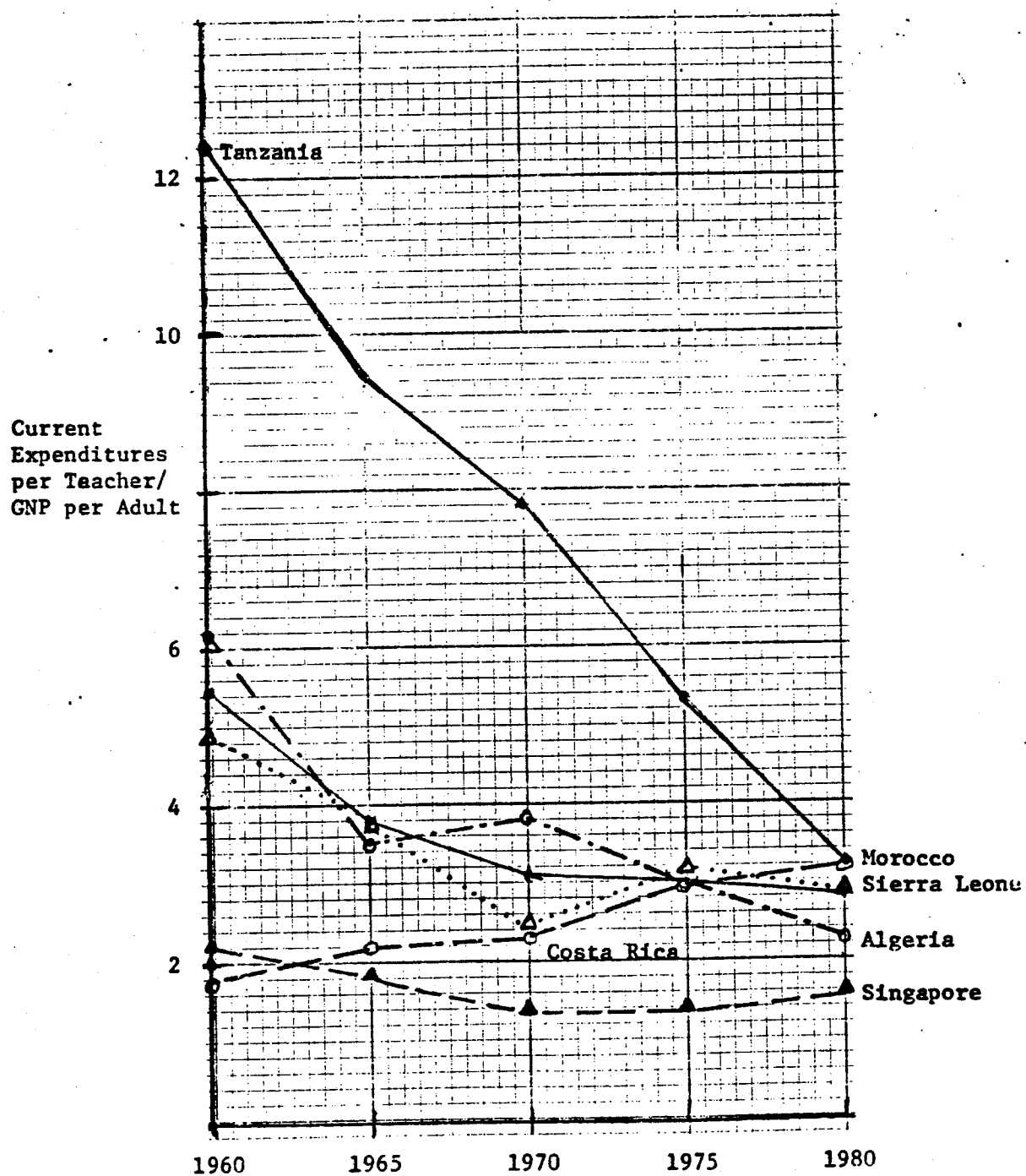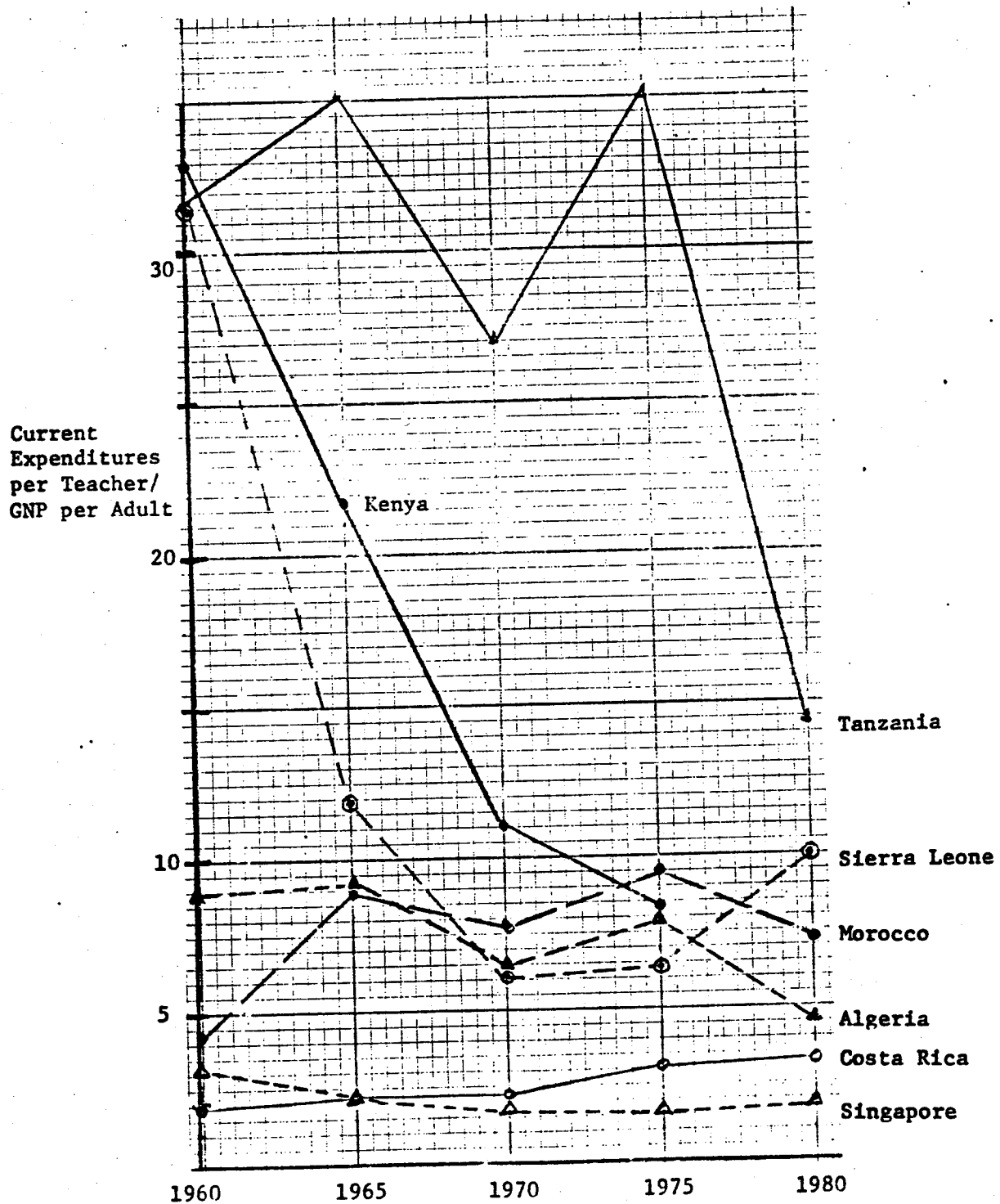Relative Price of Primary School Teachers to GNP per Adult

Figure 5

Relative Price of Secondary School Teachers to GNP per Adult

capital share, while Z is a set of exogenous technological shifters that affect the unit costs of producing schooling in different environments, but are neutral with respect to labor and capital productivity and use. One such technological factor might be the distribution of the population. Dispersed populations may incur greater private and public transportation costs, in terms of both time and money, to provide the same effective schooling services. It is also frequently assumed that rapid population growth, which increases the school age fraction of the population, strains the capacity of the government to provide desired school services.

Analyses of the private demand for public goods have generally assumed that citizens know about the costs of production and the benefits of government spending (e.g., Borcherding and Deacon, 1972). The political process is assumed to be more or less democratic, in the sense that entrepreneur-politicians seek 'election' to deliver efficiently the public goods and services and the associated tax burden that taken together command the support of a majority of voters.[8] The essential idea is that public, as well as private, institutions tend to optimize their input allocation and production decisions as constrained by consumer incomes and perceived benefits of outputs, on the one hand, and technological possibilities and relative input prices, on the other.

If the educational sector thus minimizes its unit costs, that is, produces efficiently, the marginal cost or price of schooling services, P_X, can be expressed as a multiplicative function of the wage paid labor in the educational sector, W, and the return, r, required on public capital (e.g., Borcherding and Deacon, 1972).

$$P_X = (\frac{1}{Z}) \ (\frac{W}{\alpha})^\alpha \ (\frac{r}{1-\alpha})^{1-\alpha} \tag{2}$$

World capital markets are probably more effective than international labor markets in equalizing factor returns. If rates of return on educational physical capital were equalized, the only remaining constraints that would influence the marginal cost of education across countries and over time are the real wage paid to teachers, W, and the exogenous technological conditions denoted by Z. Teacher salaries are most of the recurrent expenses for most school systems. In recent years about 95 percent of current expenses in the primary school systems of low income countries were teacher salaries, whereas in high income countries the proportion is about 75 percent (World Bank, 1983; p. 99). Current expenditures in a school system divided by the number of teachers is the rough measure used here of labor costs for the educational system and is the principal factor determining the relative price of educational services in a country. The price equation can be rewritten as the following, if the rental rate on capital does not vary:

$$P_X = e^{\beta_0} Z^{\beta_1} W^{\alpha} e^{u_1} \qquad (3)$$

where β_0 is a constant, $\beta_1 = -1$, and u_1 is a multiplicative error in the production technology affecting unit costs. Because labor's share of educational expenditures, α, can be observed, the effect of price variation can be estimated from data on teacher wages (Gramlich and Rubinfeld, 1982). For simplicity, educational services are assumed to flow equally to all citizens who have equal numbers of eligible children to benefit.

Finally, the quantity of schooling demanded by the median voter, q, is assumed to be log-linear in the tax, t (or price), in the taxpayers' income, Y, and possibly in technological factors, Z,

$$q = Dt^{\eta}Y^{\delta}Z^{\epsilon}e^{u2}, \qquad\qquad (4)$$

where u_2 is a multiplicative error in the demand relationship.

Expenditures per school aged child (E/P) are then obtained by multiplying quantity demanded by price, where the general tax rate is equal to the marginal price of school services:

$$E/P = DY^{\delta} \; P_x^{(\eta+1)}Z^{\epsilon}e^{u2}. \qquad\qquad (5)$$

Substituting from the production technology (3) in for the price of educational services, logarithms are taken of (5) and the partial effects of income per adult, relative prices (teacher wage), and technological shifters on public educational expenditures per child are expressed as a combination of underlying household demand and production technology parameters:

$$\ln (E/P) = b_0 + b_1\ln Y + b_2\ln W + b_3\ln Z + v, \qquad\qquad (6)$$

where
$$b_0 = (\eta + 1)(\beta_0) + \ln D,$$
$$b_1 = \delta$$
$$b_2 = \alpha(\eta + 1)$$
$$b_3 = \beta(\eta + 1) + \epsilon$$

The errors from the production technology and household demand relationships are combined in v, and are assumed independent of Y and Z. Knowledge of the labor share of inputs, α, permits the identification of the price elasticity, η. The net effect of incomes, δ, and the Z factors--cohort size and

urbanization--on educational inputs and outputs can also be inferred from
estimates of the reduced form equation (6). Cohort size is closely associated
with lagged fertility and family size, and these demographic outcomes are
inversely correlated with investments in child schooling at the family level.
To distinguish between these factors, the total fertility rate is also included
in the vector of control variables denoted by Z (T.P. Schultz, 1985).

An Empirical Decomposition of Educational Expenditures

The composition of educational expenditures may also vary with price,
income and demographic factors, in addition to the overall level of educational
expenditures. To evaluate these compositional effects, it is convenient to
divide school expenditures per school-age child into a multiplicative function
of four observable components:

$$\frac{E}{P} = (\frac{S}{P})(\frac{T}{S})(\frac{C}{T})(\frac{E}{C}) \tag{7}$$

The first term on the right-hand side is the ratio of students enrolled to the
number of children of school age, the enrollment ratio, which can be computed
in most countries for boys and girls separately. The second term is the
teacher to student ratio, that is treated as one possible indicator of the
human capital 'quality' of schooling (Pryor, 1968; Bowles, 1969; Fuller, 1986),
which may be contrasted with the 'quantity' response in terms of enrollments.
The third term is the current expenditures per teacher. The fourth and final
term is the ratio of total expenditures to current expenditures, or an index of
the physical capital intensity of the educational system. Logarithms of the
four component ratios in question (7) are regressed on the same income, price,
technology, and population composition variables used to explain expenditures
per child. The sum of the log-linear regression coefficients for each

conditioning variable in these four component regressions is equal to that variable's coefficient in the overall expenditure per child function. In this way, the effect of income, price, and other factors on overall educational expenditures estimated from equation (6) may be decomposed into the additive effects of each conditioning variable operating on quantity, quality, capital intensity, and teacher salaries.[9]

Educational expenditures are deflated to constant local prices using the GNP deflator and converted to 1970 U.S. dollars according to the prevailing average foreign exchange rate in 1969-71.[10] The 'average' teacher salary is the public current expenditures per primary and secondary school teachers, which is then deflated by national productivity or GNP per working age adult. This relative price of educational services is determined simultaneously with production costs and consumer demands for schooling. Unexplained variation in either production costs (u_1) or consumer demands (u_2) will thus be correlated with relative prices. Consequently, instrumental variable (IV) techniques are employed in estimating equation (6) under the assumption that the price variable is endogenous; the instrumental variables are specifically secondary school enrollment rates, incomes, and urbanization, all lagged ten years.[11] The IV estimates have the additional attraction of being consistent despite the systematic errors-in-variable problem that arises because the logarithmic transformation of relative prices, incomes, and teacher wages are linearly dependent.[12] Although the auxiliary instrumental variable equations for wages undoubtedly simplify the structural process underlying time series of educational systems, the relative price of teachers today is, as expected, inversely associated with the supply of potential teachers trained in the country in previous decades.[13]

Income is measured as GNP in local constant prices converted, as are educational expenditures, to 1970 dollars, and divided by the population of working age, 15 to 65.[14/] Population density is measured as the proportion of the population living in an urban area. The relative size of the school-aged cohort is the proportion of the population age 6-11 for primary school, and the proportion age 12-17 for secondary school, following UNESCO conventions. Period fertility is measured by the total fertility rate, which is equivalent to the sum of age specific birth rates for women age 15 to 49.

Data were first collected for 155 countries with populations greater than one million in 1983, for each five years from 1950-1980. Data on all required series were obtained for at least one year in 89 countries, of which 30 were in Africa, 19 Latin America, 21 Asia, 2 Oceania, 1 North America and 16 Europe. The maximum number of country-year observations was 321 for primary schools and 258 for secondary schools. In pooling of time series observations from a cross section, it is clear that all observations are not independent; neglect of error covariation across observations on a particular country undoubtedly biases reported tests of statistical significance and may bias estimates as well.

There are substantial differences across regions in the size and resource intensity of primary and secondary school systems, which may stem as much from differences in relative prices as they do from the more widely recognized differences in incomes. For example, primary enrollment ratios are 59 percent in Africa and 95 percent in Latin America, while the teacher student ratios and capital intensity are similar, .024 and .030, and 1.22 and 1.15, respectively. Primary school teachers are paid about the same in the two regions, but because GNP per adult is one third as large in Africa, the relative price of teachers is fully twice as high in Africa as it is in Latin America. Expenditure per primary school aged child is $20 in Africa compared with $51 in Latin America.

The potential explanatory role of income and relative prices in determining
school expenditures and achievements is suggested from even such gross regional
comparisons. The large differences between enrollment ratios for boys and
girls in Africa compared with Latin America may also stem from economic
differences between regions. The next section summarizes the fit of the
multivariate production/demand relationships across country observations and
discusses the estimated magnitude of price and income effects, as well as the
effects of urbanization and population growth.

Estimates of School Expenditure Equations

Total expenditure elasticities are reported in row 5 of Table 3, separably
for the primary and secondary school systems. Rows 1 through 4 in Table 3
report the elasticity of the expenditure components designated in equation
(12). The income elasticity of total expenditures (δ) exceed unity; they are
1.35 and 1.47 at the primary and secondary school level, respectively (row 5,
first column). The share of income expended on each level of schooling thus
tends to increase with real GNP per adult. The elasticity of total educational
expenditures with respect to the relative price of teachers is .16 and .24 at
the two school levels (second column). This implies that the elasticity of the
quantity of school services demanded, approximately enrollment, with respect to
the price of labor, or η in equation (9), is equal to -.80 and -.70 at the
primary and secondary school levels.[15]/

The components underlying these income and price effects on total public
expenditures per school aged child differ by school levels. In the primary
schools (top panel Table 3) the income elasticity is about twice as large for
enrollments as for teacher-student ratios: .31 for quantity and .17 for quality
(rows 1 and 2). The physical capital intensity index is not well explained by
any of the economic or demographic variables (row 4), and may contain largely
transitory variations in capital appropriations or measurement error. Teacher

Table 3

**Estimated Elasticity of School System Enrollments and Inputs,
with Respect to Changes in Explanatory Variables**

Level of School System	Explanatory Variables			
	Real Income Per Adult	Relative Price of Teachers	Relative Size of School-Aged Population	Proportion of Population Urban
Primary School Level:				
1. Enrollment Ratio (Quantity:S/P)	.31**	-.70**	.54*	.16
2. Teacher-Student Ratio (Quality:T/S)	.17**	-.18**	-.46**	-.14**
3. Teacher Salaries (C/T)	.87**	1.05**	-1.08**	.08*
4. Capital Intensity (E/C)	.00	-.01	-.12	-.03
5. Total Expenditures per School Aged Child (6-11) (E/P)	1.35**	.16	-1.12**	-.25**
Secondary School Level:				
1. Enrollment Ratio (Quantity:S/P)	.43**	-.96**	.08	-.38**
2. Teacher-Student Ratio (Quality:T/S)	.11	.19**	-.81**	.09
3. Teacher Salaries (C/T)	.94**	1.02**	-.69**	.05**
4. Capital Intensity (E/C)	-.01	-.01	-.23	-.03
5. Total Expenditures per School-Aged Child (12-17) (E/P)	1.47**	.24**	-1.68**	-.26**

*Underlying regression coefficient is statistically significantly different from zero at the five percent level.

**Underlying regression coefficient is statistically significantly different from zero at the one percent level.

Source: T.P. Schultz (1985, Tables 7 and 8).

salaries increase 87 percent as fast as do incomes per adult (row 3), contributing to the large elasticity of the income-expenditure relationship (row 5). Conversely, the relative salary position of primary school teachers declines by about 13 percent with a doubling of average income in a country, a pattern noted over time in figure 4.

At the secondary school level (bottom panel Table 3), the income elasticity is four times larger for quantity (.43) than for quality (.11). The price elasticity is larger in absolute value for secondary schools than for primary, -.97 versus -.70. A decline in the price of school teachers relative to national productivity is associated with a substantial increase in enrollment but with only a modest increase in the ratio of primary school teachers to students and a puzzling decrease in secondary school teacher-student ratios.

Urbanization exhibits a relatively weak, but consistent, relationship with public expenditures on schooling. A country which has ten percent more of its population in urban areas, with 50 versus 40 percent urban, tends to expend five percent less on schooling per child, at both the primary and secondary school levels. These data do not indicate precisely how urban school systems reduce the public costs of education. Consolidation of schools into more efficient sized units to exploit specialized teaching functions in more densely populated areas is often cited as an important source of economies of scale in public schools.16/ Higher population densities could also reduce the private opportunity cost or travel time for students. But the lack of large effects of urbanization reducing teacher-student ratios in secondary schools, or increasing enrollments, suggests that economies of scale or reductions in private student time costs may not lie behind this pattern in school expenditures.

The relative size of the school aged cohort, which is highly correlated with recent levels of population growth, is significantly associated with lower expenditures per student on primary and secondary schools. An increase in the proportion of the population of primary school age by ten percent, from .153 to .168, is associated with an eleven percent decline in primary school expenditures per child. In other words, primary school expenditures do not increase in response to an increase in the size of the school aged cohort. There are offsetting tendencies for primary school enrollment rates to increase for the larger cohorts, whereas teacher-student ratios fall. Teacher salaries, in addition, are substantially lower (ten percent) for the larger school aged cohort, and this appears to be the main factor explaining the lower expenditures per child.

A ten percent larger cohort is associated with an even larger decline in expenditure per secondary school aged child, of about 17 percent. Secondary enrollments are little affected, but teacher salaries and teacher-student ratios are notably lower. Thus, larger birth cohorts do not seem to receive fewer years of schooling, as attested to by the pattern of enrollment ratios, but they do appear to receive schooling of lower human and perhaps physical capital intensity.

This pattern of adjustment in the factor intensity in schools is a plausible economic response to the relative scarcity of both human and physical capital in many poor countries recently experiencing rapid population growth. Much thought has been given to how health care delivery systems might be encouraged to use less human- and physical-capital intensive technologies in low income countries, rather than borrow directly the highly capital intensive (hospital based) procedures used in the industrially advanced high income countries. The tendency for low income countries to substitute away from human- and physical-capital intensive educational production technologies

appears, therefore, to be a reasonable innovation on economic grounds to different relative factor scarcities (e.g., Binswanger and Ruttan, 1978; Hayami and Ruttan, 1971).17/

Fertility, as anticipated, is inversely associated with school expenditures per child, and this partial correlation (not reported) stems primarily from the inverse association between enrollment and fertility, particularly at the secondary level (T.P. Schultz, 1985). Such a pattern could be expected if parents substitute more schooling resources per child for not having as many children. But the estimated relationship between fertility and school enrollments or expenditures is not statistically different from zero at the five percent level, except for primary enrollments of girls. The deletion of fertility from equation (6) leads to slightly larger (more negative) estimates of the effect of cohort size on schooling inputs, but the changes are relatively small (less than 10 percent).

Sex Differences in School Enrollment Rates

Differences in the school enrollment rates of boys and girls may have much to do with the level of child mortality and fertility, the rate at which women migrate from rural to urban areas, leave family and domestic productive activities for employments in the market labor force, and in particular, for their increased participation in the nonagricultural sector, as discussed below in section V. The future economic status of women relative to men appears to depend heavily on their enrollment in school and their ability to benefit directly from the increased productive opportunities created by modern economic growth.

First, the estimates summarized in Table 4 imply that the income elasticity is larger for female enrollment rates than for male enrollment rates: the point estimates for female and male enrollment rates are .43 and .24 at the

Table 4

Elasticity of Enrollment Ratios of Females and Males
with Respect to Changes in Explanatory Variables

Enrollment Ratio by School Level	Explanatory Variables			
	Real Income Per Adult	Relative Price of Teachers	Relative Size of School-Aged Population	Proportion of Population Urban
Primary Level:				
Females	.43**	-.76**	.98**	-.21
Males	.24**	-.63**	.30	-.12
Secondary Level:				
Females	.65**	-1.07**	.75	-.49**
Males	.30**	-.91**	-.34	-.30*

*Statistically significantly different from zero at 5 percent level.
**Statistically significantly different from zero at 1 percent level.

Source: T. P. Schultz (1985, Tables 7 and 8).

primary level, and .65 and .30 at the secondary level. These differences in income elasticity are statistically significant at the ten percent level. Second, the price enrollment elasticities are greater in absolute value for female than for male enrollments: -.76 and -.63 for primary, and -1.07 and -.91 for secondary. A fifty percent increase in incomes per adult from the sample mean of $721 (1970 U.S.) would raise primary enrollment rates for girls from 69 to 83 percent, while the rate for boys would increase from 88 to 97 percent. The girls would improve their school achievement relative to boys from .78 to .85. The 'gender gap' in secondary schools would also in this scenario close by a fourth, with girls increasing their enrollment rates from 17 to 22 percent, while the rate for boys would increase from 26 to 30 percent. Reducing the relative price of schooling has a further effect of improving female enrollments relative to males. According to these cross sectional estimates of income and price elasticities, economic development with its effects on adult incomes and relative wages of teachers is associated with an equalizing of schooling opportunities between boys and girls; these tendencies are also evident in the restricted sample of less developed countries. Here may be a potent dimension of the development process that unleashes demands for the schooling of girls and young women that in turn play a pivotal role in governing the timing and pace of the demographic transition.

Religion is often cited as a traditional cultural force that influences the status of women and their educational opportunities relative to men. Muslim culture, in particular, is often singled out for its distinctive attitudes toward women's status, education, employment and, consequently, fertility. Adding to our framework percentage of the population that is Muslim and the percent that is Catholic, for example, does not change the above noted patterns (T.P. Schultz, 1985).

Regional Patterns in Residuals

Variation across countries and over time in five variables--income per adult, teacher relative prices, urbanization, size of school cohort, and total fertility--account for 92 to 94 percent of the variation in expenditures per child at the primary and secondary school levels. Somewhat less of the variation is explained in enrollment ratios, 38 to 72 percent, respectively. Half of the wide variation in teacher-student ratios is explained by the model at the primary level, but only a fifth of the more limited variation in this qualitative indicator is explained at the secondary school level. Holding these five explanatory variables constant, the residuals from the model are averaged across countries by region and by development status and reported in Table 5. Since the educational input and enrollment variables are expressed in logarithms, the average residuals can be interpreted as the proportion by which the region exceeds or falls short of that predicted by the model.

Expenditures per primary school aged child are 9 to 14 percent above average in East Asia and Africa, but 24 percent below average in South and West Asia. Enrollment rates at the primary level are also above average in Africa and East Asia, but 28 percent below average in South and West Asia and 16 percent below in Latin America. Secondary school expenditures per child are about 16 percent above average in Africa, and some 18 percent below average in Latin America. Enrollment rates at the secondary level show more variation, with Latin America and South and West Asia again reporting rates below that which is expected. In contrast, Africa and East Asia again exhibit enrollment rates well above expectations. The teacher-student ratio is above average in Latin America, but below in East Asia and Africa. Teacher wages are higher in regions such as South and West Asia and Latin America which have invested less than the predicted amount in secondary schooling in the past.

Table 5

Regional Average Deviation of Primary and Secondary School Expenditures and Outputs from Those Predicted

Region:	Africa	Latin America	East Asia	South and West Asia	Europe, Oceania & Canada
(Primary Sample Size)	(62)	(e3)	(21)	(24)	(36)
Total Expenditures per Child (log)	.135	−.0492	.0941	−.244	−.0664
Male Enrollment Ratio (log)	.151	−.164	.110	−.276	.0558
Female Enrollment Ratio (log)	.227	−.106	.202	−.663	.0601
Teacher-Student Ratio (log)	−.0002	−.0256	−.0599	.0633	.0234
Teacher Relative Wage (log)	−.0303	.155	−.0058	.0385	−.155
(Secondary Sample Size)	(35)	(18)	(16)	(21)	
Total Expenditures per Child (log)	.155	−.177	.0258	−.0383	−.0596
Male Enrollment Ratio (log)	.292	−.502	.170	−.0742	.0671
Female Enrollment Ratio (log)	.356	−.355	.235	−.615	.0289
Teacher-Student Ratio (log)	−.129	.227	−.188	.0707	.0295
Teacher Relative Wage (log)	−.0123	.0753	.0104	.0338	−.132

The primary and secondary school regressions identify similar regional patterns in residuals. They suggest an unexplained underinvestment in primary and secondary schooling in the South and West Asian region and in Latin America. Enrollment rates, in particular, are below the expected levels in these regions. The high level of teacher wages in Latin America and South and West Asia may be traced in part to the failure to enroll more children at the secondary level in earlier years. The higher current wage paid for teachers contributes to the higher price of educational services which deters these regions from expending more resources on their school systems.

Deviations from the pattern predicted by the model based on income, price, and demographic characteristics of the population may signal a disequilibrium that might encourage the private sector to provide schooling. There do not appear to be sufficient data to test this conjecture, but private schools in Latin America and portions of Asia and Africa are not increasing their share of enrollments in response to the sluggish public sector provision of schooling services (World Bank, 1986a). Another hypothesis might be that stagnant economic conditions have reduced the rewards for education in the work force, and thereby depressed social and private rates of returns to education lowering investment in schooling.[18]/At least in the case of Latin America, studies do not support the view that the underinvestment in secondary schooling is due to a low return. Indeed, the private returns that accrue to those in Latin America who manage to get a secondary education are substantial (see below Table 6). If the overall framework proposed in this section is tenable, then further study of country level educational outlays and achievements is warranted, both to discover why expenditures on schooling deviate from the pattern estimated here and to determine if these deviations help to account for the rate and structure of modern economic growth occurring in these countries.

Table 6
Average Social and Private Rates of Returns to Education by School Level
(Number of countries reported in parentheses below mean)

Region	Social			Private		
	Primary	Secondary	Higher	Primary	Secondary	Higher
Africa	27 (12)	19 (12)	14 (12)	45 (9)	28 (9)	33 (9)
Asia	18 (9)	14 (11)	12 (11)	34 (5)	15 (8)	18 (8)
Latin America	35 (8)	19 (8)	16 (8)	61 (5)	28 (5)	26 (5)
High Income Countries[a]	13 [b] (6)	10 (15)	8 (15)	19 [b] (7)	12 (14)	11 (15)

[a]Europe, USA, New Zealand, Israel.

[b]Not calculable in the majority of high income countries where the comparison group without a primary education is small and highly unrepresentative at younger ages.

Source: Calculated by the author for most recent years when social returns were available at all levels or all but primary level for high income countries. Original studies summarized by Psacharopoulos, 1973, Table 14 and 1985, Table A-1.

Cross Sectional Findings and Time Series Forecasts

One method for evaluating the overall framework proposed above is to calculate how well the educational changes in the last decade are explained by the actual changes in the conditioning variables that occurred in this period, weighted by the cross section estimates of the model.[19/] For this purpose only about half of the countries in the cross section sample report sufficient data for the decade of 1965 to 1975 and time series forecasts are described only for this subsample (T.P. Schultz, 1985).

The estimated model simulates the changes in expenditures and enrollments reasonably well for the average of 65 observed primary school systems, that is, 93 and 94 percent of the growth is explained from 1965 to 1975 in expenditures and enrollments, respectively. Increases in incomes per adult of about a quarter in this decade would have contributed by itself to an even larger increase in expenditures than the one-third increase actually observed. The relative decline in primary school teacher salaries and urbanization moderated slightly the prediced growth in expenditures. Enrollment rates at the primary level responded predominantly to the decline in relative prices (of teachers), but also increased with incomes, particularly for females.

At the secondary school level the model underpredicts the increases of a third in expenditures and a half in enrollments that actually occurred across the sample of 48 countries. Again, income growth alone would have suggested a more rapid increase in expenditures than actually occurred, whereas the decline in prices, urbanization and a small increase in cohort size restrained the growth in secondary school expenditures per child. Enrollments at the secondary level respond strongly to the decline in relative price of teacher salaries; these price effects are larger at the secondary level than they are at the primary level. Demographic characteristics of the sampled population

did not change appreciably in this period and therefore had little effect on predicted school resources or enrollments.

The main finding of this analysis of international aggregate data from educational systems is that public expenditures on schools have conformed to anticipated patterns with respect to consumer incomes, relative factor prices, and demographic constraints. At the secondary level, and probably also at the primary level, rapid population growth has depressed levels of expenditures per child of school age. This has occurred by increasing class size and lowering teacher salaries, but not by restricting notably enrollment. In the future, as the percentage of the population of school age declines markedly in Latin America and East Asia, an increase in teacher-student ratios may be expected, whereas in Africa where the share of school-aged children will continue to increase for some time, average classroom size may continue to increase. Future research may help assess whether the decline in public school expenditures per student that is associated with rapid population growth is an inefficient bureaucratic distortion in the allocation of social resources or an efficient adjustment in factor proportions to local relative factor prices and returns to the quantity and quality of school services. Since Africa still confronts relatively high prices for teachers, given the described dynamics of expanding their school systems, the continued decline in teacher relative prices should help this continent increase enrollments without necessarily increasing outlays per student. A critical policy question is how the public sector can facilitate this efficient downward adjustment in the relative level of teacher salaries. Teachers will tend to lobby in their own self interest to postpone this adjustment and if they succeed it will slow the continuing expansion in enrollments.

III. Alternative Models of Education and Earnings,

Data, and Policy Implications

A positive relationship between the schooling of workers and their earnings is observed in household surveys and censuses in many countries (Psacharopoulos 1985; Blaug, 1976). This empirical regularity was first examined in high income countries, such as the United States, and then described in many other countries. The conventional economic interpretation is to assume wages measure labor's marginal product and that persons acquire education as they do vocational training at a cost in terms of foregone opportunities that is repaid by future streams of enhanced earnings. The emphasis given to monetary returns to education in the market labor force does not preclude the private and social importance of nonmarket production returns to schooling or for that matter the pure consumption benefits of schooling. The early focus on labor market returns reflected the availability of data and the historic reliance of economists on the marketplace to adjudicate issues of value as codified in national income accounts.

The treatment of education as a form of capital investment embodied in the human agent can be traced back at least as far as Adam Smith, though it enters into the mainstream of economic thinking in the 1950s and 1960s in the work of T.W. Schultz (1961) and Becker (1964). The empirical relationship of wages and schooling is conceptualized as a life cycle regularity or age-wage profile, with the wage increasing first in the cross section with the age of the worker and then decreasing beyond some age, when depreciation of productive skills outweighs new investments in human capital. Mincer (1962) proposed human capital investments on-the-job after the completion of schooling as an explanation for the age-earnings profile. By assuming that post-schooling human capital investment declined regularly with the worker's accumulation of labor market experience, and that human capital investment eventually ceased as

retirement approached, Mincer (1974) was able to account for many interrelated aspects of U.S. earnings for males, by schooling and by post-schooling experience.

These basic empirical regularities are summarized in the earnings function. This relationship has many interpretations, however, depending on what factors generate the relationship (Rosen, 1977). Assume that the real wage, w, of a worker is a function of the individual's years of schooling, s, and other productive characteristics, z, such as ability:

$$w = f(s,z), \tag{8}$$

where z is assumed exogenously given to the individual, while hours of work, school quality and non-school investments in productive marketable skills are initially ignored. If the private cost of schooling to the student or family is approximated by the full-time opportunity cost of the student's time not spent working in the labor market, then the present value (V) of the individual's future earnings can be evaluated at the age of entering school:

$$V(s,z) = \int_s^n w(s,z) e^{-rt} dt = w(s,z)(1/r)(e^{-rs} - e^{-rn}), \tag{9}$$

where n is the number of years after entering school when the individual retires from the labor force and ceases to benefit from education. If the internal rate of return to additional schooling falls with increased schooling, and the discount rate or financial constraint, r, does not vary across schooling levels, then the family or individual continues to invest in schooling until the present value of the individual's earnings is maximized. The optimal level of schooling is that which equates the opportunity cost of attending school (i.e. not working) to the discounted value of the lifetime gain obtained from the increment to schooling, adjusted for the finiteness of the working life:

$$w_s = wr(1 - e^{-r(n-s)}), \qquad\qquad (10)$$

where w_s is the partial derivative of the wage with respect to schooling. If retirement is viewed as infinitely distant, permitting one to neglect e^{-rn}, an expression for the logarithmic wage equation is obtained:

$$\ln w = \ln rV(s,z) + rs, \qquad\qquad (11)$$

Interpersonal differences in s shift the wealth intercept and slope of the wage with respect to the discount rate, while differences in z affect the intercept. Thus, observations on ln w and s do not generally identify the wage function (8) or the optimal schooling attendance rule, $s = D(r,z)$. Observations on ability, z, and the financial constraint, r, may permit one to describe empirically the wage and schooling functions. If capital markets are perfect, and r is the same for everyone, differences in z may allow one to estimate r from a regression of the logarithm of the wage on years of schooling. This estimate does not describe how schooling affects the earnings of any particular person, because z may still influence how much schooling is optimal for each individual. This interpretation of the wage equation (11) is consequently called a reduced-form hedonic wage equation, embodying both a school attendance equation conditional on r and z, and a wage function conditional on s and z (Rosen, 1974, 1977). This hedonic wage function does not presume to identify how individuals vary their school enrollment in response to human capital returns, or how the derived demand for labor depends on the educational attainment of the worker. This hedonic interpretation of the wage function, however, admits more readily to the existence of market imperfections and unanticipated developments contributing to substantial disequlibrium rents in the implicit valuation of different types of inelastically supplied skills (Rosen, 1977; Lucas, 1977; Heckman and Sedlachek, 1985).

The more common interpretation of the wage function is that developed by
Mincer (1974) in which everyone is equally well off from a lifetime
perspective; long run equilibrium compensating differences in costs and gains
leave individuals indifferent among alternative levels of investment in
schooling. In this case, $\ln rV(s,z)$ is identical for all persons or at least
unrelated to schooling. Consequently, equation (11) is an identified
structural relationship. Regressions of $\ln w$ on s provide estimates of r that
can be interpreted as the average private internal rate of return on the
opportunity costs of schooling for a representative individual.[20]

To accommodate a monotonically declining rate of on-the-job human capital
investment by workers after finishing schooling, Mincer, (1962, 1974)
illustrates how a quadratic in post-schooling labor market experience, x, could
describe proportionate changes in wages, net of on-the-job training costs:

$$\ln w_i = \ln w_o + rs_i + a_1 x_i + a_2 x_i^2 + e_i, \tag{12}$$

where the i's now refer to the variables that are observed to differ across
individuals, and e_i is the residual error that is assumed uncorrelated with all
right-hand variables. When x is unobserved, Mincer (1974) approximated it by
age minus age of entry into the school system, minus years of schooling
completed. In other words, it is assumed for males at least that they are
attached full-time to the market labor force after completing their schooling.
Hanushek and Quigley (1978) incorporate information on actual employment
experience for males, assuming that on-the-job training should be curtailed
during spells of unemployment. For women the above empirical approximation
that all post-schooling experience is equally relevant to market earnings may
seem particularly misleading and Mincer and Polachek (1974) demonstrate the

differential effects of spells of market and nonmarket work experience on
women's market earnings in the United States. However, the post-schooling
experience variable originally proposed by Mincer has the attraction of being
fixed for the individual, once schooling has been determined and is, therefore,
not a choice variable or one that is likely to be particularly correlated with
unobserved market-oriented abilities or preferences. Women's actual entry into
and exit from the labor force and even unemployment are endogenous choice
variables that must be jointly modeled with training investment, if the effect
of labor market histories on wages are to be suitably estimated.

Four broad overlapping problems with this human capital approach will be
taken up in the next section. First, there are variables that may determine
wages, such as ability, but which are omitted from the above simplified
specification of the earnings function, and their omission may lead to biased
estimates of the partial association between schooling and wages that is the
basis for benefit-cost calculations or internal rate of return estimation.[21]
Moreover, some variables used as explanatory variables in the earnings function
are to some degree adult lifetime choice variables, such as labor supply or
tenure on current job, and treating these as exogenous conditioning variables
to explain the wage may also bias the estimated coefficient on schooling.
Finally, even education can be viewed as endogenous to the wage determination
process, when the focus of analysis is to estimate how parents trade off
various human capital investments in their children and other bequests
conditional on their children's exogenous endowments, such as sex and innate
ability. But the simplifying convention in most studies of wage determinants
is to treat education as parentally determined and thus exogenous to the
child's lifetime choices as an adult that affect her or his life cycle
productive opportunities in both market and nonmarket activities.

Second, the profile of post schooling on-the-job training investment cannot generally be observed, and alternative proxies for Mincer's post-schooling investment profile have been proposed. An analogous tendency may exist for employers to adopt a life-cycle incentive scheme that drives a wedge between wages and labor's short run marginal product, with the goal of reducing shirking by employees whose output is costly to monitor (Lazear, 1979). In either scheme the present value of the workers' profile of wages is equivalent to the present value of their marginal productivity.

Third is the absence of suitable comparison groups. It is never possible to observe what particular persons would have earned, if they had obtained more or less schooling than they did. Comparisons are needed across schooling groups to estimate benefits and they therefore depend on restrictive assumptions, of which the most convenient is that parents choose the schooling of their children, according to the parents' endowments and preferences, but that these parent attributes do not affect their children's earnings, except to the extent that they influence the children's schooling (see alternative specifications estimated by Leibowitz, 1974). Holding constant in the wage function for parent economic attributes (status) is then one strategy for developing better schooling comparisons (Carnoy, 1967a; Bowles, 1972), but other strategies exist and they can yield divergent conclusions (Griliches, 1977; Chamberlain and Griliches, 1977; Behrman and Wolfe, 1984a). Another approach is to specify explicitly the decision rule for schooling and then correct for the implicit selection bias of schooling in the estimation of the wage function (Willis and Rosen, 1979). In this quasi structural equation approach to self selection of education and the determination of earnings, the researcher must still specify variables that influence the education decision, but do not have a persisting effect on wages, conditional on schooling. This

identification restriction has not yet been motivated by an economic theory and, therefore, has some of the arbitrariness associated with the earlier approach that assigns the decision to prior parent attributes. The empirical importance of these alternative comparison methods are reviewed in Section IV.

Fourth is a discontinuity between the conceptual framework and observations. Theory pertains to individuals investing in their productive capacity over a life cycle, but most data relate to different individuals of different ages, which are then combined to describe a "synthetic" life cycle profile of earnings by age. The different aged individuals in the cross section have matriculated through different quality schools, lived through different historical conditions, such as depressions and spells of unemployment, and were born into different sized birth cohorts which may influence their schooling and earnings opportunities (Freeman, 1979; Welch, 1979; Falaris and Peters, 1985; T.P. Schultz, 1985; Freeman and Bloom, 1985). Moreover, the standard interpretation of the coefficient on schooling in the wage function is that of a private rate of return in an equilibrium investment setting (Mincer, 1974). The applicability of the equilibrium investment theory to a country where modern economic growth has only established itself recently, and then occurred sporadically over time, may be misleading. Older cohorts were probably educated without the expectation of their current realized returns. The effects of economic growth on life-cycle returns to schooling in low-income countries have rarely been analyzed with appropriate longitudinal data, an exception being that of Malaysia by Smith (1983). Lacking the required panel or retrospective data in most countries, short- and medium-run fluctuations in the aggregate economy can perturb the apparent levels of educational returns as estimated from "synthetic" age cross sections, particularly at younger ages.[23/]

All of the above problems in the human capital interpretation of the relationship between schooling and earnings could be viewed as "revisionist" in spirit. This is because they attempt to revise and reformulate the human capital concepts, to modify its empirical specification, to use better estimating techniques for the wage equation, and to collect more appropriate data to bring the evidence closer to the core of the theory. Other critiques of the human capital interpretation of the education-wage regularity seek to find a fundamentally different way to explain how education influences labor market outcomes.

The primary alternative hypothesis is that of signaling or screening (Spence, 1973; Arrow, 1973). According to this view, education does not act to train or to socialize a worker to perform more productive tasks individually or in a team. Rather, education filters or screens on the native ability or productivity of the worker, without enhancing it. Information on ability is signaled to the employer by the worker investing his time and resources in the acquisition of schooling. A private gain from schooling may still be inferred from the schooling-wage relationship, but the social return to schooling is more complex. The production of information needed to assign more able workers to jobs where these abilities are more productive yields a social product, but what is not clear is whether education is an efficient mechanism to accomplish this matching of workers and jobs? To many observers, education would seem to be a time consuming and costly device to screen for the ability of workers, if schools do not also augment their skills. If it could be shown that an alternative screen worked as well as education, but had lower social costs, then the alternative scheme would be socially preferable to education.

The simple fact that no society, capitalist or socialist, has pursued an alternative scheme to education to produce the information needed to match

workers to jobs casts doubt on the validity of this extreme form of the signaling hypothesis. But a more moderate interpretation would hypothesize that school credentials provide an important source of information in the labor market that employers can access at low cost. Educational attainment is a means to "discriminate statistically" among workers in hiring; it is moreover a means that is accepted by some as fair (Blaug, 1985), whereas many other groupings of individuals that might be used to discriminate statistically are challenged by some as socially unfair, such as by race, sex, age, marital status, and ethnic group.

Within an undistorted general equilibrium framework, both the human capital and the screening hypotheses provide alternative explanations for the schooling-wage relationship. It remains to be demonstrated whether the screening theory "can be made to yield interesting and testable implications in the absence of direct measurement of ability" (Arrow, 1973:215). Empirical tests of the importance of the screening hypothesis have followed several directions. The first identifies situations where labor market institutions appear more or less likely to depend on the screening information of schooling in determining labor's payment. Private returns to schooling according to the screening hypothesis should be greater in those situations where the hiring mechanism could readily rely on schooling as a screen. Many studies have contrasted the private returns to schooling in wage employment and in self employment. Self employed, and in particular small farmers, are a class of workers producing within a reasonably well understood technology, where outputs and inputs are competitively sold and bought, respectively. Higher earnings associated with a farmer's schooling, net of inputs, cannot be readily explained by screening but can by human capital. Analogous reasoning suggests that public sector employment might be most prone to emphasize educational

credentials as a screen, but this does not emerge clearly from empirical studies (Psacharopoulos, 1985; Van der Gaag and Vijverberg, 1986b). Educational differentials in wages might be exaggerated at the time of hiring by screening, but should diminish with job tenure as the employer learns more about the worker's productivity. But they do not appear to (Layard and Psacharopoulos, 1974). Since none of these testable implications of the screening hypothesis receive strong support from data in high or low income countries, are we to conclude that screening by education does not occur? Self selection of occupation could explain the first results, if the ablest educated workers choose to be self employed and the ablest uneducated seek to be wage earners, widening the observed education-wage differentials for self employed compared with wage earners. Analogously, job tenure is not exogenous, and employers may selectively fire the educated worker who does not produce at the anticipated level, leading to the persistence in wage differentials by educational level with increasing job tenure. Self employment may be more risky than wage employment and a risk premium to the self employed complicates comparisons of earnings across these types of jobs. The more educated worker may be less prone to quit or turn over at his or her initiative, and this tendency may explain part of the wage premium received by the more educated (Weiss, 1984; Kiefer, 1985; Donohue, 1986). The intrinsic difficulty in discriminating between the human capital and screening interpretation leaves in doubt whether for most practical purposes it matters which mixture of these stories best describe reality.

A third approach views education as an instrument for job competition in a distorted labor market (Bhagwati and Srinivasan, 1977). If wages are not flexible downward and an excess supply of educated labor exists for the available jobs requiring a specified level of education, the employer is

assumed in this model to clear the market by raising the educational standards for the job until the supply of educationally qualified job applicants no longer exceeds the respective demand for labor. This "job ladder" model is similar to the Harris-Todaro (1970) model where urban unemployment, a form of queuing, clears the labor market that is also distorted by an excessive and rigid wage in urban employment. The rationing of jobs by education, if wages are sticky downward, provides a second-best economic outcome in the presence of labor market distortions, and leads to the employment of over qualified workers. An inefficient match of workers and jobs occurs in this formulation. A similar "bumping" model is proposed by Fields (1974a) in a partial equilibrium context. I have not found empirical tests of this third approach to modeling the effects of education in a distorted labor market.

Measurements of distortions in labor markets are rarely conclusive, even though many influential theories of economic development are built on specific sectoral distortions and distinctions in the labor market. The intrinsic problem with estimating the magnitude of distortions is the expectation that variation in unobserved productive characteristics of workers provides an alternative explanation for wage differences between workers in distorted and undistorted sectors. For example, the empirical tendency for union wages to exceed nonunion wages, given the worker's observed skills, suggests an economic distortion may be created by unions (Lewis, 1963, 1985). But if unionized sectors attract more productive workers or the union as an institution raises the productivity of its membership, no loss in efficiency may result (Freeman and Medoff, 1984). A challenge to labor economics is to document situations where there appear to be wage differences between otherwise similarly endowed and situated groups of workers. If explanations for these regularities, or group wage differences, cannot be confirmed, the empirical weight of the

evidence may grow and a consensus for policy might follow, as in the case of the effect of minimum wage policies on employment opportunities for the least experienced and skilled workers in high income countries (Welch, 1978). One conclusion of this survey is that studies that ignore the human capital heterogeneity of labor in low income countries may be seriously misleading. The large wage differentials observed by worker education (as well as by sex and often region) realistically preclude interpretation of aggregate sectoral wage variation as compelling evidence of distortions, particularly in low income countries. Refining the evidence of labor market distortions within and across low income countries at the disaggregate level of workers and firms is an important research frontier in development economics. The theories of wage variation that were recapitulated in this section may provide a basis for these microeconomic studies of wage structures. The next section reviews in more detail the empirical problems of inferring the returns to education from microeconometric studies.

IV. Rates of Return to Schooling in Market Activities

Estimates of the rates of return to education can be calculated on two bases. The private rate of return is the internal rate of return that equalizes the present discounted private opportunity and direct cost of schooling with the discounted value of the private after-tax gains. The social rate of return adds to private costs the public and private subsidies that the individual student and family do not bear, and augments the private gains to include taxes and any net positive social externalities that are not captured by the private individual and family. In reality, it is rare for studies to assign monetary values to social externalities of education, or to private nonmarket benefits of schooling. Relatively few private return calculations

even deduct for the marginal income taxes paid the state by the more educated worker. This latter task is not conceptually difficult, but would not make any difference if taxes were proportional to wages. Consequently, the distinction between private and social returns is in practice the inclusion of the social cost of public expenditures per pupil in addition to private family costs of schooling. Social returns are, therefore, lower than private returns to the extent that the educational system is publicly subsidized.

Private returns provide one incentive for individuals and families to invest in education, while the consumption value of schooling provides the second (unobserved) motivation for private decisions regarding education. For social resources to be efficiently allocated, they should be invested in each level and type of education to the point where the marginal social returns are driven down to levels that social and private investments receive in other sectors of the economy.

Private individuals are attracted to higher private return activities, but the efficiency rationale for public subsidies in education is no different than elsewhere, as Becker observed many years ago (1964). Neglecting distributional issues, public subsidies for education should vary in proportion to the positive social externalities generated by the specific type and level of education. It is commonly believed that externalities from education are more substantial at the basic primary level, and eventually peter out at the higher technical specialized levels of university training, where persons capture most of the social benefits (minus taxes) from their education (Weisbrod, 1964). Research activities that are often combined with higher education may, however, be responsible for substantial social externalities, to the extent that their services are nonappropriable by the research university and hence freely available to firms and households.

Estimates of rates of return to education for 46 market economies are summarized in Table 6, by region and school level (data drawn from Psacharopoulos (1973, 1985) based on the most recent year reported.) As noted earlier, social returns decrease at more advanced levels of development across countries and they decrease, as a rule, at higher levels of schooling within countries. Social returns tend to be about twice as large in Africa and Latin America (15-30 percent) as they are in high income countries (8-13 percent). Moreover, private returns are often twice social returns in low income regions. The exception is Asia, where social returns in secondary and higher education for the same countries (not reported) are only moderately higher than private returns, because public subsidies at these levels are a moderate share of private costs. Africa, and to a lesser degree Latin America, has provided large public subsidies for secondary and higher education. These relative differences in rates of return are generally replicated by estimates of Mincerian earnings or wage functions based on household survey data, as illustrated by equation (5) in section III. The average proportionate shifts of these earnings functions with respect to years of schooling are smaller, however, ranging from 13-20 percent for Latin America and Africa to 6-9 percent for high income countries (e.g. Psacharopoulos, 1985: Table 3).

Within a country the pattern of diminishing social marginal efficiency of human capital investments gives support to the view that public subsidies should focus first on the expansion of primary and then secondary school systems. The overall picture suggests that returns are highest in Africa where large educational investments began only recently. The high returns in Latin America may be due to the sluggish expansion of public schools (Section II), whereas East Asia and high income countries have achieved a level of human capital investments such that social returns to schooling are roughly on a par with private returns after taxes from physical capital.

There are, however, issues surrounding the empirical measurement of the returns to schooling outlined in section III, that need to be discussed further. The first class of problems involve estimation bias introduced by inadequate specification of student ability, parent background, and school quality. Ideally, these could be corrected by agreement on specification and availability of better data. Short of that ultimate goal, most studies must build on imperfect specifications and data. My own judgments are offered below as to what are the more serious problems and the direction of bias to be anticipated. The second class of problems arise because only a portion of the population reports the information sought on wages and related productive characteristics. If selection into the sample is related to the schooling-wage relationship, a bias may be expected. Selection problems are likely to be more important when the criteria for inclusion in the sample involves the choice of occupation, labor force participation, or migration, all of which can be plausibly linked to the educational qualifications of the worker. In these cases, the sample selection problem is essentially one of estimating by simultaneous equations methods some form of labor market behavior and the wage equation. There is no consensus, however, on how to choose the identifying restrictions needed to estimate thus the returns to education while correcting for this source of sample selection.

Student Ability, Parent Background, and School Quality

The foremost source of bias embodied in estimated education-wage relationships occurs because of the role of student ability and parental status in a more completely specified model of the wage determination process. As illustrated earlier, it is likely that more able students obtain more schooling, and wage payments for native ability are then being incorrectly attributed to schooling. Even when ability is observed before schooling

occurs, a rich variety of alternative methods have been proposed to disentangle education's independent effect on wages. This large literature cannot be adequately summarized here (e.g. Griliches and Mason, 1972; Hause, 1972; Welch, 1975; Taubman, 1976; Behrman et al., 1980; Willis, 1987). If ability is simply omitted from the wage function, estimates of the rate of return to schooling may be upward biased, but in most cases by no more than 5 to 15 percent. Indeed, when ability and schooling are symmetrically treated as variables which are measured with error and potentially affected by common unobservables, Griliches (1977) illustrates with U.S. panel data how the "true" effect of schooling is actually underestimated by omitting ability and covariant unobservables from the analysis. Boissiere, Knight and Sabot (1985) examine data from Tanzania and Kenya to assess how cognitive achievement is influenced by schooling and native ability, and how all three factors affect later earnings in the labor force. Not only can ex ante ability be held constant, it is also possible to evaluate whether education's effect on wages operates through test scores or by other means such as credentialism or screening. They conclude from their data that "literate and numerate workers are more productive, and education is valuable to workers because it can give them skills that increase their productivity" (p. 1029). Their analysis of contemporary East Africa "provides strong support for the human capital interpretation of the educational structure of wages" (p. 1029).

Another important and often omitted variable is parent background or social status. If wealthy and powerful parents secure for their offspring both education and a well-paying job, the correlation between their children's education and wages may overstate the "true" effect of education on wages or labor productivity. Carnoy (1967a) examines this hypothesis with intergenerational data from Mexico and others have replicated this approach

elsewhere, conditioning wages on various characteristics of the parents as well as on the worker's education, age, etc. Most studies have found, as did Carnoy, that father's occupation is strongly related to the child's wages, but contrary to expectations, that much of this "effect" of parent background is intermediated through the child's educational attainment. Thus, "increasing the average skill level of the father has only a small effect on the son's incomes" given the son's schooling (Carnoy, 1967a; p. 418). In other words, the substantial private rates of return to education that Carnoy found in Mexico "show little sensitivity to changes in average occupational level" of the father. Heckman and Hotz (1986) found a greater sensitivity of schooling returns to their inclusion of both mother's and father's education in a recent analysis of a 1983 survey from Panama . Their results suggest that the role of the mother's education may exceed that of the father's, just as Leibowitz (1974) found in a U.S. sample from the 1950s. The estimated average private rate of return to schooling in Panama was reduced from 13.0 to 8.6 percent with the inclusion of both parent's education variables (Heckman and Hotz, 1986).

Various interpretations are given to the explanatory role of parent education or background in the child's wage function. The one proposed at the outset is nepotism and social stratification that allow influential parents to place their child in a favorable job, frustrating efficient market mechanisms. (Bowles, 1972). Alternatively, more educated parents may provide the child with a more favorable learning environment at home, thereby lowering the cost of learning or increasing the market productivity of attending school for a given number of years (Leibowitz, 1974; Murnane, et al. 1981). The genetic transmission of ability from parent, proxied by education, to child is another possible mechanism behind this relationship. Parents may also vary their market investment in their children, given the number of years that their

children attend school, through the "quality" or resource intensity of the schooling they provide their children. Adopting this final interpretation of the source of the parent background effects on the child's future wages, social scientists have proceeded to specify and measure how home learning environments differ, and how the level and mix of resources internally allocated by the school system to the pupil's education varies, and, finally, what are the effects of these different mixes of investment inputs on the child's subsequent earnings in the labor force.

Originally the addition of parent education or other indicators of parent socioeconomic status to the earnings function of a child was designed to purge the returns to education of the effects of parent wealth and influences that were not operating through the child's education. But Griliches (1977) and others have shown that inclusion of parent education or background can also over-correct for this possibility and bias downward the educational returns or merely increase the erratic performance of the earnings function. To the extent that more educated parents tend to invest more in the education of their children, it is not clear why this component of education should not be examined to infer returns to schooling. To understand how educational decisions are made intergenerationally should provide a structural foundation for explaining who gets educated, as well as eventually estimating how the observed returns to education are affected by who receives the education (Willis and Rosen, 1979). It may then be possible to estimate additionally how parent education also influences their children's earnings by providing them with home investments, social connections, and physical wealth.

Unfortunately, relatively few bodies of data measure the home and school environment in such detail and also follow over time the child's subsequent wage profile in the labor market. Nonetheless, imperfect data have been used

widely since the 1960s to appraise the returns to the quality as well as quantity of schooling, culminating in the estimation of education production functions (Kiesling, 1971; Averch, 1974 et al.; Hanushek, 1979, 1986). Welch (1966) first analyzed public expenditures per pupil, length of school year, teacher salaries, and classroom size, among other variables, to account for market wage returns to expenditures on schooling across U.S. states (assuming people did not move). Where parallel school systems serve distinct segments of the population, the consequences for wage differences between these populations can be decomposed into those attributable to different years of schooling and to the different resource intensities of their segregated school systems (Welch, 1975; Orazem, 1983).

Others have employed micro data on the earnings of individual workers, their schooling, and the characteristics of the schools they attended (e.g. Johnson and Stafford, 1973; Link and Ratledge, 1975; Rizzuto and Wachtel, 1980). The analogous analytical process has been pursued in low income countries with proxies devised to measure the "quality" of schools and teachers (Birdsall, 1985). These studies address the policy choice of extending more schooling to more people by pushing out the extensive margin, or investing those resources in more intensive schooling activities, such as improving the training and salaries of teachers. Clearly, a tradeoff of efficiency and equality of opportunity may have to be faced when in practice public funds may either be used to expand the quantity or quality of schooling (Behrman and Birdsall, 1983). Even if it could be assumed that the benefits flow in either case to the same person, and thus there were no distributional effects, it is difficult to infer whether the future market productivity of a worker who is offered more years of existing quality schooling will be larger or smaller than if those same educational resources had been used to provide the worker with better quality schooling.

One empirical conclusion should be expected: when "qualitative" measures of schooling are added to the earnings function, the estimated private returns to "years of schooling" will undoubtedly decrease. This follows from the general underlying positive covariance between quantity and quality of schooling. Regions spending more on schooling will attract more students to enroll and stay in school longer, because for the same private opportunity cost of the student's time, a more concentrated and presumably more valuable investment is accumulated. It is also a common empirical regularity to observe a positive regional association between parent private home investments (that are generally unobserved in data used to study wages) and public school quality investments. Thus, unless the home environment is held constant, variables that measure school quality will also proxy these reinforcing background private investments and bias upward estimates of the wage returns to school quality and quantity. Regardless, the simple estimate of returns to school quantity should always be interpreted as capturing the effect of increased quantity plus the uncontrolled background association in the sample between school quality and levels of schooling.

While we cannot confidently generalize about the relative returns of school quality and quantity on market wages, international comparative studies of education's effects on standardized school achievement tests do suggest several regularities that might guide future research to measure how the economic returns to schooling differ across these extensive and intensive margins. Generally, "the potency of a pupil's home background or social status is significantly less (important) than it is in the industrialized countries in determining pupil achievements" (Heyneman, 1984: p. 299). Conversely, "the variation in academic achievement attributable to factors internal to school classrooms, such as the quality of the teacher and physical facilities" is

significantly more important in explaining test performance in low income countries than in the more developed countries (Heyneman, 1984: 299). Although the reason for these differences in the roles of family background and school quality in determining pupil achievement is not well established, some have concluded that the leverage of public policy on pupil performance through improvements in school quality is greater in low income countries than it is in high income countries (Heyneman and Loxley, 1983). Unfortunately, the relationship between test achievement scores and subsequent wage rates is not always strong, raising the question whether test achievement is a satisfactory indicator of schooling output, particularly across countries where the derived demands for educated skills differ greatly. Indeed, it has been a frustrating finding of many of the more thorough studies of educational production functions in the United States and in other countries that well-accepted dimensions of school quality, such as teacher-student ratios, exhibit little systematic relationship to student performance (Averch, 1974; Simmons and Alexander, 1978; Hanushek, 1979, 1986). More research is required to generalize about how changes in the mix of school inputs and management incentives affect school outputs. Moreover, economic evaluation studies of schools must go beyond assessing the impact of schools on student test achievements and follow up the differential economic success of students in the labor market by measuring their subsequent earnings. As with estimates of the returns to years of schooling, estimates of the benefits from using a more efficient mix of inputs in the school may be biased if the sample variation in input mix is not randomized, and thus potentially correlated with unmeasured variables determining earnings or who is educated, either at the level of the individual or school.

Reallocations of inputs internal to school systems may improve the efficiency of schools, but inputs other than teachers absorb only a small fraction of public school expenditures in poor countries. Policies that attempt to raise the quality of educational services, when public sector educational budgets are already strained, may retard the growth of enrollments. The last to enroll or to be allowed to advance to the next class, when rationing of school places occurs, is likely to be a child from a relatively poor family. Hence, improvement in the quality of schooling may, in practice, be purchased at the cost of a less equitable distribution of schooling opportunities. Given the pattern of social returns by level of schooling (Table 6), both efficiency and equity would dictate expansion of basic primary and secondary education. When it comes to reorienting educational policy to improve school quality in low income countries, achieving this goal will probably entail a sacrifice in terms of moderating growth in enrollments. Any gain in returns associated with increasing school quality will come at a cost in terms of equity or the personal distribution of those returns.

Labor Supply and Unemployment

Individuals with different levels of education may choose to work different numbers of hours. Rates of return to education will then differ depending on whether returns are based on comparisons of hourly wage rates or on an annual rate of earnings (T.P. Schultz, 1968). Appropriate methods for dealing with adjustments in labor supply in constructing the benefit stream from education have received little attention, but may be more important in low income countries than they are in the industrially advanced countries.

The first source of such a change in labor supply behavior might be attributed to the investment resources used to acquire the education. This reduction in the more educated individual's or family's physical wealth would

reduce the demand for leisure and induce him or her to work longer hours
(Lindsay, 1971). The negative sign of the physical wealth effect on labor
supply is based on the standard assumption that the demand for leisure and time
in nonmarket production is a positive function of wealth. But according to
Mincer's (1974) equilibrium investment framework, the present value of the sum
of human and physical capital is not affected by investments in schooling. In
this case, the total wealth effect of schooling should be unimportant.

The voluntary labor supply response to the increased wage rate offered to
more educated workers can be decomposed in the Slutsky equation into an income
effect and an income-compensated price (wage) effect. Again the Mincerian
framework would lead us to expect relatively small income effects associated
with schooling, if individuals face a common financial constraint and can
borrow at the same interest rate. This assumption may be less realistic in
countries with less developed loan markets for investment in human capital and
greater inequality in family wealth. In these countries one should expect to
observe a greater tendency for the more educated to work fewer hours. This
tendency would lead to underestimating the private return to schooling based on
annual earnings, because the more educated receive part of their return from
schooling in the form of increased time for nonmarket activities, including
leisure. Conversely, this argument would lead one to expect a greater tendency
for the more educated to work longer hours in societies where family wealth is
more equally distributed and loan instruments for investments in human capital
are widely available. The income compensated price (wage) effect would
encourage the more educated to work longer hours. If this were the only effect
of education on labor supply, annual earnings comparisons would overstate the
private returns to schooling.

For youth and married women, the partial association of education and hours of market work tends to be positive, if other sources of income, such as family or husband income, are held constant. If hours in the labor market increase with education, then the change in "annual earnings" associated with schooling probably overstates private returns, because the offsetting loss of nonmarket production and leisure is not deducted from the gains in market earnings. Change in "wage rates" (e.g. annual earnings divided by hours) attributable to education is thus a more suitable approximation of the welfare benefits from schooling than changes in weekly, monthly, or annual earnings, particularly for women.23/ The preferred dependent variable in the earnings function is, thus, the logarithm of the hourly wage rate, deflated of course by local prices. To introduce measures of labor supply among the right-hand-side explanatory variables in the wage function is also inappropriate, unless they are treated as endogenous.24/

Unemployment can represent a productive period of search for an appropriate match of workers' skills and job opportunities. If unemployment is greater among more educated youth during a relatively short period after they complete their schooling, the opportunity cost of this search should be reckoned along with the other costs of schooling to be paid back by enhanced earnings in later employments (Blaug, 1973; Turnham, 1971; Berry, 1975; Gregory, 1980; Berry and Sabot, 1984). A decade or longer after entry into the labor market, unemployment is generally lower among the more educated (Ashenfelter and Ham, 1979; Nickell, 1979). If this pattern does not reflect a current choice of the worker between nonmarket activities and market work, then unemployment may be called "involuntary." One of the private gains from increased schooling is presumably the enhanced access to regular work opportunities in the market labor force, and hence a lower incidence of such involuntary unemployment.

While individuals may reduce their own unemployment by investing in schooling, it has not been empirically shown that a more educated labor force experiences in the aggregate less unemployment. Private returns to education may, thus, exceed social returns from this source.25/   In many studies that construct estimates of the returns to education, the unemployed appear to be excluded and variation in labor supply is neglected. One explanation for the omission of the unemployed from the working samples from which rates of return to education are estimated by regression methods is simply the lack of an appropriate wage for the currently unemployed. Unemployment is probably also more difficult to measure reliably in low income than in high income countries, because of the greater ambiguity in classifying activity as nonmarket or market. Nonetheless, returns to schooling should be estimated for all persons, to avoid potential sources of selectivity bias. Simultaneous analysis should, therefore, evaluate how education affects market labor supply behavior, unemployment, and the wage rate of those employed.

Occupational Choice

Returns to education are, for a variety of reasons, sometimes calculated within subpopulations. If these subpopulations are defined by exogenous characteristics, such as race, caste or sex, interpretation is relatively straightforward, though differential participation in the labor force may remain a source of bias in intergroup comparisons. But when the subpopulations are not closed, as in the case of regions, because interregional migration is substantial, or in the case of occupations, because education may be an important qualification for entry into an occupation, a complex problem of selection bias may be present, and its empirical valuation may be difficult. In an extreme instance, Eckaus (1973b) calculated for the United States returns to education within a large number of narrow occupations, and drew the

conclusion that educational returns (within occupations) were lower than other studies would have led us to expect. With hindsight, it is obvious that what Eckaus had shown was that much of the returns to education accrue through the changes in occupation that education facilitates. University education might not increase substantially the productivity of a plumber, for example, and consequently persons with university degrees who remained plumbers would be a highly unrepresentative sample of university graduates. Both the technology of plumbing and the self selection of persons into that occupation could contribute to the observed unrepresentative returns within this single occupation.

The same criticism is relevant to the careful studies by Wolpin (1977) and Riley (1979), that sought to determine whether the wage-education relationship would differ across subsamples of occupations, for which the informational screening role of schooling might be more or less important. Their evidence in support or against the screening hypothesis is ambiguous, therefore, because of the possible self-selection of different types of persons into different occupations. The problem is posed and solved under specific assumptions by Hay (1984), where he models the decision of U.S. physicians of their specialization, for example surgery, and the later earnings they receive within such a medical specialty. A selection correction term (see Heckman, 1979) is introduced for all of the occupational choices in all of the occupation-specific earnings equations. Hay's method then permits one to estimate the returns to each specialized educational path for a representative individual, rather than the biased-by-selection returns for those who actually opted for each specialization. Vijverberg (1986) has also developed a method for analyzing jointly the occupational choice and wage equation, conditional on being a wage earner. Much further empirical study of occupational choice and

<u>earnings will be needed before it can be confidently concluded that returns to education are distinct in different occupations, or that these differences in returns are those prescribed by any form of the screening hypothesis</u>.

It is still tempting to decompose the effects of such exogenous traits as education, race or gender on earnings, and appraise what portion of the effect occurs because of occupational sorting and what portion occurs within occupations (Polachek, 1979). Since the stochastic processes determining occupation and earnings are undoubtedly affected jointly by unobserved factors, this form of decomposition of a simultaneous equation system is feasible only when identifying restrictions are known <u>a priori</u>, that is, a factor is known that influences occupation but not earnings, which can therefore be used to explain occupational sorting but can be justifiably omitted from the structural earnings equation. Studies nonetheless assume, without a clear justification, that occupational choice and earnings are block recursive and hence stochastically independent (Birdsall and Sabot, forthcoming). How well these single-equation estimation methods approximate reality is not yet known.

Possibly the most important occupational distinction is between wage and salary earners, on the one hand, and self-employed workers, on the other hand. Most research on the returns to schooling focuses on the former class of employees, because labor earnings are more directly observed for them, without first deducting inputs from gross income.[26/] When wage earners are a large fraction of the labor force, as in high income countries, omitting the self employed has become a standard, if indefensible, practice in empirical studies. When employees are a small but growing fraction of the labor force, there is reason to suspect that the synthetic age-wage profile across education groups of employees may not be a satisfactory basis for estimating lifetime returns to schooling in the overall economy.[27/] Yet there are relatively few studies that

analyze how selection into the employee subsample could bias estimated returns to education (e.g. Anderson, 1982; Griffin, 1985).

If one ignores the probable covariance between the choice of whether to be a wage earner or a self employed worker and the worker's potential earnings, it is possible to estimate without selection correction the wage functions for self employed and wage earners separately, and simply compare the coefficients on the worker's years of schooling within the two strata. The proportionate upward shifts in wage rates or earnings with schooling are of a similar magnitude within these strata in Thailand (C. Chiswick, 1979), Colombia (Fields and Schultz, 1982), and Israel (Ben-Porath, 1986). The greater role of transitory income variation in the earnings of self employed has been frequently emphasized in the economics literature, but its relevance to the returns realized from education is unclear. There are, nonetheless, two salient weaknesses with such comparisons. First, they assume that the self employed are able and willing to report their labor earnings, net of the value of purchased and owned inputs (e.g. rental value of owned land and business capital). In fact we know from developed countries such as the US that farmers and unincorporated business persons report incomes to surveys and tax authorities that are much less than the income imputed to them by trustworthy national accounts. How this understatement of self-employed income would bias comparisons by education is unclear. To reduce this potential source of reporting bias, Teilhet and Waldorf (1983) followed a small sample of self-employed in the informal sector of Bangkok to derive estimates of their net return to labor. The returns to schooling appeared to be no less for these self employed than for wage earners, though obtaining more education predisposed men in their sample to obtain a job for wages.

Second, the fraction of the labor force that is self employed tends to increase across age groups in the cross section. It would appear then that the life cycle process of accumulating skills, experience, contacts, and physical capital increases the likelihood that the individual chooses to become self employed (Fields and Schultz, 1982; Ben-Porath, 1986). In approaching retirement, self employment may also afford a worker more opportunity than does wage employment to adjust labor supply downward and is thus more attractive as a means to smooth the labor supply path at older ages (Fuchs, 1980). However, the tendency for the share of self employed workers in the labor force to decline with development has been long noted (Kuznets, 1966) and it could also explain the below average fraction of young workers in self employment and the rising fraction before retirement. There is little empirical evidence to disentangle the life cycle and the development process as they both influence who chooses wage versus self employment and how this choice interacts with returns on education. The null hypothesis remains to be rejected, namely that education increases the productive possibilities of workers in both wage and self employments.

A study by Behrman and Wolfe (1984b) of Nicaragua in 1977 presents estimates of earnings functions for men and women corrected for two aspects of sample selection: participation in the labor market, and reporting of labor earnings. This second restriction of the sample may exclude many self-employed workers, whose gross income includes undetermined amounts of returns to capital and land and unpaid family workers. How to treat missing variables in microeconometrics is a largely unresolved problem; to treat missing date as a potential source of selection bias is appealing in its generality. However, this corrective strategy can be effective only to the extent that the structure of the selection decision rule is well understood. Observed variables must be

singled out that reasonably enter that decision rule but do not belong directly in the earnings equation. In the Behrman and Wolfe study of Nicaragua, the self-employed may find it particularly hard to reckon net earnings exclusive of the value of intermediate inputs and the rental value of land and owned productive assets. In their sample, only 68 percent of Nicaraguan male members of the rural labor force report earnings, while 91 percent of the male labor force in the capital city of Managua report earnings. Reporting earnings may thus be a proxy for the individual's occupation or sector of employment. The variables that Behrman and Wolfe specify to identify who reports earnings are the participant's "other income" and "own-farm other income" and the female respondent's "participation in the formal or informal sector." As anticipated, farmers and participants in the informal self-employed sector report their earnings less often than do those working in the formal sector, particularly those in Managua. Selection correction procedures that introduce occupational effects into the earnings function may introduce their own bias, as discussed above, and these might be more serious than ignoring the original selection problem associated with non response. This would seem a danger when the variables identifying the selection correction are themselves endogenous and correlated with the earnings outcome, as would appear to be true here (i.e. owned land or informal sector attachment). But the perennial problem of missing data and nonresponse bias is important and must continue to be studied from many perspectives in the hopes that eventually we will learn how to live with this limitation of microeconomic household survey data.

Anderson (1982) corrected for the selection bias in her sample of Guatemalan husbands, where only about half of her sample reported a wage and the others were mainly self-employed. The slope of her estimated market wage offer curve (identified by the exclusion of wealth) with respect to schooling

was slightly larger than the slope of the nonmarket (reservation) wage curve (identified by the exclusion of experience) with respect to schooling, .094 versus .074, based on Heckman's (1979) assumption that the errors were normally distributed (Anderson, 1982; Table 3). Her selection correction was statistically significant but her data do not appear consistent with the normality assumption. In this case, husband's weeks of participation as a wage laborer are positively related to his education, and negatively to his wealth.

The Education and Productivity of Farmers

Many studies have specifically analyzed the education of farmers as a factor in agricultural productivity. Griliches (1964) in the U.S., and Hayami and Ruttan (1970) across countries, found that the education of farmers was an important determinant of agricultural productivity. Sixteen studies of the relationship between farmer education and productivity in low income countries were recently surveyed by Lockheed et al. (1980) and extended in Jamison and Lau (1982). These studies analyzed 37 sets of farm level data that allowed estimation of the effect of farmer education on profits or output, controlling for other variables. Averaging the varied effects of education obtained in these studies, the productivity of farmers was on average 8.7 percent higher if they had completed four years of primary schooling (a threshold level) compared with none. More refined calculations are also developed by Jamison and Lau (1982) for three countries where they could further analyze the primary data. From their samples from Malaysia, Thailand, and South Korea they estimate a year of schooling is on average associated with a net increment to farm product of 5.1, 2.8 and 2.3 percent. Social returns to rural schooling are then calculated for the 1970s under various working assumptions; the social returns are between 25-40 percent, 14-25 percent and 7-11 percent in Malaysia, Thailand and South Korea, respectively.

How education influences production has been scrutinized most closely in the case of farmers, where researchers can build on a long tradition of econometric production and management studies. The organizing hypothesis first advanced by Welch (1970) was that education could have three distinct effects on production. First, education might enhance the productivity of measured inputs including that of an hour of labor. Second, education might lower the cost of deciphering information about the production technology that thereby increases productive efficiency by changing the selected mix of outputs and inputs. This is a static allocative efficiency effect. Third, education might facilitate more rapid entrepreneurial responses to disequilibria created by changes in output and input prices, and by the introduction of new inputs and production technologies. Huffman (1974, 1976, 1977), Fane (1975), Khaldi (1975), Wu (1977) and Pudassini (1983) proceeded to decompose the productivity gains of more educated farmers into efficiency and allocative gains. Huffman (1974) illustrates how the decline in fertilizer prices led more educated farmers to use more fertilizer and thereby increase their net farm income. Aggregate and individual data are also used to document how more educated farmers are more likely to adopt new productive innovations and accelerate the diffusion of such innovations (Rosenzweig, 1982b; Jamison and Lau, 1982).

A final dimension of the adaptive response of the more educated farmer is his supply of family labor off-farm. In other words, the occupational mobility that education facilitates is also linked to dual employments, on-farm and off-farm. In the U.S. and in low income countries, a growing share of the income of farm families is from non-farm activities (Huffman, 1980; Rosenzweig 1980) and education increases these income flows as well as adding to agricultural production. When returns to education are larger elsewhere in the economy (Gisser, 1965; Moock, 1976), the more educated farmer and his family

are the first to leave agriculture, and when returns in agriculture boom, it is the more educated managers who are the first to reenter agriculture, at least in the US (Tolley, 1970). The measurement of returns to education from migration can, thus, as with occupational choice, not be readily separated from the returns to education within a particular segment of an open economy.

Migration

It is generally observed that the better educated are more likely to migrate, unconditionally and when conditioned on other motivating factors (Schwartz, 1976; Greenwood, 1975; T.P. Schultz, 1982b). Several of the working assumptions that permit one to interpret the proportionate shift in the earnings function associated with a year of schooling as a private rate of return may be in error when migration occurs. Real wages are generally higher in urban than in rural areas of low income countries, 28/ and net migration therefore tends to occur from the rural to the urban sector. Individuals who incur their opportunity costs of education (foregone earnings as a student) in the low wage rural sector and then enter the high wage urban labor force stand to gain from education, from migration, and from a combined effect of arbitrage in the investment process. Given the tendency for more educated men and women to migrate in their youth shortly after finishing school, it can be misleading to estimate a return to schooling within the rural sector that excludes the gains from the increased probability of outmigration from the rural sector. Conversely, estimating a wage function for only the urban labor market may also be misleading, because it does not recognize that rural in-migrants realize larger returns than estimated given because their costs of attending school in rural areas were lower.

The problem is illustrated empirically in Table 7 with data from the 1973 Census of Colombia. Estimates of monthly earnings functions in the upper panel

Table 7

Monthly Income Equations for Rural and Urban Workers
by Current Residence and Birthplace: Colombia 1973
(beneath regression coefficients in parentheses are the absolute values of the t ratios)

	Intercept	Schooling in Years	Post School Experience in Years	Experience Squared (10^{-2})	Sample Size	R^2
A. By Current Residence						
Men:						
Urban	5.029 (447.)	.181 (227.)	.0827 (100.)	-.118 (75.)	77,320	.4130
Rural	5.320 (294.)	.103 (48.)	.0389 (29.)	-.0539 (23.)	42,130	.0638
Women:						
Urban	4.742 (332.)	.208 (181.)	.0547 (48.)	-.0813 (36.)	38,144	.4656
Rural	4.624 (.77)	.201 (36.)	.0246 (5.53)	-.0270 (3.43)	4,734	.2279
B. By Region of Birthplace						
Men:						
Urban	4.972 (340.)	.191 (185.)	.0831 (73.)	-.121 (53.)	37,330	.4858
Rural	4.924 (386.)	.190 (192.)	.0699 (73.)	-.0969 (57.)	82,120	.3191
Women:						
Urban	4.798 (218.)	.205 (118.)	.0589 (34.)	-.0892 (24.)	15,451	.47195
Rural	4.666 (251.)	.213 (135.)	.0487 (33.)	-.0706 (25.)	27,429	.4050

Source: Data are from the four percent public use sample of the Colombian 1973 Census of Population. The dependent variable is the natural logarithm of monthly earnings of individuals in pesos. Urban areas of residence are Cabeceras or county seats in the 900 municipalities and other urban areas. Birthplaces are only identified by municipality. Thus, it is not known whether a person was born in an urban or a rural area or whether the location of the birth was the family's usual residence. Here it is assumed that persons born in municipalities with a Cabecera larger than 35,000 inhabitants in 1973 were born in an "urban area," and otherwise they are attributed to a rural birthplace category. See Schultz (1983) and Fields and Schultz (1982) for further description of data.

for men and women are reported separately for the subpopulations resident in urban and rural areas. Estimated private returns to schooling for men who reside in rural areas appear to be about one half as large as for men in urban areas, 10 as contrasted with 18 percent. This pattern of lower returns to schooling in the rural sector is frequently noted and often attributed to the lesser quality of rural schools (Behrman and Birdsall, 1983) or to the less dynamic technology of traditional agriculture that creates fewer opportunities for the educated worker to recoup his investment (Jamison and Lau, 1982). Correspondingly, the slope of the earnings profile with respect to post-schooling experience, that is interpreted by Mincer (1962, 1974) as a return to on-the-job training, is substantially lower within rural than within urban residential strata of Colombia. These differences are equally evident among employees and the self-employed male workers in Colombia (Fields and Schultz, 1982: Table 6). Smith (1983) finds similar rural-urban differences in returns to post schooling experience in Malaysia based on longitudinal data. The explanation may be fewer opportunities to accumulate on-the-job training and work experience that raise the workers' subsequent earnings in traditional agriculture compared with those experiences available in the urban economy.

But about half of the men born in rural areas of Colombia had migrated to urban areas by 1973, and half of those residing in urban areas in 1973 were born in rural areas. Categorizing the workers by whether they were born in a municipality with an urban center (i.e. a town over 35,000 in 1973) or otherwise in a rural area, leads to the second panel of stratified income equation estimates. Ignoring the relocation costs of migration, the private returns to a year of schooling for the rural born are now virtually identical to those earned by the urban born, namely 19.0 and 19.1 percent, respectively. The slope of the income experience profile is also much more similar between

rural and urban birth cohorts than it was between rural and urban resident populations. Thus, almost half of the gains to rural schooling is obtained through migration to urban areas of Colombia.

Other studies of earnings in Colombia document that rural migrants are not disproportionately among the unemployed upon arrival in the cities. Indeed, the immigrants overtake the earnings of the native city-born workers within five years of their arrival, holding constant for their education, age, and sex. (Ribe, 1979). Yap (1977) found a similar tendency for rural-urban migrants in Brazil, where they achieve income parity with city natives in less than a decade. These studies are parallel to the extensive evidence that immigrants to the U.S. progressively close the earnings gap they initially confront in competition with U.S. natives, and reach income parity after about a decade (B. Chiswick, 1978). Estimates of the private return to rural schooling for men are seriously biased downward in Colombia when analysis is restricted to persons remaining in the rural sector. Analyses focused on regional or rural populations subject to large net outflows of migration may contain similar biases, as in Colombia. The magnitude of this bias in educational returns within the rural sector in developing countries warrants more study.[29]/

Alternatively, if many local markets are aggregated to include possible migratory destinations, and thereby approximate a closed population, returns to schooling can also be biased by the omission of regionally relevant factors (Birdsall and Behrman, 1984). For example, geographical variation in the cost of living, the quality and private cost of schooling, migration costs, and region-specific income reporting problems may all deserve explicit attention in the aggregate, but may be more easily neglected in some stratified samples. Because the perfect single capital and labor market underlying Mincer's (1974)

equilibrium model for the earnings function is not entirely realistic, modifications may be made in the list of conditioning variables, while the levels of aggregation should correspond as closely as possible with the birth cohort which proceeds to obtain specific amounts and qualities of schooling.

Since the rate of rural-urban migration and its educational selectivity differs substantially from Latin America to South Asia and Africa, to East Asia and the Middle East, there is no reason for the rural-urban migration effects evident in Colombia to be universally replicated. Some areas of traditional agriculture may not have off-farm opportunities open to the educated. For the same reason that Eckaus (1973a) found private returns to education low within a sufficiently narrow US occupation, private returns to schooling among day labor in rural India for relatively unskilled agricultural tasks may also be low, unless mobility is allowed for. The private returns to schooling for the landless in these circumstances may reside in the ability of the more educated to gain access to other forms of employment and possibly exit the rural sector altogether. Care must be exercised in constructing comparison groups, therefore, to evaluate the returns to education including the full range of economic opportunities open to the more and less educated. Following a birth cohort or school-class cohort provides one way to minimize the sample selection bias that mobility may otherwise introduce. Stratifications of samples along the lines of regions, rural-urban areas, or occupations can all lead to selection bias in estimating returns to schooling. These sources of bias may be particularly serious in the study of educational returns in low income countries, as illustrated above with reference to Colombia.

Male-Female Return Comparisons

If all men and women work the same time for wages, private market returns to schooling could be calculated for each sex separately and readily compared.

An efficient allocation of investment resources to the schooling of women and men would then tend to equalize these sex-specific market returns, to the extent that returns to schooling in nonmarket production within households were of a similar magnitude for women and men. But women generally participate less often and when they do participate they may work fewer hours in the market labor force than do men (Layard and Mincer, 1985; Durand, 1975; Standing, 1978). Thus, the potential for a sample selection bias on this account would appear more obvious in the case of computing returns to women's education than in the case of men and add to our uncertainty in comparing rates by sex. But the nature of this bias, if any exists, remains to be empirically documented in the various cultural and economic regions of the world.

It is incorrect to assume that women gain less from schooling merely because they spend fewer years after school working in the market labor force. As shown in section V below, schooling also increases the productivity of women's time in nonmarket production. Demands for nonmarket production, however, are limited by the extent of the household market, because the final commodities produced in the household are largely untradeable.[30]/ The tendency for more educated women to allocate more of their time to market labor force activities can be explained by both the relatively inelastic demand for nonmarket output and the likelihood that education enhances specialized market production skills more than education increases the value of the marginal product of women's time in nonmarket production. The family labor supply model suggests that it is also appropriate to control in such comparisons for the wage rate of the woman's husband or other family members and the nonearned income of the family.[31]/ Because the value of other members' time and nonearned income is likely to reduce the woman's market labor supply and be positively correlated with her education, these controls specified by the

family labor supply framework are likely to increase the estimated positive

partial effect of women's education on her market labor supply. Moreover, this

empirical regularity may be strengthened further if unpaid family work that is

conventionally counted as being in the labor force is excluded from our measure

of market labor supply. Unpaid family worker status for women is the least

satisfactorily measured aspect of labor supply across societies (Durand, 1975;

C. Chiswick, 1978; Hill, 1983) and it is precisely a labor market transaction

within the family rather than in the labor market for which a shadow wage

cannot be directly observed.

Thus, given the sensitivity of women's market allocation of time to their

educational attainment, direct estimates of market returns to schooling

inferred from only women working for wages may well be unrepresentative of the

potential returns received by a representative woman in the population.[32/]

Here is an important issue for public policy, that has received surprisingly

little empirical study.

Griffin's (1985) analysis in the Philippines is an exception. He considers

the earnings of married women in the Bicol region in 1980 to appraise how

robust estimates of schooling returns are to alternative methods for dealing

with this pervasive source of sample selection bias. He estimates jointly for

women outside the market labor force a nonmarket (reservation) wage function

and a market wage function for wage offers to those working. The

selection-corrected model of Heckman's is plausibly identified within the

context of the family labor supply model. Based on the conventional log linear

specification of the earnings function where returns to schooling are constant

across schooling levels, the selection-corrected estimate of schooling returns

is 18 percent, compared with the conventional estimate of 14 percent, based on

only the quarter of the sample who is working in the market labor force and

reporting the requisite wage. The selection correction is highly significant statistically and certain features of earnings function change. But based on a single regional sample from a single country, it is not reasonable to draw any general conclusions regarding the magnitude or even direction of this selection bias on women's returns to schooling.

Conventional earnings function estimates of the private returns to schooling for males and females that ignore the selected nature of the female samples are summarized in several papers (Woodhall, 1973; Psacharopoulos, 1973). The average of 16 country studies recently cited by Psacharopoulos (1985: Table 5) suggests that the uncorrected returns to women may be somewhat higher than to men at the secondary level and overall, but marginally lower at the primary and higher educational levels. Because there is no a priori basis to conclude that sample selection bias would necessarily alter these estimates upward or downward, they must stand as the best evidence currently available. In that light, a modest bias may exist in underinvesting in women's schooling relative to men's on efficiency grounds, which is not inconsistent with the cross country comparisons of enrollments analyzed in section II. This is an area that needs further empirical research. The family labor supply model provides some guidance as to how corrections for the self-selection of women into the market labor force can be reasonably identified by family wealth or husband wage variables.

Traditional labor market institutions may segregate different groups of workers by industry, occupation, or activity. Though such arrangements may have had at one time relatively little effect on the efficient allocation of labor, they may become increasingly inefficient as economic opportunities for individuals change more rapidly with modern economic growth (Birdsall and Sabot, forthcoming). Women in particular may be caught in family enterprises

and household production functions that are displaced by firms that exploit new technological economies of large scale in the organization of production. Until women can acquire the requisite schooling and transferable skills to find suitable employment in firms in expanding sectors of the modern economy, the opportunity value of women's time relative to men's time may decline. Fragmentary historical and anthropological evidence supports the view that early industrialization reduced the relative value of women's contribution to the household. During later stages of industrialization the economic contribution of women relative to men has increased (Boserup, 1970; Shorter, 1975; Goldin, 1980, 1983; T.P. Schultz, 1987b). This cycle may be associated with a change in the returns to schooling for women, but historical evidence to test this hypothesis is not yet in hand.

Interactions with Educational Returns

If returns to education reflect in part the acquired general ability of workers to profit from new opportunities, as emphasized by Welch (1970) and T.W. Schultz (1975), then investments in enlarging the pool of locally relevant technological options and other profitable resource reallocations should spur the private returns to education. This pattern of complementarity between local research and development activity and the returns to schooling in agriculture is a widely noted empirical regularity (Griliches, 1964; Huffman, 1974; Jamison and Lau, 1982; Evenson, 1986).

By the same reasoning, it is expected that agricultural extension activity, while it raises productivity in specific agricultural functions, it would also substitute for farmer schooling, diminishing the productive advantages enjoyed by the more educated farmer in exploiting new specific opportunities. Schooling's effect on nonmarket production may also be sensitive to the rate of growth of knowledge in that specific area of nonmarket production. As effort

is expended to diffuse that specific knowledge, the differential advantage
enjoyed by the educated worker would eventually diminish. The generalized
knowledge obtained by schooling substitutes (imperfectly) for the specific body
of functional knowledge disseminated by vocational extension programs.
Rosenzweig and Schultz (1982) found that the effect of mother's education in
reducing child mortality and fertility in Colombia was diminished with
improvements in local health infrastructure. Barrera (1986) examined child
height and height-for-weight as measures of child health and nutritional status
in the Bicol region of the Philippines. He found that gains associated with
mother's education were larger in communities that lacked health
infrastructure. In contrast, Strauss (1987) found evidence in a rural Ivory
Coast survey of complementarity of mother's education and local health
infrastructure, as they interactively affected child height and
height-for-weight. T.P. Schultz (1971) and Rosenzweig and Schultz (1985) found
in Taiwan and the U.S. that schooling of couples and local family planning
extension activity are substitutes in their effect on fertility reduction.
Consequently, the least educated gain the most from some types of
information-extending programs, whether they provide farmers with new
agricultural inputs or provide housewives with knowledge of health practices or
family planning techniques. There would seem to be a basis, therefore, for
analyzing other research and development and information diffusion and
extension programs to refine our understanding of which activities increase or
decrease the private nonmarket and market returns to schooling. It may be
noted that though extension activity may depress private returns to schooling,
they may still be an efficient or cost effective method to increase average
productivity and to redistribute income more equally. Here again, more
empirical documentation of these patterns of substitution and complementarity

of activities with schooling in low income countries could clarify the distributive implications of policy options that focus on educational endowments and family welfare.[33/] The pattern of productive interactions between education and the family's environment and endowments can be estimated from reduced-form equations, and consequently do not depend on controversial structural assumptions.

There appears to be an inverse empirical association between fertility and the resources parents provide each of their children, proxied generally by the child's schooling. An interaction between the quality (i.e. schooling) and quantity (i.e. number) of children in the parents' budget constraint is a widely accepted rationalization for this tradeoff between "quality" and quantity of children (Becker and Lewis, 1974). Alternatively, the empirical relationship can be interpreted, without imposing a specific structure on the budget constraint and family choice process, as indicating parents view child quality and quantity as substitutes (Rosenzweig and Wolpin, 1980). In either case, estimating without bias the magnitude of this cross-substitution effect is difficult, because both outcomes are endogenous to the family's lifetime allocation problem. What exogenous factor can be specified that shifts either fertility or the amount of schooling children receive, allowing the other factor to then behaviorally adjust, but not be directly affected by the identifying constraint? Only in the natural experiment of "twins" are we presented with a clear situation for evaluating the magnitude of this quantity-quality substitution effect, and for rural India the data support the economists' conjecture (Rosenzweig and Wolpin, 1980). This would imply that family planning programs that lower the cost of averting unwanted births should encourage parents to invest more in the schooling of each of their children. Conversely, extending effective compulsory schooling should be expected to

contribute to a fertility reduction. Here then is another area in which public policy, i.e. family planning, may induce greater investments in schooling, presumably by raising the privately perceived rate of return to educating children.

Efficiency and Equity

A recurrent theme in the literature on economics of education is a discussion of who benefits from the public subsidies extended to education (T.W. Schultz, 1972). This policy objective is more salient in low income countries where the public subsidy to secondary and higher education can be relatively large and these educational levels are filled by the children of the upper class (Bhagwati, 1973). For example, in 1962, the Colombian government's operating expenses per public school student was five times greater at the secondary than at the primary level, and fifty times greater at the higher education level than at the primary level (T.P. Schultz, 1968: Table 8). These differentials tend to be smaller in South Asia and perhaps even larger in Africa, because cost-of-living stipends are often provided to university students. The disproportionate size of public subsidies for higher education may have begun to decrease in some low income countries, but the inequities of the current schemes for financing higher education remain clear in economic terms (Minget and Tan, 1985). The distribution of public educational subsidies is an area of increasingly active debate. This concern with public financing of education and its implications for equity as well as efficiency is outlined later in section V; it is reviewed extensively in several recent studies (Psacharopoulos and Woodhall, 1985, World Bank, 1986a).

V. Nonmarket Production and Schooling

While the effects of schooling on market earnings are relatively well documented, though sometimes subject to uncertainty due to problems of measurement and estimation, the evidence is more recent and fragmentary on the returns to schooling in nonmarket production within the household (Michael, 1982; Haveman and Wolfe, 1984). In low income countries these benefits are particularly important. This review only surveys the evidence in this field. Two other chapters of this volume also address health and fertility consequences of education (Behrman and Deolalikar, and Birdsall).

More educated workers tend to work more in the market labor force, holding constant for other sources of family income and capital that may combine to enhance their productivity in nonmarket production. As noted earlier, a married woman is likely to work less time in home production the greater is her education, given her husband's education and business capital . This pattern prevails in most low income surveys of urban areas and in rural areas where off-farm employment opportunities for educated women are reasonably developed. Thus, nonmarket production activities must be curtailed or at least substitutes found for the educated woman's nonmarket time. Nonetheless, most studies confirm increased home output in several quantifiable dimensions with a woman's schooling, despite the fact that she may actually spend less time in the home.

Child mortality, for example, is lower for more educated mothers whether or not family income or husband's wages and education are also held constant (Cochrane et al. 1980; T.P. Schultz, 1980). An additional year of mother's schooling, in either rural or urban subpopulations, is associated in many low income countries with a 5-10 percent reduction in child mortality, regardless of the tendency for these more educated women to reallocate their home time toward market activities (Cochrane, et al., 1980). By neglecting education's

effect on rural-urban migration and its consequences on child health, these studies understate the child health returns to rural schooling of girls (T.P. Schultz, 1983).

Is this empirical association of schooling and child mortality due to (1) the benefit of the purchased health inputs obtained from the mother's added market earnings, or (2) the enhanced productivity of her remaining time at home, or (3) her improved allocative efficiency in using various health inputs, given their prices? Because the household's nonmarket output--child health in this case--is consumed directly by the couple, tastes or preferences of the couple are relevant to production decisions, unlike the market sector where profit maximization alone determines production decisions. Consequently, education might modify child health (and fertility) investments by inducing a change in tastes, holding constant prices, income and household technology (Easterlin, Pollak and Wachter, 1980). To disentangle efficiency, input allocation, and taste effects of education on household production, the household production technology must be separately identified and estimated (Rosenzweig and Schultz, 1983). Lack of sufficient information on this technology has slowed progress toward understanding precisely how education affects nonmarket outcomes. The total effect of schooling on the outcomes can, nonetheless, be estimated by reduced-form like equations that embody both the parameters of the utility/demand system and that of the household production technology.

The association between female education and fertility and contraceptive behavior is analogous, but more complicated. Education may permit a couple to achieve more precisely their desired target level of fertility, given uncontrolled biological reproductive capacity (i.e. fecundity) and other random events. A simple association is noted between schooling levels of women and

their contraceptive knowledge or use, recent marital fertility rate, and
cumulative number of births in recent sample surveys from 22 low-income
countries (United Nations, 1983). Schooling of the women is positively
correlated with contraceptive knowledge and use in every country and between
every pair of (five) schooling levels, controlling for the woman's age and age
at marriage. This descriptive regression study by the UN does not control,
however, for the household demand determinants, such as husband's income,
earnings, assets or land, which often exhibit a positive partial correlation
with fertility (T.P. Schultz, 1973; Mueller, 1984). Since these income
variables tend to be positively correlated with wife's schooling, their
omission as controls for wealth from the above fertility regressions is likely
to weaken the reported inverse mother schooling-fertility association.
Regardless of this lapse in specification, the association was inverse in 20 of
the 22 countries. Cochrane (1979), in an earlier review of the evidence,
reached similar conclusions, but stressed the non-monotonic simple association
between women's schooling and their fertility. She noted the tendency for
fertility, particularly in a few of the poorest rural populations, to increase
with basic primary schooling and only thereafter fall. The unanswered question
is, if controls were included for husband's wealth or land, whether the early
rising phase of fertility with the woman's education would have been mitigated
or eliminated, leaving a monotonic negative partial relationship of women's
education on fertility.

But to proceed further and assess how education affects nonmarket
production and thereby influences fertility requires the estimation of
contraceptive use and contraceptive efficiency equations, conditional on the
woman's schooling, the couple's endogenous demand for further births, and the
couple's biological fecundity inferred from past reproductive behavior and

performance. Better educated wives in Malaysia and the US appear to know more about contraception, and are able to use contraceptive methods more efficiently. The more educated couple is better able than a less educated one to perceive their reproductive propensities and effectively compensate by means of birth control for these differences in fecundity (Rosenzweig and Schultz, 1985, 1987).

The investments of parents in the "quality" of children are difficult to measure, but two outcomes of this nonmarket production process are the health and schooling of the children. Child mortality discussed above is the least ambiguous indicator of child health investments by parents. Schooling of the children is frequently studied as another nonmarket outcome of the family, and one in which the education of the mother often appears more important than that of the father. Evidence on these issues has been reported for the U.S. (Swift and Weisbrod, 1965; Leibowitz, 1974, 1975; Hill and Stafford, 1974; Murnane, et al. 1981), Philippines (King and Lillard, 1983), Malaysia (DeTray, 1987), and India at the aggregate district level (Rosenzweig and Evenson, 1977). The empirical basis to generalize about the family-level determinants of child schooling investments may depend on different regional configurations of the family and the distribution of child rearing responsibilities between mother, father and extended family. It would be surprising, nonetheless, if parent education did not help to explain offspring educational attainment, when controls are included for local school facilities, parent assets, and wages opportunities.[34]/

The significance of nonmarket production effects of schooling, particularly those associated with the education of women, should not be underrated as factors shaping the development process.[35]/ A major research challenge is to measure these effects of schooling on nonmarket production with greater

precision and to begin to develop methods for measuring the value to these effects in a way that is more or less commensurate with the estimates of private market returns to schooling derived from wage functions.

Nonmarket returns to schooling are not generally an additional benefit from education over and above the market returns described earlier. Nonmarket production is usually obtained by foregoing market income and reallocating time from market to nonmarket production. Just as it is inappropriate to conclude that women receive a low return on their schooling because they allocate only a small fraction of their time after school to market work, it is incorrect to attribute the market rate of return to their schooling and then additionally credit their schooling with the noted nonmarket production gains, such as in child health, child schooling, and birth control.[36]/

To the extent that reductions in disease, decreases in fertility, and increases in child schooling embody social externalities that benefit other members of the society beyond the private family, then an externalities case can be made for public subsidization of education that contributes to these types of nonmarket production activities. Current research on household production suggests that female schooling may, according to this reasoning, warrant a larger subsidy than male schooling. But most of the benefits of family health improvements, fertility control, and child schooling that are associated with female education are privately captured by families.

VI. Policy

Public expenditures on education absorb between two and eight percent of the GNP of most countries (World Bank, 1986a; p. 46). The share of school aged children is substantially larger in low income than in high income countries, because the less developed countries have recently experienced rapid population

growth. This age composition may increase the GNP share of educational budgets in low income countries, while the income elastic demand for schooling operates in the opposite direction. In reality, the share of GNP devoted to education is on balance positively related to per capita income, but the relationship explains little of the variance across countries (T.P. Schultz, 1985). Many poor SubSaharan African countries, for example, spend more than five percent of their GNP on public education, whereas this is also the figure reported on average for both the Western and Eastern European industrial countries. Education is frequently the largest or second largest share of the public budget, after defense, claiming between ten to twenty percent of the total (World Bank, 1986a). The efficient and equitable allocation of this relatively large budget warrants careful scrutiny by economists.

The educational system influences in complex and subtle ways the long run evolution of an economy and society; some of these channels of influence are as yet poorly understood. The interdependence among the levels and parts of the educational system indicates the need to evaluate the long run implications of expansion or change in priorities, for they will have ramifications at many points in the public and private sectors (Hicks, 1965). Enrollment levels at primary, secondary and higher educational levels must mesh with each other, and, as discussed in section II, the educational system is one of the largest employers of educated workers in the economy. If the demand for teachers outruns the domestic supply, the rising cost of expanding the school system hinders the achievement of long run goals. Confronted by the complexity of the educational system, forecasting manpower requirements of the economy and dynamic educational planning models were developed in the 1960s as a guide to policy in developing countries (Harbison and Myers, 1964; Bowles, 1969; Pyatt, et al. 1983). But forecasts of the derived demands for educated labor have

proven unreliable, particularly at the level of specific occupations and technical specialities. They have even been misleading in projecting the distribution of enrollment demands among primary, secondary, vocational, and higher education (Psacharopoulos and Woodhall, 1985). Accumulating evidence suggests that private returns to schooling are a useful alternative means for monitoring imbalances between the supply of and demand for educated workers in an economy. Although these estimates of returns are subject to all the difficulties of measurement discussed in section IV, they nonetheless provide a means for objectively describing the economic scarcity of many specific levels of skills that the educational system produces.

Imbalances between the educational system and the developing economy have been noted by policy advisors, but not all of them are empirically well founded. As public expenditures on education increased in the 1960s and 1970s, overinvestment in education was attributed a role in creating unemployment among the educated and encouraging the inefficient allocation of relatively unskilled jobs to overeducated workers (Lewis 1962; Edwards, 1974; Edwards and Todaro, 1974). But these subjective interpretations of labor market conditions were rarely confirmed by analyses of labor market surveys, where lifetime unemployment was below average for the better educated workers (Gregory, 1980; Berrry and Sabot, 1984), and wage differentials by education continued to reveal substantial market returns to basic primary and general secondary education (Table 6). Where imbalances have occurred, the means of financing higher education have frequently been a contributing factor as well as the mechanisms used for rationing excess private demands for schooling.

In some countries higher education overexpanded and a "brain drain" emerged, as in Colombia in the 1960s (T.P. Schultz, 1968). To deal with the international "brain drain", a variety of tax-transfer schemes were proposed

(Bhagwati and Partington, 1976; Scott, 1970), but the welfare implications of labor mobility between nations are unclear because individual and state objectives may conflict, and thus a coordinated international response never materialized. The methods of financing higher education may often account for the instances of overexpansion in higher education. Tuition fees are often minimal and student living stipends are awarded only on the basis of merit or examination. The resulting public subsidies per student enrolled in higher education have become sufficiently large that there is little likelihood that the private sector will evolve complementary higher educational services, even in the form of a low cost-low quality system. Private returns to the student admitted to the public higher educational system may, as a consequence, be substantial, while the social returns are unjustifiably low. When domestic university graduates can obtain employment abroad, as may be the case in engineering, medicine and technical sciences, these job opportunities can augment further the private returns to higher education. Depending on the level of remittances of the emigrants to their families and the likelihood that they return home and bring with them enhanced productive skills and capital, this form of publicly subsidized "brain drain" may erode further the realized social returns to public expenditures on higher education. The obvious economic solution is to reduce the size of the public subsidy and allow student fees to cover a larger share of the costs of higher education. Scholarships and educational loans awarded on the basis of family means can still achieve redistributive objectives (Hansen and Weisbrod, 1969; T.W. Schultz, 1972; Blaug, 1973; Fields, 1974a, 1974b; Psacharopoulos and Woodhall, 1985; Tan, 1985; World Bank, 1986a).

In other countries, such as Brazil, the rapid pace and structure of economic growth sustained unusually large returns to higher education in the

1970s. Public and private university enrollments increased accordingly (Langoni, 1973). Other countries, such as Taiwan, were reluctant to expand general university education as rapidly as the private demand for enrollment increased for fear of creating unemployment among its educated youth. To deal with the excess demand for higher education, college entrance examinations were increasing relied upon to ration access to the high quality public subsidized universities. But in contrast to other Asian countries, lower quality private schools were not allowed to expand and fill the gap. Secondary school graduates in Taiwan retake repeatedly the college entrance examinations and their failure to enter the labor force in the interim suggests that rationing can be an inefficient mechanism for dealing with excess demands for schooling (Academic Sinica, 1983).

Kenya and Tanzania illustrate the consequences of following quite different educational expansion policies combined with alternative mechanisms for the selection of students. Starting from a similar base in the 1960s, both countries achieved nearly universal primary educational attendance by the 1980s, but public and private secondary schools expanded more rapidly in Kenya than in Tanzania with the introduction of substantial school fees in Kenya to finance the secondary school systems. Tanzania alternatively employed a "meritocratic" examination system to ration the excess demand for places in the secondary school system. These different responses to growing private demand for secondary education allowed a larger share of the children of less-educated parents to advance into secondary schools in Kenya than in Tanzania (Armitage and Sabot, 1986). In other words, the meritocratic examination system screened on characteristics that the educated parents were willing and able to produce in their offspring, either through greater investments of own time and market goods (including higher quality primary schooling), or because of inherited

ability. Including the secondary school fees in Kenya, the private rate of return to secondary schooling was only marginally lower in Kenya than in Tanzania (Knight and Sabot, 1985). Consequently, the increased rate of investment in secondary educations in Kenya compared with Tanzania may have contributed importantly to the more rapid growth enjoyed by Kenya in the 1970s, though other misguided economic policies in Tanzania probably played a more important role in that country's slower growth. The egalitarian intentions of the Tanzanian meritocratic rationed educational policy frustrated rather than facilitated intergenerational mobility and deterred an efficient level of schooling investment (Armitage and Sabot, 1986). The market clearing expansion of secondary schools in Kenya also contributed to a more equal distribution of income among educational classes, as the relative wage premia for secondary school graduates has slowly diminished over time among younger Kenyan workers (Knight and Sabot, 1981), analogous to figure 3 (p. 16). There are clear advantages in terms of efficiency when some of the costs of secondary and higher education are borne by students who will thereby gain higher lifetime incomes. Special means-tested financial aids can then be designed to achieve a wide distribution of subsidized educational opportunities. If these financial aids can be used by students in either public or private schools, pluralism might be maintained and desirable competitive pressure exerted on public (and private) schools to improve their quality and efficiency.

Schools in low income countries are often observed to be inefficient (World Bank, 1986a). Unfortunately, the task of defining and then measuring productive efficiency is complex, and requires agreement on (1) the valuation of outputs and (2) on the opportunity cost of inputs, as well as (3) knowledge of the production technology that defines how the inputs are transformed at the margin into outputs. Evidence cited in the educational literature to

demonstrate school inefficiency is not yet rigorous, and includes characteristics such as high dropout rates and low advancement rates (Fuller, 1986). To interpret such evidence on efficiency requires a measure of student productivity associated with exposure to various training regimes. If returns to education fall at the margin after completing four or five years, it may not pay all students to continue in school to obtain a primary or secondary certificate. It could be an efficient use of educational resources to train partially many students, but graduate few. The efficiency of a training regime depends on the gains in labor market productivity produced in a birth cohort passing through the schools, and on how much more public and private resources are required to effect a change in the relevant retention and advancement rates without altering the standards of the graduates that matter for the labor market. Clearly, collecting the necessary figures to measure efficiency in schools is difficult. I have not seen an analysis that defines, in this sense, the optimal schedule of retention and advancement rates for any country's school system. This is not to say, however, that current regimes with low attendance rates and frequent repetitions represent an efficient use of either the student's or teacher's time.

Decentralized management of school systems could have advantages in setting local enrollment goals and fixing programs priorities. An orderly flow of information to the central government would nonetheless be needed to rationalize centralized educational subsidies and evaluate national progress. Monitoring labor market returns to schooling may also be a function that is best performed by the central government. Student fees might be retained to fund local school initiatives, while centrally administered financial aids would reduce differential access to schools across economic classes and regions of a country. Recommendations to increase sharply school quality in low income

countries (World Bank, 1986a) need to be evaluated thoroughly (Zymelman, 1982, 1985). Local communities may be better positioned than the central government to evaluate the trade-offs between expanding enrollments and increasing the quality of school offerings. Nonetheless, there is an urgent need for more quantitative analysis of how effective schools are in producing valuable skills in low income countries.

VII. Conclusions

This paper has reviewed several themes in the economic literature on education and development: (1) intercountry evidence of how income, price, and demographic constraints govern public expenditures on schools, (2) alternative conceptual interpretations of the relationship between education and income, (3) uncertainties underlying the micro statistical evidence on the private and social returns to schooling in the labor market, and finally (4) indications of the returns to schooling in nonmarket production of child health and education, and fertility control.

To integrate these four themes has not yet occurred. It would entail a firm idea of the factors that initiated the modern disequilibrium in education. What change in the institutional or technological environment created the derived demands for more educated labor? How did these conditions increase the private returns to schooling, encouraging the increased investment of private resources in schooling and public expenditures on education throughout the world. As these resources in schooling increased, they enlarged the pool of educated workers which operates, other things equal, to reduce returns to schooling, until a new equilibrium rate of return is established that more or less equals the opportunity cost of diverting public and private investment from the formation of further physical capital. It cannot be said, with any precision, how far the expansion of education can expect to proceed in any

particular country before demands for educated labor are satisfied and returns decrease to "normal" levels. A dynamic model of both the demand for and supply of educated workers is needed to answer these questions. Given the time lags between production of students, their entry into the labor force, and the determination of their lifetime wage levels, it may be possible in the future to use the historical record to form estimates of a recursive model of education and development than could answer questions such as these. The challenge of the field is to clarify the origins and dynamic structure of such a model of education and development, and though speculatory theory is beginning to emerge (Lucas, 1985), we have a long way to go.

This paper surveys several limited empirical regularities and provides economic frameworks to help interpret the meaning of these patterns, and to focus attention on many unresolved problems in model specification and empirical implementation. It will prove impossible in practice to deal with many of these complicating issues simultaneously, and hence assigning priority to questions for further research reveals my intuition on which issues are most important to advance our understanding of education in the process of modern economic growth.

The wage function is a powerful device for summarizing data on individual wages or earnings. Even the most simplified semi-logarithmic wage function, conditioned on years of schooling and a quadratic in postschooling years of experience, accounts for a remarkable one-quarter to one-half of the log variance in male wages across most national labor markets. There are few internationally replicated regularities in the social sciences that have this descriptive power at the individual level, and also have the intuitive appeal of providing a rough approximation of the market pecuniary rate of returns earned from schooling, viewed as an economic investment in human capital.

Once economists had developed a conceptual framework for inferring the private rate of return to schooling, estimates of returns were derived for different types and levels of schooling and for different racial groups. Returns to qualitative improvements in the educational system are also estimated frequently, but findings as to the returns to various dimensions of school quality differ markedly across studies. Returns to school quality are approximated by measuring variation in schooling inputs per student across schools in a single labor market. Variation in input use is then related to the earnings of pupils across regions, holding constant years of schooling (e.g. Welch, 1966). Since observed variation in years of schooling is generally positively associated with the quality of schooling across schools, the estimates of returns to school years tend to decrease as controls are added to the wage function for the qualitative dimensions of the schools. The more parsimonious specification of returns to only "years" of schooling implicitly assumes that changes in years of schooling will parallel as in past changes in quality, and measured returns capture both the prevailing quantity and quality variation in the population. When the single proxy for educational inputs (i.e. years) is supplemented by other measures of input mixes, there is a basis for predicting how changes in years of schooling and the input mix will subsequently influence the earnings capacity of educated workers.

Wage and earnings functions stratified by sex reveal that relative wage differentials by schooling are of about the same magnitude for women in the labor force as they are for men. Because the sample of women reporting wages is not representative of all women in the population, a sample selection bias could affect these estimates of schooling returns for women. Too few studies have addressed this important empirical issue to draw any firm conclusions. Nor have many studies collected reliable data on the net earnings of

self-employed workers and analyzed them appropriately to clarify whether returns to schooling in this self-selected segment of the labor force are the same as among employees. Clearly farmers recoup substantial income from their education, and there is no obvious reason why the self-employed in nonagricultural activities should fare differently. But appropriate statistical evidence is not yet in hand.

Finally, schooling raises the productivity of individuals in nonmarket production. The schooling of parents affects the level of home production of health, nutrition, mobility, fertility control, and child schooling. Decomposing the sources of these changes requires the identification and structural estimation of household production functions and input demand equations. The gains in household production attributable to a mother's schooling are important for social welfare and should not continue to be neglected by economists. The topic of this chapter will remain incomplete until it is possible to clarify the origins and trace through the consequences of these nonmarket returns to women's schooling. A microeconometric framework for such studies of household production and behavior has been proposed (Rosenzweig and Schultz, 1983). Current progress in implementing such analyses is limited by the scarcity of suitably detailed longitudinal or retrospective household survey data for low income countries.

Table A-1

Growth in Educational Enrollments by School Level and Countries
by Income Classes, 1960-1981

World Bank Country (Number)	Primary (6-11) Education		Secondary (12-17) Education		Higher (20-24) Education		Expected Years of Enrollment[b]		Percent of Increase in Enrollment Ratios (1960-1981)			
	1960	1981	1960	1981	1960	1981	1960	1981	Primary	Secondary	Higher	Expected
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Low Income (34)	.80	.94	.18	.34	.02	.04	5.98	7.88	18	89	100	32
excluding China[c] and India	.38	.72	.07	.19	.01	.02	2.75	5.56	89	171	100	102
Middle Income (38) oil exporters	.64	1.06	.09	.37	.02	.08	4.48	8.98	66	311	300	100
oil importers	.84	.99	.18	.44	.04	.13	6.32	9.23	18	144	225	46
Upper Middle Income (22)	.88	1.04	.20	.51	.04	.14	6.68	10.0	18	155	250	50
High Income oil exporters (5)	.29	.83	.05	.43	.01	.08	2.09	7.96	186	760	700	281
Industrial Market (18)	1.14	1.01	.64	.90	.16	.37	11.5	13.3	-11	41	131	16
East European Non-market (8)	1.01	1.05	.45	.88	.11	.20	9.31	12.6	4	96	82	35

[a]The low income class has an annual GNP per capita of less than US $410 in 1982 prices. The middle income class includes countries with GNP per capita between $410 and $1650, while the upper middle income class ranges from $1650 to about $6000.

[b]Synthetic cohort concept defined as six (years) times the sum of primary and secondary enrollment ratios plus five (years) times higher educational enrollment ratio.

[c]The lack of expenditure data for China and India in Table 2 justifies our consideration of the "low income" class of countries excluding these two large states.

Source: 1984 World Development Report, World Bank Staff, New York: Oxford University Press, 1984. Table 25, pp. 266-267.

Table A-2

Educational Enrollment Ratios by School Level and Region for Males and Females, 1960-1980*

	Primary Education (approx. 6-11)		Secondary Education (approx. 12-17)		Higher Education (approx. 20-24)		Expected Years of Enrollment** (weighted sum)		Percentage Increase in Enrollment Ratios, 1960-1980			
	1960	1980	1960	1980	1960	1980	1960	1980	Primary	Secondary	Higher	Total Expected**
Africa, excluding Arab States												
Male	.540	.864	.050	.203	.005	.027	3.57	6.54	60	306	440	83
Female	.309	.704	.022	.131	.001	.008	1.99	5.05	128	495	700	154
Total	.424	.784	.036	.167	.003	.017	2.78	5.79	85	364	467	108
Arab States												
Male	.641	.936	.148	.454	.033	.112	4.89	8.90	46	207	261	82
Female	.339	.680	.052	.279	.007	.051	2.38	6.01	101	437	628.6	153
Total	.493	.810	.101	.368	.019	.082	3.66	7.48	64	264	331.6	104
Asia, excluding Arab States												
Male	.809	.952	.267	.417	.044	.109	6.69	8.76	18	55	148	30.9
Female	.527	.734	.139	.270	.013	.052	4.06	6.28	39	94	300	54.7
Total	.670	.846	.205	.346	.029	.081	5.40	7.56	26	69	179	40.0
Latin America												
Male	.750	1.052	.149	.435	.042	.160	5.60	9.72	40	192	281	73.6
Female	.712	1.025	.136	.448	.018	.126	5.18	9.47	44	229	600	82.8
Total	.731	1.039	.143	.442	.030	.143	5.39	9.60	42	209	377	78.1
Northern America												
Males	1.174	1.221	.694	.828	.348	.537	13.0	15.0	9.4	19	54	15.4
Females	1.164	1.227	.714	.833	.208	.531	12.3	15.0	5.4	17	155	22.0
Total	1.169	1.224	.704	.831	.279	.534	12.6	15.0	4.7	18	91.4	19.0
Europe, including USSR												
Male	1.034	1.041	.465	.738	.123	.234	9.61	11.8	0.7	59	90.2	22.8
Female	1.027	1.032	.446	.791	.072	.210	9.20	12.0	0.5	77	192	30.4
Totals	1.030	1.036	.456	.764	.097	.222	9.40	11.9	0.6	68	129	26.6
Oceania												
Males	1.022	1.022	.533	.702	.140	.231	10.1	11.5	0	30.5	65	13.9
Female	1.007	.986	.518	.711	.056	.189	9.43	11.1	-2.1	37.3	238	17.7
Total	1.015	1.005	.528	.706	.099	.211	9.75	11.3	-1.0	33.7	113	15.9
Developed* Total												
Male	1.064	1.069	.553	.766	.165	.317	10.5	12.6	0.5	38.5	92.1	20
Female	1.054	1.064	.544	.801	.091	.282	10.0	12.6	.9	47.2	210	26
Total	1.059	1.066	.548	.783	.128	.300	10.3	12.6	0.7	42.9	134	22
Developing Total												
Male	.726	.951	.180	.373	.031	.095	5.59	8.42	31	107	206	51
Female	.476	.765	.073	.249	.010	.052	3.34	6.34	61	241	420	90
Total	.602	.859	.117	.312	.020	.074	4.47	7.40	43	146	270	66
World Total												
Male	.850	.981	.304	.471	.080	.163	7.32	9.53	15	54.9	104	30
Female	.687	.842	.228	.386	.040	.122	5.69	7.98	23	69.3	205	40
Total	.770	.913	.267	.430	.060	.143	6.52	8.77	19	61.0	138	35

*Europe, Oceania, North America, Japan, Israel and South Africa.

**The Expected Years of Schooling is derived by multiplying the sum of the primary and secondary enrollment ratios by six (approximate duration of school levels) and the higher education enrollment ratio by five (assumed five year age group in denominator).

Source: UNESCO, Statistical Yearbook 1984, Table 2.10. Adjusted gross enrollment ratios divide enrollment for level by age group that according to national regulations should be enrolled at this level. Note these are UNESCO estimates and projections as assessed in 1982.

/u/lv/EduDevNotes

Notes

1/As Kuznets observed, "the inescapable conclusion is that the direct
contribution of man-hours and capital accumulation would hardly account for
more than a tenth of the rate of growth in per capita product -- and probably
less" (1966:81). Since man-hours per capita tended to decline by 2 to 3
percent per decade, relatively rapid accumulation of capital could not provide
a satisfactory explanation for sustained periods of modern economic growth.
One may recall the labor share of national income was increasing from the 19th
to the 20th centuries from somewhat more than half to about three quarters in
the 14 industrially developed countries for which Kuznets had long-term
economic series.

2/The literature on economics of education is vast, and much of it is relevant
to low income countries. For different perspectives on this field, consult the
surveys by T.W. Schultz (1963), Blaug (1973, 1976, 1985), Rosen (1977, 1985),
Griliches (1977), Psacharopoulos (1973, 1981, 1985), Psacharopoulos and
Woodhall (1985), and Willis (1987).

3/I appreciate that J. Behrman drew my attention to the fact that in the period
1960 to 1981 one country did indeed report a decline in expected years of
schooling. In El Salvadore this figure declined from 5.63 to 5.06 years
according to the 1984 World Development Report (Table 25). The 1986 World
Development Report (Table 29), however, reports even in El Salvadore an
increase in expected schooling from 1965 to 1983 from 6.04 to 6.18 years.

4/Section II draws on Schultz (1985).

5/The gap in expected education and life at birth between the lowest income
countries (excluding India and China in the World Bank categories) and the high
income industrial market economies decreased markedly in the last two decades.
Life expectation stood at about 43 and 71 years in 1960, and had increased to
roughly 51 and 75 years by 1982 in these two groups of countries, respectively.
Expected years of schooling, on the other hand, increased for these two groups
of countries from almost 3 and 11.5 years in 1960, to almost 6 and 13.3 years
in 1982, or from one-to-four to one-to-two. These achievements were recorded

despite the fact that income (GNP) per capita in constant prices grew in the same period three times faster in the high income countries than it did in this lowest income group of countries. These illustrative figures are drawn from World Development Report 1984, World Bank Staff, Oxford University Press, 1984, Tables 1, 23, and 25. See also Preston's (1980) comparisons of life expectation across more uniform and reliable data from a smaller number of countries. There are differences between and limitations of such synthetic summary measures of health and education. The schooling in high and low income countries (as suggested in Tables 1 and 2) may be of increasingly disparate quality, so the gap in quality-adjusted years may not be decreasing though the gap in years is. Analogously, the gap between the quality of life (however that is measured) in high and low income countries may be widening, undermining consideration of the expectation of life as an overall indicator of health and vitality. There is also the bounded nature of both life expectation and years of education which may imply a narrowing gap as many countries aproach that boundary.

6/See explanatory footnotes to Table A-1.

7/ The most comprehensive comparison of rate of return studies is that by Psacharopoulos (1973, 1981, 1985). Differences in methodology across these summarized country studies limits the precise comparability of the return calculations.

8/The political process may not assign everyone's vote an equal weight, however. For example, urban populations in many low income countries appear to exercise greater influence on public sector decisions than do dispersed rural populations (Lipton, 1977). Without data on the distribution of income, public services, or taxes across subgroups within countries, it is not fruitful to speculate further here on the distributional implications of how this political process works.

9/ Equation (11) may be rewritten in logarithms:

$$\ln(E/P) = \ln(S/P) + \ln(T/S) + \ln(C/T) + \ln(E/C)$$

and regressions would be calculated of the following form at each level of schooling:

$$\ln(E/P) = \beta_{11} + \beta_{12}\ln Y + \beta_{13}\ln P_x + \beta_{14}Z$$
$$\ln(S/P) = \beta_{21} + \beta_{22}\ln Y + \beta_{23}\ln P_x + \beta_{24}Z$$
$$\ln(T/S) = \beta_{31} + \beta_{32}\ln Y + \beta_{33}\ln P_x + \beta_{34}Z$$
$$\ln(C/T) = \beta_{41} + \beta_{42}\ln Y + \beta_{43}\ln P_x + \beta_{44}Z$$
$$\ln(E/C) = \beta_{51} + \beta_{52}\ln Y + \beta_{53}\ln P_x + \beta_{54}Z$$

The adding up of component effects implies that

$$\beta_{1i} = \sum_{j=2}^{5} \beta_{ji} \qquad \text{for } i = 1,\ldots,4.$$

10/ It may be argued that the use of foreign exchange (FX) rates in 1969-71 to translate GNP from local currencies into the common unit of dollars gives insufficient weight to nontraded commodities. The tendency is to exaggerate differences across countries in real consumer income per adult. Recent work to construct a purchasing power parity (PPP) basis for comparing incomes across countries by Kravis, Heston and Summers (1982) is built on a sample of countries for which price indexes were constructed and then generalized and revised to apply to other countries by Summers and Heston (1984). For example, FX translated GNP per adult is forty-three times larger in the U.S. than in India in 1970, whereas the PPP real income per adult difference is only thirteen to one. Consumer welfare may be better approximated by the PPP income deflator and therefore the PPP deflated figures were used in reestimating the schooling equations reported in this paper. In general, PPP income elasticities of school expenditures increased by as much as a quarter, as would have been expected since the sample variance in log PPP incomes is markedly less than the variance in log FX incomes. Price elasticities were reduced somewhat, suggesting that some of the differences in the relative price of teacher salaries are captured in the PPP adjustment procedure. No systematic changes occurred in the coefficients on relative size of school aged cohorts, nor were the estimated effects of urbanization noticeably changed by this substitution of one measure of real GNP for the other. Substantive conclusions were not particularly sensitive, therefore, to this choice of procedure for translating GNP across countries into common welfare units.

11/ The disturbances in the equation determining current demand for schooling that would affect today's wages of teachers might also be correlated with the

unexplained disturbances in the equation determining enrollment rates ten years
earlier, such as might arise from a persistent country-specific unobserved
effect. This form of error structure would imply that the lagged enrollment
variable was not actually exogenous to the wage equation. The two-stage esti-
mates based on the lagged enrollment instrument would then be subject to the
classical simultaneous equation bias and also would be inconsistent. Estimates
were calculated without the lagged enrollment as an instrument and the
coefficient estimates of the price elasticities did not change appreciably,
though their standard errors tended to increase. See also footnote 13 below.

12/An analogous errors-in-variable bias occurs in the study of labor supply,
where earnings are divided by hours worked to obtain a wage rate that is
specified by theory as a determinant of hours.

13/The implicit primary and secondary school logarithmic wage equations for
teachers were estimates as conditioned on the secondary school enrollment rate,
income per adult and proportion of the population urban, all of which ex-
planatory variables were evaluated ten years earlier:

$$\ln W_{pt} = -1.84 - .349 \ln E_{st-10} + .355 \ln GNP/A_{t-10} - .808U$$
$$(3.38)(6.22) \qquad\qquad (4.30) \qquad\qquad (2.67)$$

$$n = 186 \qquad\qquad R^2 = .264$$

$$\ln W_{st} = -.931 - .646 \ln E_{st-10} + .305 \ln GNP/A_{t-10} - 1.25U$$
$$(1.18) \quad (8.25) \qquad\qquad (2.61) \qquad\qquad (3.22)$$

$$n = 139 \qquad\qquad R^2 = .601$$

where E_{st-10} refers to the secondary school enrollment proportion ten years
ago, GNP/A_{t-10} indicates GNP per adult (age 15 to 65) measured ten years ear-
lier, U_{t-10} is the urban proportion of the population ten years ago, and W_{pt} or
W_{st} are the school current expenditures per primary or secondary school teacher
divided by GNP per adult today.

14/Wealthier countries may have lower labor force participation rates in ages
15 to 24, in part because the returns to schooling are relatively attractive
for these youth. Thus, this available productive resource of the time of
students is being saved and invested, though it is not fully counted in
national income accounts. At the other end of the life cycle, wealthier

countries tend to report lower participation rates, at least for males after age 55. In other words, earlier retirement from the market labor force occurs at higher income levels. The time of the elderly is also a productive resource available to the society, but it is used increasingly for direct consumption (e.g. leisure) as per capita incomes rise. The bias in my measure of GNP per adult arises because the market value of leisure in retirement and the time of students is not included in GNP and thus differentially understates the real value of national factor income in wealthier societies that invest in more schooling and consume more of their life cycle budget of time in retirement activities.

[15]/From equation (6) the coefficient on the relative price or teacher wage variable in the expenditure function is $b_2 = \alpha(\eta + 1)$, and thus the estimated price elasticity, $\eta = (b_2/\alpha) - 1$. The sample mean of α is .82.

[16]/Economies of scale in producing school services might be distinguished at three levels: (1) with the size of the national educational system, (2) with the size of the school measured in terms of its number of full time teachers, and (3) with the size of the teacher's span of control or student-teacher ratio. The importance of (1) in primary and secondary school systems was assumed at the outset to be negligible. The number of primary schools is reported in the 1984 UNESCO Yearbook. If the system's average school size (i.e. log of teachers per school) is added to equation (6), one might expect this added scale variable to diminish the coefficient on urbanization, if larger urban schools realized economies that reduced unit costs. In a sample of 60 countries for which these data are recently available, school size is associated with greater expenditures per child due to higher teacher-student ratios and higher current outlays per teacher. The coefficients on urbanization are not reduced in magnitude by the addition of school size. Consolidation economies, however, could remain important at the secondary level, but no data were found to test this conjecture.

A plausible interpretation of this pattern would presume that there are economies in using teachers in the larger scale urban schools and perhaps compensating amenities in urban areas that teachers value, such as attractive employment opportunities for teachers when schools are not in session. In fact, urban teachers are probably better trained than rural ones in most countries,

so qualitatively one would expect to otherwise see higher teacher costs in urban school systems.

17/Standardized test comparisons do confirm that spending far less per student in low income countries is associated with lower standardized test scores (Heyneman and Loxley, 1983). What is not clear is whether marginal gains from additions to school quality and quantity that can be purchased with marginal increments in educational expenditures raise the market wages of existing students by more than the amount those resources would accomplish if they extended education to a larger number of students as discussed in the next section of the paper. One suggestive study that draws this conclusion for Brazil is Behrman and Birdsall (1983).

18/Returns to education may not increase with modern economic growth because of limited regional and occupational mobility rewarding individuals on the basis of their skills and education. Public policies may also have failed to encourage technological change through adaptive research and development. Finally, the absence of competitive domestic factor and product markets, or distorting trade and foreign exchange regimes, may have eroded the incentives to invest in education or skewed the distribution of income so as to discourage broadly based educational programs. These possibilities cannot be explored here.

19/ There are several possible reasons for divergence. First, the model is fit to a pooled combination of cross section data from several time periods, and not to just the 1965-1975 time series changes within countries. Second, the sample of countries for which the 1965-1975 comparisons can be performed is more restricted than the sample used in estimating the model. A third reason is, of course, the omission or misspecification of explanatory factors. On the other hand, this test is less strong than it might appear, because it is based on overlapping samples. Though the within country changes are not the basis for the reported estimates, repeated observations on these same countries do represent about a fifth of the pooled cross section sample used for the estimation of the original model.

20/If there are additional private direct costs of schooling, these are assumed to be offset by part-time employment by the student. Obviously, where students incur large direct costs, private returns are overstated by n and conversely where private stipends are available for all students, such as in Francophone Africa for higher education, the private returns are understated in this Mincerian earnings function. Clearly, this specification is a simple approximation, which fits reasonably well many sources of data. Tests of specification are rarely performed but some that have been reported do not reject this semi-log form (Heckman and Polachek, 1974).

21/If z had a proportionate effect, a_3, on wages in equation (11), its omission would bias the OLS estimate of r to the extent that z and s were partially correlated in the sample, i.e. $cov(z)/var(s) > o$. Thus, if z were height and $cov(z,s)$ were zero, the bias due to omitting a factor affecting wages would not affect estimates of educational returns. Alternatively, if more able individuals in each birth cohort were selected to obtain more schooling, $cov(z,s) > 0$, and more able workers received higher wages given schooling, the omission of ability from the wage equation (11) would bias upward the OLS estimate of r due to the misspecification of the wage equation by $a_3cov(zs)/var(s)$ (Griliches, 1957, 1977).

22/If the labor supply equation is jointly estimated with the wage equation, the gain in earnings associated with education can be decomposed into direct wage effects plus income and compensated wage effects on labor supply. The case could be made for focusing analysis on the direct wage and indirect income effects of wages on hours as the benefits to education, holding constant for the loss of leisure induced by the compensated change in relative wage. If the income effect of the wage change is indeed zero, as is frequently estimated, then the effect of schooling on wage rates is a satisfactory approximation for the total private market benefits to schooling.

23/ Cases have been described in the literature, such as Brazil in the 1960s and 1970s, where rapid modern economic growth created large rents for well educated workers. Before the rapidly expanding educational system of Brazil could catch up to these demands for higher educated workers, the private returns to secondary and higher education reach high levels (Langoni, 1973;

Fishlow, 1973). But these rents were reduced among the younger birth cohorts whose relative supplies of schooling increased. High returns persisted, however, for some older educated workers for whom the more plentiful young educated workers were apparently poor substitutes. Conversely, foreign exchange crises in Colombia were associated with depressed wage premia for younger university graduates in Bogota in 1965 (Schultz, 1968). As the import dependent modern sectors of Colombia revived in the late 1960s and 1970s, private returns to university training rebounded (Psacharopoulos, 1981; Fields and Schultz, 1982). The point is that the business cycle may perturb substantially the apparent cross-sectional returns to schooling in the short run (Kniesner et al., 1978), while the appropriate criteria for a long-run human capital investment should be returns averaged over short-run business cycles and not confounded with other short run changes that occur cyclically, such as changes in the relative size of birth cohorts entering the labor force (Freeman and Bloom, 1985).

24/Mincer introduced the logarithm of weeks worked to explain the logarithm of annual earnings (1974: Table 5.1, p. 92). This specification should be avoided except where weeks worked is treated as endogenous and estimated suitably.

25/Job turnover and quit behavior is also a decreasing function of education for men and women (Weiss, 1984; Kiefer, 1985; Donohue, 1985). These aspects of job search and mobility might be interpreted as increasing the private returns to schooling. Social returns might also be realized if the labor market in the aggregate sustained a lower level of turnover as schooling levels increased. Private returns may thus differ systematically over the business cycle with the changing distribution and level of unemployment (Kniesner et al., 1978).

26/Another serious problem is the treatment of unpaid family workers. This group should be imputed wages for their labors in family enterprise. Kuznets (1959, 1966) made various working assumptions to estimate factor shares. C. Chiswick (1977) has proposed a method that uses the survey detail available at the household level. Other studies examine income distributions and impute an opportunity value to the time of unpaid family workers. (Fishlow, 1972, 1974). However, even if a satisfactory wage could be imputed to unpaid family workers, few data sets report the number of hours these workers contribute to family enterprise. See for example C. Chiswick, 1973.

27/For example Armitage and Sabot (1986) report an interesting analysis of wage relationships in the manufacturing sector of Tanzania for men and women. In this country in 1967 this elite sector employs 1 percent of the male labor force and .05 percent of the female labor force. Can one assume the same type and magnitude of selection bias would be present for men and women, so that the evidence of wage differences in manufacturing between men and women could be accepted as indicative of broader patterns in sex differences in wages.

28/Price levels tend to be higher in urban than rural areas primarily because of housing and food prices. Health and educational services that are publicly provided may be an exception to this pattern. There are few countries where regional price indices are readily available over time.

29/The average private returns to schooling of Colombian women summarized in Table 7 are much less sensitive than were those for men to the migration bias. This is probably due to the much greater female market labor force participation in urban than rural areas of Colombia, (i.e. 25 versus 10 percent of the women over age 25 to 54), whereas for men at these ages the difference in labor force participation is negligible between urban and rural areas (Schultz, 1981: Table 7.5). Birdsall and Behrman (1984) control for origin and destination effects on earnings in Brazil and find different results. It is difficult for me to interpret their findings, although Brazil is different from many countries in having large differences between rural and urban areas in the northeast and elsewhere in the country.

30/"The extent of the market" limits the amount of human capital individuals invest in themselves, according to Becker (1964, p. 52). Because women often prepare to work both in the home and market, they are less likely to invest as do men in specialized market skills. The limitations of the household market circumscribe the opportunities for specialized investments open to women, and help to account, in Becker's view, for fewer US women than men graduating from college (p. 101).

31/The family labor supply model is based on the household demand framework where the wife's labor supply is conditioned on the wage rate of her husband or

other family members, the family's nonearned income, and an exogenous proxy for her permanent wage opportunities (e.g. education and age). Ashenfelter and Heckman (1974) examine only couples for whom the wife and husband work for a wage, and they simply treat her actual wage as though it were exogenous. The papers edited by Smith (1980) explore other procedures for dealing with sample selection for wage earners and wage imputation for nonworking women.

32/The direction of such a bias is not prescribed by the selection model and empirical evidence is scarce. Suppose an unobserved trait, called taste for market production, influenced positively the likelihood that a woman is observed to work for wage and to get an education. Then the direct correlation of education and wages among working women will be upward biased even if this taste has no independent effect on labor productivity. But if women's education increases the likelihood that they will retire from the labor market when their children are of preschool age (Leibowitz, 1975), then the bias could change direction at different stages in the life cycle.

33/ Caldwell (1979), for example, believes that in Africa the provision of health facilities widens differentials in health status by education class, for only the educated mothers know how to use effectively the over burdened public health facilities.

34/This intergenerational effect of education could be interpreted as arising from at least three distinct mechanisms: a genetic component of ability proxied by education, a disproportionate productivity in educating one's child, and an acquired taste for having children become like oneself.

35/Other nonmarket benefits not considered here are in spouse selection and subsequent marital stability (Becker, et al. 1977; Boulier and Rosenzweig, 1984; Montgomery, 1985). Reduced marital dissolution might also influence child investments. The reduction in crime (Ehrlich, 1975) is often cited as a source of private and social gains. Political behavior and the functioning of democracy are also often linked to schooling as are the social benefits of a more equal personal distribution of income. These issues were beyond the scope of this paper.

36/This would appear to be the implication of Woodhall (1973) and Psacharopoulos and Woodhall (1985) where the nonmarket effects are cited as added support for the very high returns to women's schooling.

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/u/lois/MsEducDev