Education and Industrialization

Walter W. McMahon
Abstract

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This is a survey of the current state of knowledge on the relation of education to per capita economic growth, income distribution, and industrialization.

The analysis finds a highly significant 25% contribution by education to growth. This is increased another 20% or so in developing countries when the effects on per capita growth of reduced population growth as women receive education and as the absorption of otherwise illiterate underemployed into industry are considered.

An analysis of investment strategies finds that nations that invest heavily only in physical capital, or in human capital alone, do less well. The eight with the fastest sustained per capita growth invest heavily in both, and also exhibit far less income inequality than the slow growing nations. Rate of return evidence suggests that investment in primary and lower secondary contributes the most, that narrow, severely tracked vocational schools are less cost effective, and that modern advanced technology transfer through education can be effective but with longer lags.
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Introduction

Many now accept that primary, secondary, and some types of higher education contribute to growth, development, and industrialization in developed and developing countries alike. But it is only in the 70's and 80's that techniques have been refined and applied to the more precise measurement of the contribution of different levels and types of education to earnings, productivity, industrialization and per capita economic growth.

Application of rate of return calculations to investment in education, as well as of returns to investment in research and to technology transfer, used appropriately, offer new possibilities for reducing waste and increasing growth. They suggest which kinds of investment offer the largest payoffs.

There are at least four advantages to developing and using objective and accurate rate of return estimates. First, rates of return (or other benefit/cost comparisons) allow ranking of investment in different types of education relative to investment in different types of physical capital and/or in various options for technology transfer. Such ranking can assist in achieving greater allocative efficiency in critical saving and investment decisions. Second, use of rates of return or present value techniques can help to improve the internal efficiency of education and manpower development systems. Third, rate of return concepts are familiar to bankers and lenders, although their
application to human resource development is just now becoming better known to non-human resource economists. This opens new channels of communication with sources of development funds. Finally, policies based on relative growth payoffs need not be at the expense of equity, and can in fact help simultaneously to reduce excessive inequality in the distribution of the fruits of growth, which can become an important source of political instability as industrialization occurs. This is because pure internal social rates of return to human resource investment (with no income distribution weights) frequently turn out to be very high for the same kind of human resource investments that simultaneously make the largest contribution to achieving greater equity in the income distribution (e.g., investment in basic literacy has social rates of return that average 28% in Africa and Latin America). Investments in education that have high growth payoffs and that simultaneously contribute to greater equity in distribution are not incompatible. Both efficiency and equity can be advanced simultaneously by the policies of governments and donors if they choose to do so, as high per capita growth examples offered below will show.

Because raw labor is usually the most plentiful underdeveloped resource in many poor countries, emphasis on more efficient human resource development is a very promising policy option for growth. Education and training guided by objective social investment criteria measuring the returns to basic literacy, to human resource development in science, social science, business, and other aspects of technology transfer can be less costly than emphasizing physical capital imports
that use more scarce foreign exchange and often aggravate unemployment and labor absorption problems.

What follows is organized to bring out the current state of knowledge on the relation of education to industrialization and development rather than emphasizing its historical development. Our concern is with education's overall impact, and with the returns to different types of education and in different sectors. There are insights from inter-industry studies on the contribution of education and R&D to productivity growth, as well as from the relation of education to efficiency in labor markets. Some attention will be given to inefficiencies and inequities that have their roots in the current methods of financing. Finally, what government can do through more efficient and equitable human resources development policies to achieve industrialization and growth forms the last strand of inquiry.

I. The Evidence: Education and Industrialization

Since T. W. Schultz's (1961) famous Presidential address to the American Economics Association, the evidence about sources of industrialization and growth is normally provided in terms of a production function that includes human capital formed by investment in education, raw unimproved labor, physical capital, and finally, technology advanced by investment in R&D. It is now generally accepted that all are necessary for industrialization, each as a necessary condition but none alone as a sufficient condition. It is also generally accepted that all public and private expenditures on education (including the investment of foregone earnings), as well as investment in R&D or in
technology transfer, are forms of investment with returns later, and are not inherently expenditures on current consumption. This is not only because education is productive of earnings over the life cycle (see Grant, 1985, and U.S. Bureau of the Census, 1985, p. 166), but also because it contributes in measurable ways to physical productivity (e.g., Jamison and Lau (1982) who measure the contribution of education in bushels of wheat). There is also evidence that it contributes to inter-industry differences in productivity (see Kendrick, 1932, pp. 44, 48), to multi-factor productivity growth in micro-economic data over time (see Waldorf, Rosenblum, and Tennon, 1937), and to differences in economy-wide per capita growth among the industrialized and developing nations (see Denison, 1967 and 1984 and McIlhahon, 1934a and 1987).

Evidence About the Overall Relation of Education to Industrialization

Anne O. Krueger (1968) provided clear and dramatic evidence on the relation of education to per capita growth. This included the relevance of education to the absorption of labor by the industrial sector. It was also a precursor of more recent research which views the total contribution of education to growth as including its indirect effects. For example, education raises per capita income by increasing health and longevity, lowers fertility and hence raises per capita growth, and embodies new technology so that it is brought to bear on production in developed and developing countries alike. Her conclusion, based on her study of a wide range of factor endowments, is that "the difference in human resources between the United States
and the less developed countries accounts for more of the difference in per capita income than all of the other factors combined" (Krueger, p. 658).

As summarized in Table 1, education alone was found to explain directly 25-33% of the difference in per capita income. Its indirect contributions through effects on health and survival (research now finds clear positive effects of the education of women on the health of the children, and of the husband, see Michael in McMahon and Geske (1982) or McMahon (1985c, p. 982), through its effect in lowering fertility rates thereby raising per capita growth (see Schultz, 1974, pp. 3-22), and through education's effects in assimilating a larger fraction of the female population into the industrial sector were found to explain the other 25% shown in the first column of Table 1. This adds up to the 50-58% of the growth in per capita income shown in Table 1 as explained by these direct and indirect contributions of education.

Overseas education also contributes to industrialization. New technology is embodied in newly educated scientists, social scientists, engineers, and managers, many of whom return to their home countries. The foundations for these additional indirect effects through embodiment of technology in human capital were laid by Robert Solow (1957) when he concluded that "87% of the increase (in output per man hour is attributable to technical change and the remaining 12% to the increased use of physical capital (in the U.S.)." He stressed that technical change is increased by investment in research and development and brought to bear as it is embodied in new machines as
Table 1

Direct and Indirect Effects of Education on Industrialization

<table>
<thead>
<tr>
<th></th>
<th>Per Capita Income Growth (1)</th>
<th>Growth of Output per Worker in Agriculture (2)</th>
<th>Return Per Year Per &quot;Dollar&quot; Invested (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Direct Effects of Basic</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>25-33%</td>
<td>7-15%</td>
<td>17-41%</td>
</tr>
<tr>
<td><strong>Indirect Effects Via:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Better Health and</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduced Population</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Growth Rates</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Absorption of a Larger</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent Into Industry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advanced Technical Education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>that Embodies New Technology</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>15-25%</td>
<td>21.2%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50-58%</td>
<td>25.6%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7-15%</td>
<td>17-41%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15-25%</td>
<td>17-41%</td>
</tr>
<tr>
<td><strong>Direct Plus Indirect Effects</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Percent of Per Capita</td>
<td></td>
<td>50-58%</td>
<td>46.8%</td>
</tr>
<tr>
<td>Income Differences Explained by Education</td>
<td></td>
<td>30-32%</td>
<td></td>
</tr>
<tr>
<td>Total Return Per Year Per Unit Invested</td>
<td></td>
<td>17-41%</td>
<td>17-41%</td>
</tr>
</tbody>
</table>

Sources:  
(1) Krueger (1968).  
(2) Yamada and Ruttan (1980, p. 560), accounting for differences between the U.S., Argentina, India, Denmark, and Turkey.  
(3) Jamison and Lau (1982, pp. 10-11). Column 3 assumes an average educational attainment of farmers in Korea, Malaysia, and Thailand, the countries studied, of 8 years.  
(4) McMahon (1987a, Table 5).
each new vintage of machines is built (Solow, 1959, p. 90). A similar
effect occurs as education embodies the technology and management
techniques in each new student generation before each one enters the
labor force. Investment in physical capital was then found by Solow
to have a greater effect on growth through this embodiment of tech-
nology. Analogously, the impact of basic education on industrial
employability and productivity is augmented by that of more advanced
technical education that brings the more recent technology to bear.
Yamada and Ruttan (1980, p. 560) for example find that technical
education alone accounted for 15-25% of the difference between the
United States and Argentina, India, Denmark, and Turkey in the output
per worker in agriculture after controlling for investment in
fertilizer and machinery, as shown in Table 1. This was in addition
to the contribution they found from basic education. The basic edu-
cation of farmers not only helps to make those employable that move
to urban industrial employments, but it also helps those who stay in
10) find that this raises the physical output of the farms they oper-
ate by an average of 3.05% for each additional year of elementary and
secondary education, or by a total of 17-41% for 8 years and 22-51%
for 10 years of schooling in Korea, Malaysia, and Thailand as summa-
ized in Table 1. This dissemination of technical change and indus-
trialization of agriculture involving investment in physical capital,
in human capital, and in adaptation of new technologies leading to a
technologically more modern, mechanized, and higher labor productivity in the
agricultural and agribusiness sector is a very important part of the industrialization process.

Other recent evidence on the overall contribution of education to industrialization and per capita growth finds that in the industrial countries, where growth slowed down following the world wide oil price shock in 1983, education continued its positive contribution to growth. Simultaneous cuts in rates of investment in physical capital and in investment in R&D, as well as underutilization, help to explain why the overall productivity growth rate was lower. Kendrick (1981) split the 1960-79 period into two sub-periods and found that the contribution to economic growth in seven out of nine industrial countries was a larger percent of the total during the later 1973-79 slowdown than during the earlier faster growth period. Consistent with this is Denison's (1984) finding that for 1973-81 following the first oil shock education made a positive .6 percentage point contribution to per capita growth even though the overall growth of labor productivity was a negative -.2% as this positive contribution of education was simultaneously offset by the other negative factors. Denison's results using growth accounting techniques are consistent with similar findings by McMahon (1984a, 1984b, 1987a) using multiple regression techniques with data for the 14 major OECD industrial nations, and separately for 30 sub-Saharan African nations. For the U.S. alone for the entire 1948-73 period prior to the first oil shock Jorgenson (1984) finds that education accounts for almost all (93%) of the improvements in the quality of labor which in turn accounts for .45 percentage points, or just over 20%, of the overall per capita growth
rate. For purposes of comparison to the estimates in Table 1, Jorgenson's estimate is confined to the direct contribution of education to growth and does not include the indirect contributions to the per capita growth rate. Nonetheless, in Jorgenson's words, education has been "... a very important source of U.S. economic growth" (p. 97).

The argument that the causal relationship runs only in the other direction with higher income and growth rates enabling countries to invest more in education has been directly addressed in a number of studies. There is of course a joint dependence, or two way flow of causation, as is commonly found in economics. For examples, does income growth cause consumer demand to grow, or is it that consumer demand increases cause aggregate demand and income to rise? Both of course are true. A two way joint flow of causation does not invalidate the causal effects of increased education contributing to increased per capita growth, so long as checks are made to determine the time lags and to avoid confusing this with the reverse effect, while recognizing that a reverse effect of education-induced growth on support for education after a time delay is of course also present. Wheeler (1980), Harris (1982), and McMahon (1987a, 1987c) all use simultaneous equation models to explain differences over time in the variables (rather than levels) and thereby control for these feedback effects to the extent that they are simultaneous. After controlling for these, all find that education has an independent effect on income. Wheeler's study of eighty-eight countries finds that an increase of 10% in the literacy rate raises real gross domestic
product by 8 to 16 percent, an elasticity of .8 to 1.6. Harris focusing on 66 developing countries finds that increases in the primary enrollment rate have benefit-cost ratios in terms of their total growth payoff of 3.4 to 7.4. His study is notable in that he finds that investment in physical capital plays a weak role when not supported by investment in education. McMahon (1987a) includes investment functions explaining investment in education and in physical capital as part of the simultaneous equation estimation of the coefficients as a check for bias produced by the reverse effects. This study of 30 African countries from 1965 through 1985 arrived at similar results. He concludes that some of the reverse effects of growth on investment are simultaneous (i.e., within a five year time period), but that most occur with a 10 to 15 year lag, especially for investment in higher education, and can be controlled for either by using lagged endogenous variables in the regression, or by using a recursive system that includes separate equations for the feedback effects, rather than stressing the simultaneity. He presents both, but opts for the recursive version of the model as did Harris. This led to direct and indirect independent returns of 21.2% to basic education and 25.6% to higher education, the latter with a 10-15 year lag. The latter included investment in higher education abroad, which takes time, but also facilitates technology transfer. These results also are summarized in Table 1. In light of the inefficiencies in resource recovery from parents and students in higher education within Africa developed by McMahon, this relatively strong augmentation of the effect of basic education can hardly be explained except in terms
of the extent which the effects from higher education include the benefits of technology transfer and management techniques adapted and applied to local conditions.

Technical change sometimes gets brought to bear on production through formal education which is highly correlated with learning through experience on the job, sometimes through physical capital investment, and sometimes through trade. These different means of bringing technology to bear lead to differences in the measurement of the effects of education. Industrialization often involves embodiment of technology in physical capital which makes ever greater economies of scale possible for example, but it is easy to overlook the fact that organized production is not possible with a mix of technology with an illiterate labor force. For instance, oxygen injection and continuous casting technology goes with ever larger steel plants (Carlsson, 1980; Eliasson, 1979; NSF, 1980, p. 13, and NSF, 1982, p. 17) which emphasizes the role of technology and economies of scale, which is only possible in Japan and other nations that have universal literacy and a relatively highly educated labor force. In other cases, without major economies of scale, technology is diffused in part as capital goods are imported (Maddison, 1984). But here again the amount of "learning by doing" that can occur through experience on the job is well known to be highly correlated with the amount of prior education of the workers (e.g., Mincer, 1974, pp. 129-44).

High tech electronic industries are even more human capital intensive, of the type that dominate Taiwan's and Hong Kong's industrialization. These human capital intensive forms of industrialization
involve considerable embodiment of technology in human capital through education followed by learning through experience on the job (e.g. Mansfield, 1980a; Kendrick, 1981), and often prior diffusion of technology to these countries as students educated abroad return, and/or as governments invest in adaptation of technology. Aspects of this embodiment of technology and diffusion of it through education are developed by Nelson and Phelps (1966), Schultz (1975, p. 832) and McMahon (1984b). Arrow's (1962) "learning by doing" can also be viewed as human capital formation on the job, with the amount of learning by doing that occurs highly correlated with the amount of prior schooling, as mentioned above, based on studies by Mincer (1974) and Bowman (1974).

Arrow's approach also has led recently to empirical work that finds a comparative advantage of educated workers in implementing the new technology (Bartel and Lichtenberg, 1985). The corollary is that new technology and investment in new machines that embody it in the reverse causal flow discussed above also raise the demand for more highly educated workers (ibid, p. 29). This is a very important point since it is evidence about how technical change offsets diminishing returns to education. It also suggests that the relative rate of expansion of advanced education in the developing countries should not proceed totally independently of the feasible rates of investment in primary and secondary education and in new physical capital which together will make the college graduates employable. However, it is the reverse that is usually true: investment in physical capital is subsidized with tax subsidies and import licenses (as in Indonesia for
example) with the result that the capital intensity of production rises, and underemployment and low and falling labor absorption rates become a serious problem.

**Some Illustrations of What Works and What Doesn't**

It is interesting to consider examples of these different investment strategies to try to see whether either investment in physical capital in isolation, or investment in education in isolation can lead to growth, or whether it would appear that the two kinds of investment are complementary.

Table 2 is intended only to provide some illustrations. The evidence concerning the direction of the flow of causation has been considered above, and will not be reconsidered here, as have rigorous studies that test for the net influence of education while controlling for other influences on growth (e.g., investment in physical capital, oil price shocks, drought, civil strife, trade policies, etc.). The rate of return evidence considered later should also be relevant to the issue of investment strategies addressed here. It would be expected to reveal the highest social rate of return to that factor in relatively shortest supply (e.g., rates of return to secondary education, for example, vs. rates of return to physical capital investment), with diminishing returns affecting the returns to whatever input is not the growth bottleneck at the time.

The four groups of countries (I-IV) in Table 2 are selected from the 128 countries in the 1986 *World Development Report* Annex of *Statistical Indicators* (pp. 180-241) on which data is available.
<table>
<thead>
<tr>
<th>Percent Illiterate in Primary 1985</th>
<th>Percent Not Enrolled in Secondary 1985</th>
<th>Percent Not Enrolled as a Percent of Total Government Budget 1983</th>
<th>Education Exp. as a Percent of GDI (%) 1965-1973</th>
<th>Growth of GDI as of % of GDP, 1984</th>
<th>GPDI as of % of GDP, 1984</th>
<th>Average Annual Growth Rate of GNP per Capita 1965-1984</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pakistan</td>
<td>74%</td>
<td>60%</td>
<td>84%</td>
<td>3.1%</td>
<td>.4%</td>
<td>17%</td>
</tr>
<tr>
<td>Nepal</td>
<td>85%</td>
<td>80%</td>
<td>78%</td>
<td>7.2%</td>
<td>n.a.</td>
<td>10%</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>94%</td>
<td>89%</td>
<td>87%</td>
<td>14.4%</td>
<td>1.5%</td>
<td>11%</td>
</tr>
<tr>
<td>34 Lowest Income Economies</td>
<td>56%</td>
<td>80%</td>
<td>9.9%</td>
<td>3.2%</td>
<td>16%</td>
<td>.9%</td>
</tr>
</tbody>
</table>

I. SLOW GROWTH: BASIC EDUCATION NOT STRESSED (AT LEAST PRIOR TO 1983), PLUS SLOW GROWTH OF PHYSICAL CAPITAL INVESTMENT:

II. LIMITED SUCCESS: THE 3 COUNTRIES MOST STRESSING EDUCATION (OVER 25% OF GOVT EXP) BUT WITH RELATIVELY SLOW GROWTH OF PHYSICAL CAPITAL INVESTMENT:

Bolivia 27% 65% 26.9% 6.9% 18%
Ecuador 9% 47% 26.0% 6.0% 20%
Philippines 5% 37% 25.6% 4.4% 18%

III. MIXED SUCCESS: THE 10 COUNTRIES THAT INCREASED PHYSICAL CAPITAL INVESTMENT FASTEST SINCE 1965 (i.e., > 14.4%)

IV. SUCCESS STORIES: THE 9 COUNTRIES WITH THE HIGHEST SUSTAINED PER CAPITA GROWTH IN THE WORLD, 1965-1985 (GROWTH OF 4.7% OR FASTER, EXCLUDING ARAB OIL EXPORTERS):

Korea, Rep. of 0% 11% 20.5% 19.7% 29%
Hong Kong 0% 32% 19.4% 3.7% 24%
Singapore 0% 31% 21.6% 22.7% 14%
Japan 0% 6% 12.0% 14.1% 28%
Taiwan 1% 25% 18.0% 14.1% 28%
Botswana 35% 7% 19.4% 48.1% 21%
Indonesia 28% 63% 9.4% 17.5% 21%
Lesotho 6% 81% 17.4% 11.0% 14%
Jordan 5% 22% 11.5% n.a. 32%

4. Not including China and India.
7. Not including China and India.
Group I, the lowest income economies, has the lowest real per capita growth rates from 1965 to 1985 of any group. Group II has stressed education, the only three countries with over 25% of their government budgets currently going to education and quite high enrollment rates in primary education going back to 1965. Group III consists of those 10 countries that have increased physical capital investment most rapidly since 1965, often with (but not always) with far less attention to investment in human capital. Group IV (which also contains four countries from Group III) are the nine countries with the fastest real per capita growth in the world since 1965.

The pattern that emerges, with an occasional exception, is that investment in human capital and in physical capital appear to make a complementary contribution to per capita growth and to the beginnings of industrialization. The poorest countries with an overwhelmingly illiterate labor force (60% or so without primary and over 80-84% without secondary education), and relatively low rates of increase in investment in physical capital, have very low rates of per capita growth averaging only .9% per year since 1965. Their low income is a cause of the low total investment, of course. But that does not contradict the proposition in any way that if the physical and human capital investment had been higher, the growth rates also could have been higher, a chain of causation proposition addressed more rigorously by the recursive models considered earlier.

In Group II, the Philippines have a good educational base. But there has been more limited (and perhaps inefficient) growth in physical capital investment there. Education again would appear to
be a necessary, but not a sufficient condition. Higher education alone is also not a sufficient condition as illustrated in the case of Pakistan (Group I) where the attempt to mix expensive scientists and college graduates with a largely illiterate labor force has led to a lot of emigration of the educated elite. There have of course been other factors in Pakistan's case (border wars, civil strife, and an overvalued foreign exchange, for example), but at least it is clear that higher education alone is not a sufficient condition for growth.

Group III countries with 14.4% to 48% per year increase in physical capital investment also have not all enjoyed rapid per capita growth. The six with slow growth (Group III) have in common large percentages not enrolled in primary schools in 1965 who are now in the work force, excepting only Panama. Currently (as well as earlier) 95% are not in secondary schools in Malawi, and 82% in Kenya, in spite of the somewhat larger percentages of (relatively small) public budgets recently being devoted to education.

Group IV, the nine countries with the highest sustained real per capita growth in the world since 1965 have in common high rates of both human and physical capital formation. They are the Republic of Korea, Hong Kong, Singapore, Japan, Taiwan, Botswana, Indonesia, Lesotho, and Jordan. All have had remarkably high percentages enrolled in primary education since 1965. Except for Lesotho, Botswana, and Indonesia which are somewhat special cases (because of the relationship of the first two to South Africa and because Indonesia is an OPEC oil exporter) secondary education also is nearly universal in these countries. The rates of increase in physical capital investment
have also been relatively high, except for Hong Kong (where the level however has been a high 24% of GDP). In all of the nine fast growth cases, relatively high rates of investment in physical capital, which is a well-known phenomenon, have been complemented by an investment strategy that includes relatively very high rates of human capital formation (a fact that is less well known). All had achieved universal or very nearly universal enrollment at the primary education level by 1965. Those a bit further along also achieved high percentages enrolled in secondary schools, and virtual universal literacy of their labor force, usually just prior to their take off into rapid industrialization and sustained high per capita growth. This combined strategy is associated with higher sustained per capita growth (and industrialization) rates than those observed in the other Group III countries.

The Specific Evidence about Rates of Return to Investment

The foregoing suggests that the rates of return for achieving growth may be the highest when investments are made in that factor input which is in shortest relative supply or in other ways contributes the most to growth. And this is the very kind of situation in which recent rate of return evidence is most helpful.

There is now extensive evidence on rates of return to investment in education for a very wide spectrum of developed and industrialized countries developed by Psacharopoulos (1973, 1981, 1984, 1985) and others so that patterns are readily apparent. The results for the social rates of return summarized by Psacharopoulos (1985, p. 591)
for 100-125 studies that cover most of the developing countries of Africa, Asia, and Latin America as well as the more industrialized countries are shown in Appendix A and Table 3. These social rates of return are the ones most relevant to development strategies since they show where the relative growth payoffs are largest. Standard social rates of return do not include income distribution weights, although the relation of the types and distribution of education to the distribution of income as industrialization occurs will be discussed later. Nor do social rates of return include any shadow pricing of benefits, beyond including earnings before taxes which reflects the social benefits generated as taxes finance public goods. This distinguishes them from private rates. What social rates of return also reflect in addition to the private costs to families that are included in the private rates of return are the costs to the donor and tax costs to the public of the investment. The social rate of return is a rate of return based on the total resource costs to the society.

The evidence based on many studies by independent analysts shown in detail in Appendix A is summarized in Table 3. It shows that the rates of return to investment in primary education are more than twice as high as the rate of return to investment in physical capital in the developing countries. Annual growth payoffs of 23% on investments in primary education in 26 developing countries, well above the 13% rate of return to investment in physical capital in Table 3, indicates that the investment pays for itself in earnings and hence in National
### Table 3

Social Rates of Return to Investment in Education and Rates of Return to Investment in Physical Capital

<table>
<thead>
<tr>
<th>Country Group</th>
<th>Social Rates of Return by Level of Education</th>
<th>Rates of Return to Physical Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Primary</td>
<td>Secondary</td>
</tr>
<tr>
<td>Industrial Market Economies (10 countries)</td>
<td>15%</td>
<td>11%</td>
</tr>
<tr>
<td>Developing Countries (4 exporters of manufactures)</td>
<td>15%</td>
<td>13%</td>
</tr>
<tr>
<td>Developing Countries (26 countries)</td>
<td>28%</td>
<td>17%</td>
</tr>
</tbody>
</table>

1Source: Arithmetic means of studies reported in *Appendix A* using latest year observations for each country where primary, secondary, and higher social rates of return are available (secondary and higher in the case of advanced countries). Most, but not all, of the approximately 125 studies on which these averages are based refer to the 1970s and early 1980s.

2Estimate based on the return in the intermediate countries. The lack of a control group of illiterates in the industrialized countries prevents a direct computation there.

3India, Israel, Singapore, and Yugoslavia.

Income Per Person Employed (NIPPE) within four years of the time the student in question enters the labor force.

Rates of return to investment in secondary education of 17% can also be seen in Table 3 to be higher than the 13% rate of return to investment in physical capital. For strict comparability the latter also must make allowance for tax supported subsidies such as investment tax credits and depreciation allowances, which would make the true social rate of return to private investment in physical capital somewhat lower than the private rate of return that is normally reported.

There is a widespread evidence for other familiar patterns that can also be observed in Table 3. The annual rates of return for higher education always tend to be somewhat lower than those for primary and secondary, mostly because each year of higher education costs more. There is also widespread evidence, observable in Table 3, that the rates of return to all capital, both human and physical, are somewhat lower in the more advanced countries where all capital is relatively more plentiful. They are higher in the developing countries also because labor without prior education is cheaper, and hence foregone earnings costs are lower at the same time that human and physical capital are relatively more scarce.

Primary education is a particularly advantageous investment therefore, with a high growth payoff. It does not use very much scarce foreign exchange, apart from foreign support for teacher training, and it is relatively labor intensive and low cost per child, characteristics that use the relatively cheaper labor advantage of
developing countries. Although the evidence consistently points to the high profitability of investment in primary education (see the detail in Appendix A), two qualifications are necessary. First, once primary education has become universal, secondary school graduates are the ones in relatively short supply and most needed by industry. This shows up in the form of relatively higher social rates of return to secondary education, as for example in Malawi (most recently estimated by the World Bank, 1984, at 30%) and in Indonesia (see McMahon, 1986b, pp. 2-224). Where labor absorption rates are low, some unemployment furthermore often appears among primary school graduates in this special case, rather than among illiterates as before. But it is a temporary phenomenon while the education system is expanding from a broader primary education base. Finally, rates of return to investment in higher education may understate its true contribution and hence the true social rate of return including technology transfer since not all the benefits of dissemination of the new technologies are always reflected in private earnings of salaried scientists and government workers as alluded to earlier. Shadow pricing could take this into account, but it is difficult because some benefits are not realized for many years.

II. Education for Industrialization: The Efficiency of Training

The efficiency issue, that is, both how the human resource development and education system relates to the needs of the economy, or its external efficiency, and how well its teaching and learning resources are organized internally, that is, its internal efficiency,
are very important to achieving rapid industrialization and growth. As suggested above, underdeveloped human resources are often the most plentiful resource in the poorest countries, and waste in their development and utilization does not contribute to growth. The efficiency issue, both external and internal, to be developed in what follows is the key issue in human resource development, and also in many ways, in overall development strategy.

It has many dimensions. The dynamic dimension is the rate of absorption of illiterate raw labor and of improved labor consistent with the development of the longer run comparative advantages of the nation in exports as industrialization proceeds. Second, there is the efficiency dimension of the division of education or training as between formal schooling and the supplementation of this by firms with training on the job. Third, there is the external efficiency question of the types of education that are most appropriate, the internal efficiency with which human capital formation proceeds, and the implications of the efficiency with which labor markets work. We will seek to discuss only the most important of these external and internal efficiency issues to industrialization.

Levels of Education Required for Industrialization

Industry cannot absorb large proportions of illiterates, such as is illustrated in the very wide base of illiterates in the labor force in sub-Saharan African countries shown in Figure 1 to the bottom left. The unemployment and underemployment rates tend to be the highest for these groups. The social rates of return to primary education as was
Sub-Saharan Africa 1985

- 40% primary
- 10% secondary
- 1% higher
- 49% illiterates

Growth rate* - .1%

Indonesia 1985

- 60% primary
- 12% secondary
- .8% higher
- 27.1% illiterates

Growth rate* + 4.9%

South Korea 1975

- 36% secondary
- 22% yr. secondary
- 19.3% std. secondary
- 6.4% higher
- 1% primary
- 43.1% illiterates

Growth rate* + 6.6%

Figure 1

Inappropriate and Appropriate Educational Attainment of the Labor Force


indicated in Table 2 are a high 28 percent. Farther along the route of industrialization, as illustrated in the center of Figure 1 for Indonesia where there already has been a big expansion of primary education, the rates of return to primary education are somewhat lower reflecting less of a shortage, as one would expect. The social rates of return to senior secondary graduates which then are in relatively shorter supply are a relatively high 23-24% (McMahon, 1986b, p. 306). The same pattern exists in Malawi, to cite another example. Still farther along the path of industrialization, South Korea illustrates the kind of educational structure of the labor force needed by industry as shown in the figure to the right in Figure 1. Korea has a higher labor absorption rate, and much lower unemployment and underemployment rates, with fewer illiterates.

Unemployment and Underemployment

Even relatively small amounts of temporary unemployment of high school or college graduates in these situations is much discussed. To keep it in perspective however, both unemployment and underemployment is normally much higher among illiterates. Further along in cases like that of Indonesia, as the bulge of primary school leavers begins to enter the labor force, more unemployment begins to show up among primary school leavers. During the 1980 Indonesian Census, for example, when nationwide unemployment was only 2.8% and averaged 5% among younger secondary school graduates, nationwide underemployment (defined as working less than 35 hours a week) was 37.2% (World Bank, 1985, and McMahon, 1986b, p. 127). But this underemployment was
concentrated heavily among illiterates and primary school leavers in the villages, where it was 40%. Although underemployment was a lower 17.6% in the urban areas, some of this is among high school graduates who migrate to the cities and remain temporarily unemployed while they search for jobs or wait for government jobs. They comprise a pool of trainable labor of the type required as industry expands.

The limited duration of this secondary school leaver "unemployment" is the other important dimension of this dynamic job search process. The evidence produced by many tracer studies for example finds that the time spent "unemployed" during job search is a declining function of both the number of months since graduation and of age. Psacharopoulos (1982) finds that the percent unemployed in Zambia, for example, declines from over 20 percent one month after graduation to only a small fraction remaining unemployed six months after graduation (see Figure 2).

![Figure 2](image-url)

**Figure 2.** Unemployment as a function of time since graduation

\( a \) Source: Psacharopoulos 1982 p. 151
For the Philippines, Psacharopoulos and Sanyal (1981, pp. 453, 457) find a similar pattern, with students expecting an average search time of 4.0 months and graduates experiencing an average unemployment plus search time of 5.3 months. Unemployment generally tends to be higher among young people, and the developing economies are no exception (e.g., data for Indonesia in McMahon, 1986b, p. 128). But in the majority of cases it lasts only a few months at the most. This point is developed in detailed evidence on the duration of unemployment as related to education in the developing countries by Psacharopoulos (1980). The duration of job search also varies by fields. In the U.S., for example, where McMahon (1985b, p. 4850) found that at a time when 54.25% of all college graduates had accepted permanent employment by graduation day, 95% of engineers had jobs, whereas only 40% of the Liberal Arts graduates and 13.79% of the education graduates had jobs. However within six months, 96.47% of all graduates had jobs (ibid, p. 4849).

This temporary duration of unemployment of young people has to do with imperfections in the labor market that are related to job search theory but are also largely irrelevant to education policy. In Indonesia, for example, the government pay scales for those with no school, primary, and secondary school are from two to 20 times the monthly income of non-government employees (McMahon, 1986, p. 288). This pay differential does not persist at the college bachelors level and above (ibid, p. 288). It also follows a pattern found by Psacharopoulos (1983, p. 126) for a number of developing countries. This pay policy results in a long queue of persons with high school
training in Indonesia that are waiting for government jobs. Simajuntak (1985) has found with a follow up study that they wait in fact for an average of two years. Those with less than a high school education from poor families cannot afford to wait so long, but a successful wait by high school graduates for two years carries a rate of return of over 25%. So it is quite a rational decision. Other portions of the temporary unemployment after graduation is due to slack aggregate demand, as for example during the 1931-1985 worldwide recession with repercussions that are still being severely felt in many developing nations. But most of the structural unemployment right after graduation is primarily a reflection of the job search process. Certainly it would be a serious mistake to base longer term educational investment decisions, which by their very nature should have the individual's contribution to productivity over his entire life cycle clearly in view, on the transitory effects of short term macroeconomic fluctuations or on short-duration job search data.

What Subject Fields Are Needed for Industrialization?

It is clear that beyond basic education, various sets of specialized skills are needed in both production and service industries. Advanced specialized skills are also needed to help develop industries at the leading edge in fields where a nation has potential comparative advantage to the point that these industries become internationally competitive.

The risk is in overlooking the contribution of basic education, and in overlooking the greater flexibility of general education as
distinguished from specialized vocational education, to productivity. The evidence from employability, rates of return, inter-industry differences in productivity (e.g., Kendrick, 1982), or from differences in physical output (Jamison and Lau, 1982) all points to the conclusion that basic literacy in language and mathematics, the ability to think more widely and adaptively, and the simple discipline of showing up regularly, all of which are taught by schools, contribute directly to productivity. This is general education, albeit at a very basic level. This is not to say that all courses at the secondary level in developing countries should be general education, which may be "vocational" for civil service employments but are not suitable terminal courses for many other employments. So beyond this there are the more specialized vocational and technical courses, focused on training for particular vocations. Considered more comprehensively, some can be at the secondary school level, but there are also vocation-oriented curricula at other levels (e.g., practical nursing, bachelor's level CPA's, Masters level MBA's, Law degrees, and even the Ph.D.). At the terminal level educational curricula in all fields of necessity become "vocational," even Ph.D.'s in Music and Classics. Viewed in this way, the relevant question becomes how much and what types of specialized vocational education are appropriate?

There is quite a bit of evidence that developing countries tend to expand rigidly tracked relatively high cost separate vocational/technical schools too fast in relation to the employability, earning capacity, and productivity of the relatively lower cost secondary general education graduates. This is not to say that some practical
vocational courses for the terminal students in general secondary school curricula do not make important contributions. For example, the course in vocational agriculture in rural high schools teaching use of hybrids, fertilizers, and animal antibiotics is an important one for those who are to spend their lives in farming. Similarly, in urban contexts, a vocational course or two can give a student who might otherwise drop out a trade, and create a cadre of local job skills that later can be supplemented with more adaptable general education graduates if the economy finds those skills in short supply. The problem is instead with the over expansion of rigidly tracked separate vocational schools. The earnings of the graduates are often no higher (e.g., McMahon, 1986b, p. 309), even in industry, and the rates of return are much lower (e.g., 16% for secondary general, and 12% for secondary vocational for developing countries as a whole, from Psacharopoulos, 1988, p. 589), partly because the vocational school costs are higher. The parents and students seem to know this and they try hard to avoid being forced into these schools, where there is no opportunity to change to other vocations later (on the option value of education see McMahon, 1985e). Since these schools require many male teachers, it is extremely difficult to keep them staffed competently, and the expansion is often both costly and very wasteful. In spite of the evidence, expansion continues, with continuing rapid expansion sometimes still supported by donors.

There is further evidence that the reported earnings, and hence the measured social rates of return to education, are considerably, higher for those students in developing countries that are employed by
industry than they are in farming or Government other than the military. This reflects the fact that there are excessively low prices for agricultural products in most LDC's which then leads to an understatement of the monetary rates of return to education in agriculture. Table 4 shows that the returns to education are about twice as high if the student enters industrial employment in Indonesia, for example. In other countries returns are also consistently higher in the Private Sector than in government employment, as seen in Table 4, where there may be externalities (e.g., the benefit to future generations from the services of scientists, teachers, and foreign service officers that are not fully captured in current civil service earnings). This difference is in spite of the fact that the private sector includes street vendors and many other lower income employments that are not usually thought of as "industry." The significance of this evidence is that as persons shift from agriculture and government employments into private industries as industrialization occurs, the rates of return to education since they are higher in these industries should cause the overall average rates of return to rise.

Finally, Table 5 shows a variation in the returns to education by subject field. Returns and rates of return tend to be higher in those fields that are in demand and where there are jobs, and lower where there are fewer jobs. Higher returns in engineering and in economics in the developing countries than in other fields can be clearly seen in Table 5. High returns in medicine as well as in law (lawyers familiar with contracts, and legal forms of organization, for example, are also needed if businesses are to operate), both of which are human
Table 4

Social Rates of Return by Type of Employment in Middle and Lower Income Countries¹

<table>
<thead>
<tr>
<th>Country</th>
<th>Industry Only</th>
<th>Private Sector</th>
<th>Government (Non Military)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesia (Males only, 1982)</td>
<td>35%</td>
<td>15%</td>
<td>17%</td>
</tr>
<tr>
<td>Primary Education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Senior Secondary General</td>
<td>49%</td>
<td>19%</td>
<td>14%</td>
</tr>
<tr>
<td>Senior Sec. Vocational/Tech.</td>
<td>1%</td>
<td>14%</td>
<td>12%</td>
</tr>
<tr>
<td>Senior Sec. Commercial</td>
<td>51%</td>
<td>20%</td>
<td>13%</td>
</tr>
<tr>
<td>Teachers Training Sec.</td>
<td></td>
<td>20%</td>
<td>12%</td>
</tr>
<tr>
<td>Brazil</td>
<td>19.3%</td>
<td>14.9%</td>
<td></td>
</tr>
<tr>
<td>Colombia</td>
<td>14.6%</td>
<td>13.4%</td>
<td></td>
</tr>
<tr>
<td>Guetamala</td>
<td>12.7%</td>
<td>10.6%</td>
<td></td>
</tr>
<tr>
<td>Malaysia</td>
<td>22.5%</td>
<td>17.7%</td>
<td></td>
</tr>
<tr>
<td>Pakistan</td>
<td>7.6%</td>
<td>7.4%</td>
<td></td>
</tr>
<tr>
<td>Portugal</td>
<td>8.0%</td>
<td>4.9%</td>
<td></td>
</tr>
<tr>
<td>Tanzania</td>
<td>14.2%</td>
<td>10.7%</td>
<td></td>
</tr>
<tr>
<td>Venezuela</td>
<td>11.1%</td>
<td>10.6%</td>
<td></td>
</tr>
</tbody>
</table>

¹Sources: For Indonesia: McMahon (1986, pg. 306).
For all other countries: Psacharopoulos (1985, Appendix B-2).
### Table 5

**Social Rate of Return to Education by Subject**

<table>
<thead>
<tr>
<th>Industrialized Countries</th>
<th>Social Sciences %</th>
<th>Economics %</th>
<th>Liberal Arts %</th>
<th>Physical Sciences %</th>
<th>Engineering %</th>
<th>Agriculture %</th>
<th>Law %</th>
<th>Medicine %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium, 1967</td>
<td>9.5</td>
<td></td>
<td>8.0</td>
<td></td>
<td>2.0</td>
<td></td>
<td>6.0</td>
<td>11.5</td>
</tr>
<tr>
<td>Canada, 1967</td>
<td>9.0</td>
<td></td>
<td></td>
<td></td>
<td>8.0</td>
<td>10.0</td>
<td>5.0</td>
<td></td>
</tr>
<tr>
<td>Denmark, 1964</td>
<td>9.0</td>
<td></td>
<td></td>
<td></td>
<td>4.3</td>
<td>2.2</td>
<td>10.6</td>
<td>3.1</td>
</tr>
<tr>
<td>Norway, 1966</td>
<td>8.9</td>
<td>4.3</td>
<td>6.2</td>
<td></td>
<td>8.7</td>
<td>2.2</td>
<td>10.6</td>
<td>3.1</td>
</tr>
<tr>
<td>Sweden, 1967</td>
<td>9.0</td>
<td></td>
<td></td>
<td></td>
<td>7.5</td>
<td></td>
<td>9.5</td>
<td>13.0</td>
</tr>
<tr>
<td>U.K., 1967</td>
<td>13.0</td>
<td>13.5</td>
<td>11.0</td>
<td></td>
<td>11.4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Upper Middle Income Countries</th>
<th>Social Sciences %</th>
<th>Economics %</th>
<th>Liberal Arts %</th>
<th>Physical Sciences %</th>
<th>Engineering %</th>
<th>Agriculture %</th>
<th>Law %</th>
<th>Medicine %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil, 1962</td>
<td>16.1</td>
<td></td>
<td></td>
<td></td>
<td>17.3</td>
<td>5.2</td>
<td>17.4</td>
<td>11.9</td>
</tr>
<tr>
<td>Greece, 1977</td>
<td>4.4</td>
<td></td>
<td></td>
<td></td>
<td>8.2</td>
<td>2.7</td>
<td>12.0</td>
<td></td>
</tr>
<tr>
<td>Iran, 1964</td>
<td>18.5</td>
<td>15.3</td>
<td></td>
<td></td>
<td>18.2</td>
<td></td>
<td>13.8</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lower Middle Income Countries</th>
<th>Social Sciences %</th>
<th>Economics %</th>
<th>Liberal Arts %</th>
<th>Physical Sciences %</th>
<th>Engineering %</th>
<th>Agriculture %</th>
<th>Law %</th>
<th>Medicine %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colombia, 1976</td>
<td>26.2</td>
<td></td>
<td></td>
<td></td>
<td>24.8</td>
<td>16.4</td>
<td>22.7</td>
<td>23.7</td>
</tr>
<tr>
<td>Philippines, 1969</td>
<td>10.5</td>
<td></td>
<td></td>
<td></td>
<td>8.0</td>
<td>5.0</td>
<td>15.0</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Low Income Countries</th>
<th>Social Sciences %</th>
<th>Economics %</th>
<th>Liberal Arts %</th>
<th>Physical Sciences %</th>
<th>Engineering %</th>
<th>Agriculture %</th>
<th>Law %</th>
<th>Medicine %</th>
</tr>
</thead>
<tbody>
<tr>
<td>India, 1961</td>
<td>12.7</td>
<td></td>
<td></td>
<td></td>
<td>16.6</td>
<td>16.4</td>
<td>22.7</td>
<td>23.7</td>
</tr>
<tr>
<td>Philippines, 1969</td>
<td>10.5</td>
<td></td>
<td></td>
<td></td>
<td>8.0</td>
<td>5.0</td>
<td>15.0</td>
<td></td>
</tr>
</tbody>
</table>

capital intensive service "industries," is also a pattern as seen in Table 5.

Students do tend to vote with their feet, and gravitate to those curricula where the jobs are, and hence where the private rates of return are high, if not prevented from doing so. In this way, a decentralized system breaks monopoly quasi-rents and responds to where the economy's expressed needs are. (See McMahon 1981; McMahon 1984c; McMahon 1985; McMahon and Geske, 1982, Ch. 3; and Freeman 1971). Students are currently flocking toward engineering, business, and medicine in the U.S., for example, and away from teaching, humanities, and social work where there are fewer jobs, lower salaries, (and hence lower private and social rates of return). The budget money does follow the enrollment pressures and the changes in "instructional units" to some extent, but not fully. So quotas are erected, standards are changed, and many obstacles are placed in the student's path. The result is that it is hard for market forces to "get the prices right," and that large differences in rates of return between fields persist for long periods of time. This occurs also in developing countries. There the problem of rigidities to quick adjustment to market needs is often aggravated by an excessive-commitment to overly detailed manpower planning. (See Psacharopolous 1984 for analysis of the problems with the current practice,) Manpower planning may help to get things started. But if carried too far, it is often oblivious to the costs, so that detailed manpower planning adhered to too rigorously is inefficient. The rigidities are overcome in a more decentralized system by the superior capacity of the latter to adapt.
The economy needs to respond to the shortages and surpluses of the types of manpower needed, as signaled to a fair extent by earnings in relation to costs if the growth process is to be efficient and reach its potential.

Who Does the Training?

Much learning and human capital formation occurs on the job, more in some jobs than others. The amount of human capital formation that occurs on the job is positively correlated with the amount of prior schooling, in evidence comprehensively developed by M. J. Bowman (1974) in her "Learning and Earning in the Post School Years." The amount of human capital formation on the job is also more a function of the years of work experience on the job than it is of age, in evidence developed by Mincer (1974), and earlier by Arrow's (1962) learning curves in the experience with new air frames. (See also reviews of Mincer and of Dean by McMahon, 1976, 1986c). This interdependence between formal schooling and learning on the job is carried full circle by the finding in recent NBER research alluded to earlier that if the investment in new machines which also helps to stimulate learning on the job brings in the new technology this leads to a relatively larger increase in the demand for the types of workers that have more formal schooling.

But given this important interdependence between formal schooling and OJT which does influence the amount of learning that occurs on the job, who is to finance this training? The basic economics of this have been developed by Gary Becker (1983). The principles he develops
govern the economically feasible allocations of costs both as between firms and schools and as between firms and their employee-trainees. Firms have no incentive to invest in training if they can never recoup the costs. With respect to the allocation of types of training therefore, the more general marketable skills running from basic literacy through advanced preparation for professions are too expensive for firms to provide and must be provided by the educational system. Firm-specific training however, that type of training which increases an employee's productivity but is not as marketable outside the firm, is an investment that the firm can recoup, and generally is willing to finance. Firms therefore generally support social investment in formal education, which raises worker productivity in ways that are less costly to them, and will prefer to locate in those localities where the education of the labor force and the schools are good, even though local school taxes are high (e.g., A. J. Heins, 1976, p. 19). But most firms must be given encouragement to invest if they are to invest more of their private resources in other than firm-specific training, such as through the 5 to 6% of all company budgets that firms in Korea are required to spend on education. Trainees also are more tied to firms in Korea and Japan as a lifetime commitment than they are in the West. In spite of these two special inducements for on the job training there, it is likely that a relatively high proportion of the training still is firm-specific and less generalizable if the employee should leave the firm.

The other dimension of this allocation of cost is the portion of the training financed by the firm vs. the portion financed by the
employee. Employees will frequently defer gratification, or accept lower current salaries while in training (e.g., apprenticeship wages, or the salaries of teaching assistants at universities) for a job or a profession that "has a future." In this case the investment is being made by the employee, not by the employer or the firm.

But in spite of the basic economics of this which will always leave the comparative advantage with formal schooling for the more general and widely marketable skills, and with firms when it comes to adapting these skills to their more firm-specific unique needs, it still would help growth if firms could be encouraged to participate and invest more in training. The basic policy of offering tax subsidies to firms that invest in physical capital and no similar subsidies to firms that invest in education and training for example needs to be re-examined. The capital intensity of production is increased artificially, contributing to inefficient factor proportions, increasing inequality in the distribution of the benefits as industrialization proceeds, and serious problems with low labor absorption rates. The Ministry of Finance in Indonesia is currently moving to reduce some of these import licenses, overpriced foreign exchange, and other distorting subsidies to imported physical capital in the effort to increase the labor absorption rate during industrialization. The same kind of steps need to be taken in many African countries to foster the kind of industrialization that encourages the use of domestic rather than imported inputs with higher labor absorption and training rates. If the social rates of return to human capital formation on the job are as high as they appear to be,
at least equalizing the incentives to invest in human vs. physical capital and thereby raising the relative private rates of return to firms for their investment in on the job training would be conducive to a more human capital intensive form of industrialization and to "getting the prices right" for growth.

III. **Industrialization, Education, and Improved Income Distribution**

A serious problem in many developing countries in Africa, South Central Asia, Central America, and South America is that as industrialization proceeds it creates a narrow "modern" sector which then coexists with a large, poor, traditional agricultural sector and an unemployable semi-literate population on the urban fringe. The fruits of industrialization do not reach these latter groups, and there is excessive inequality in the income distribution among families. In the poorest countries, for example, the lowest 20% of the households get only 4.6% of the income and the highest 20% get 54.2% of the income. Inequality is considerably less in the industrial market economies where primary and secondary education are nearly universal, with the bottom 20% of the households getting a larger 6.9% of the income and the top 20% getting a significantly smaller 40% of the income. This reduction in inequality which reflects the greater relative importance of earnings from human capital relative to property income emerges here in the simple arithmetic averages for the 13 developing countries and for the 18 industrial market economies for which income distribution measures exist in the World Bank data (1986a, pp. 226 and 227 respectively).
Education therefore is not only supportive of industrialization and rising per capita income, but the distribution of education has an important bearing on how widely the fruits of industrialization are distributed. A series of studies commissioned by the International Labor Organization and by the World Bank reach the general conclusions summarized by Psacharopoulos and Woodhall (1985) that:

1. If participation in education is confined to the children of the rich (as it often is in secondary schools and in universities in Africa especially, but also in other developing countries), education then merely *transmits* intergenerational inequality.

2. If certain groups obtain higher financial rewards (e.g., urban males) than other groups (e.g., inhabitants of rural villages, especially females), then education *increases* income inequalities.

3. If primary and junior secondary education are expanded and extended more equitably to children (e.g., fees at this level eliminated), then the famous earlier conclusion of the World Bank report (1980) is likely to be observed. That is that "much depends on government policy, which can reduce the unevenness of the (industrialization) process, and accelerate growth, by promoting productivity growth in agriculture and increasing the rate at which (this excess labor in agriculture can be) absorbed into the modern industrial sector", (ibid, p. 41). There are other studies, some of varying quality, that bring in some of the other factors including
financing that affect income distribution as industrialization occurs that are surveyed by Psacharopoulos and Woodhall (1985, pp. 244-83). But the simplest generalization goes back to the basic point that the income distribution later depends heavily on who gets the education.

The hypothesis that fast growth and increasing equality in the income distribution are compatible and possible if appropriate government policies are followed is consistent with the data for the five highest inequality and five low inequality countries shown in Table 6. The low inequality countries include three of the nine fastest growing countries in the world in terms of sustained real per capita growth since 1965. Two of the other rapidly growing countries (Hong Kong and Indonesia) have only slightly greater inequality, and they are two for which there is no income distribution data available. Taiwan and South Korea, the two fastest growing countries in recent years, have aggressively pursued a policy of universal primary education and very rapid expansion of junior and senior secondary education, as have Hong Kong, Singapore, and Japan. In Taiwan, for example, the proportion of primary school graduates that went on to junior high school increased from 32% in 1951 to 80% in 1971. Illiteracy decreased in the labor force from 55% in 1946 to 10% in 1980 (Kuo, Ranis, and Fei (1981, pp. 13, 39, 64). These education policies that make a broader spectrum of the population employable as industrialization occurs, together with an export-oriented growth strategy (e.g., avoiding getting the foreign exchange overpriced) appear to have been conducive
### Table 6

**Industrialization Can Be Accompanied by Improved Distribution, Depending on the Policies Followed**

<table>
<thead>
<tr>
<th>Countries Ranked from Highest to Lowest Inequality:</th>
<th>Relative Shares of Income by Income Class (%)</th>
<th>Percent Industrialization and Growth Rates</th>
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<tr>
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<td>Top 20% of All Households</td>
<td>Lowest 40% of All Households</td>
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<td>n.a.</td>
</tr>
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<td>Philippines</td>
<td>54.0</td>
<td>14.2</td>
</tr>
<tr>
<td>Moderate Inequality</td>
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<td></td>
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<td>Hong Kong</td>
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<td>Low Inequality</td>
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<tr>
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<td>Japan</td>
<td>37.5</td>
<td>21.9</td>
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</tbody>
</table>

Source: World Bank (1986a, pp. 180, 1984, and 226) except for Taiwan and South Africa data which is most recent as of 1985.
to a broader based development and increasing equality in the income
distribution.

In contrast, Brazil and South Africa have pursued policies that
have resulted in some growth, but also have resulted in great inequal-
ity, as shown in Table 6. In neither instance is the equality of
educational opportunity widespread. Chile, for which the income dis-
tribution data is not comparable to the form in which it is reported
for the other countries, may be an example of the fact that great
inequality is not always conducive in the longer run to political
stability (which is of course influenced by other factors as well that
are not the subject of this paper).

IV. What Educational Policies Can and Cannot Do

Many things have been suggested throughout this paper that
education policy, donors, and lenders can do to increase the internal
and external efficiency of the education and human resource develop-
ment systems. The point has been developed that this greater effi-
ciency, guided in part by expanding investment fastest where the
social rate of return is highest, has the potential as a development
strategy of contributing not only to faster per capita growth but also
to reduced inequality in the income distribution.

High priority to expanding both the quantity and quality of
primary education, and then when that is well underway, the secondary
system, not only offers high returns, but also increasing equity.
Vocational and technical high schools seem somewhat less advantageous
when one looks at the evidence, apart from their superficial appeal.
There is evidence that investment in the education of women does have almost as good a return in terms of earnings. When the indirect effects of the education of females on the improved health of their children and husbands, as well as on reduced fertility rates, is taken into account, the total effects on per capita growth of the education of women are significantly larger.

It is hard to measure accurately the extent to which higher education and the advanced training of graduate students abroad facilitates technology transfer. Donors are prone to concentrate on higher education policy, which also has a key role in the development process. But governments and donors must guard against creating a top heavy system, of which several examples have been offered in this paper. Although there are lower social rates of return at this level, the role of higher education in embodying the new technology, in creating a domestic research capability that is necessary to the adaptation of technology to local conditions, and the importance of economies of scale in higher education (e.g., Psacharopoulos, 1980) justify a continuing judicious expansion at that level in most developing countries.

With respect to the management and finance of the domestic higher education systems, somewhat more decentralization of both would seem to be warranted. The decentralization to universities that avoids overly rigid manpower planning and encourages universities to set up job placement services allows students to gravitate to those fields where the jobs and the growth bottlenecks are. Governments can also more adequately finance equitable expansion of their higher education
systems by more resource recovery, combined with tuition waivers and loans subject to standardized family financial need analysis systems.

Education policy alone cannot reverse low labor absorption rates, when these are induced by structures of tax subsidies and trade policies that artificially encourage an uneconomically high capital intensity of production. In this case the tax laws and the tariff policies need to be changed. Education policy alone cannot eliminate temporary unemployment caused by the normal duration of job search, or caused by recessions due to fluctuations in aggregate demand. If there is queuing for government jobs at the secondary school level that increases the duration of job search for example, the remedy needs to be in changing the government pay scales, not the education policy. If there is slack aggregate demand, created by monetary policies and/or a world wide recession, education policy is neither an appropriate or workable tool to eliminate the general unemployment. Educational policies should instead look to longer run, lifetime oriented, human resource investment strategies.

Finally, economic development strategies do need to pay attention to where the returns are highest, and where equity simultaneously can be served. The returns to most investments are positive. But that does not mean that they are necessarily the highest relative to the alternative use of the scarce resources. The evidence is that the relative private and social rates of return to investment in human resources for industrialization are relatively quite high. Furthermore, industrialization that benefits the few at the expense of the many is less likely if efficient human resource development is a centerpiece of the development strategy.
Box 1

Success Stories: What Works
South Korea

For the last twelve years, South Korea has been the fastest industrializing and fastest growing country in the world, faster than Japan. What is less well known is its very strong commitment to expanding the quality and quantity of primary and secondary education while simultaneously requiring the involvement of firms in more training on the job. It has maintained a steady growth of demand, including export demand as labor productivity grows, and a relatively high .44 labor absorption rate with decreasing unemployment. These high education and labor absorption factors together with physical capital investment contributed not only to fast per capita growth but also to steady reductions in inequality in the income distribution.

The educational distribution of the labor force is shown in Figure 1 for sub-Saharan African currently, for Indonesia currently, and for South Korean in 1975 just prior to its take off into high sustained per capita growth. The educational structure of sub-Saharan Africa is unsuitable for industrialization, and the per capita growth rate for these countries has been -.1% annually in the period since 1965. Indonesia, which made a massive effort to expand primary education and reduce illiteracy now faces considerable pressure to expand junior and senior secondary education and would appear to be primed for a take off into rapid industrialization. The educational structure of South Korea's labor force would appear to be what is required currently for maintaining rapid industrialization. Korea has even larger percentages completing secondary education and above, suitable for the high-tech forms of industrialization, and has even fewer illiterates to absorb into the work force.

As further evidence of its strong commitment to education, since 1960 South Korea has differentiated the salaries of its teachers above those of other civil servants, an especially important commitment to quality and to retention of teachers in math and science fields. Since 1960 South Korea also has insisted that companies spend at least 3 to 4% of their total budget on education and training programs, involving the private sector in the educational process in a meaningful way.
References


Education was of major concern to the government prior to the fast industrialization take off that began in Taiwan in the 1970's. The expenditure for education, science, and culture accounted for more than 13 percent of the budget at all levels of government during 1954-1968, increasing to 18 percent by 1971. Because of the government's emphasis on expanding primary education, enrollment in the 6-12 age group reached 96% by 1961. The proportion of primary school graduates who went on to junior high school increased from 32% in 1951 to 51% in 1961 to 80% in 1971. These dramatic increases in the number of junior high school graduates were followed by an equal rate of expansion of the senior high schools throughout the 1951-71 period preceding the high 9.4% real growth rate in the 1960's followed by a 9.9% growth rate in the 1970's. Illiteracy decreased throughout this period from 55% of the labor force in 1946 to 10% in 1980.1

Since industry can not absorb very many illiterate workers who are too costly to train, and as a high quality labor force is a necessary condition for effective labor absorption, the government's emphasis on eliminating illiteracy and upgrading education contributed in part to effective labor absorption. Evidence of this is that during the period that vastly increased numbers of primary and later of secondary school graduates were entering the labor force, unemployment fell from 6.5% in 1965 to about 2.5% in 1970, and then to 1.2% in 1980.1 The typical pattern of rapidly developing countries can be observed as productivity in agriculture rose sufficiently so that a smaller fraction of the total population was able to support the entire economy with food and raw materials. This released workers from the agricultural sector who, since they met the necessary condition of an adequate education, were absorbed into industry. Furthermore, an emphasis on expansion of labor absorbing industries, rather than on giving tax subsidies to the relatively more

1Source: Kuo, Ranis, and Fei (1981, pp. 13, 39, 69)
capital intensive types of production that displace labor, contributed simultaneously to higher labor absorption and to a more equitable distribution of income.

Three out of nineteen manufacturing industries, namely food processing, textiles and footwear, and electrical machinery accounted for almost half of the total labor absorbed into manufacturing. These industries initially served domestic demand as domestic demand expanded and imports were displaced. Later they continued to expand as labor productivity continued to increase, aided by the improving formal education of workers, which contributed to the expansion of exports, mostly to developed countries. As the income from labor and human capital increased relative to the more unequally distributed income from property, the degree of inequality in the income distribution steadily decreased. Unfortunately martial law, and severe limitations on opposition political parties have prevailed in Taiwan since 1949. But it is noteworthy that this increased income equality is being accompanied by steps toward improving political freedom, as evidenced by government moves toward lifting martial law and lifting the ban on new political parties to be effective by the end of 1986.

The evidence of the relatively low inequality in Taiwan, South Korea and Japan is shown in Table 6 in the text. In the case of Taiwan, the relative share of income received by the top 20% of all households declined from 41% in 1964 to 37.5% in 1979, and roughly comparable to the 39.9% received by this group in the United States. This is far below the 66.6% of the income received by the top 20% of the households in Brazil, or the 61% received by this same group in slow growing Zambia and

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Peru (with negative per capita growth rates of -1.3% and -1.1% for 1965-84 respectively). 4 The share received by the lowest 40% in Taiwan increased from 20.3% in 1964 to 22.3% by 1980. By another measure, the Gini coefficient measuring inequality in the income distribution fell from .32 in Taiwan in 1964 to .28 by 1980 during its most rapid growth period. 5 This is clear evidence, very similar to the story for Korea 6 which is currently the fastest growing country in the world, that if appropriate basic education policies and appropriate policies for high labor absorption are followed, fast growth and an equitable sharing of the fruits of that growth are quite compatible and can be advanced simultaneously.

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5 Kuo, Ranis, and Fei (1981, pp. 92-93).
<table>
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<tr>
<th>Country</th>
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Sources: Australia: 1976, Miller [44], Tables 1 and 2; Austria: Clement [15]; Bahamas: Gabregiorgis [22], Table 33; Botswana: Botswana Ministry of Finance [9], Table 2-50; Colombia: 1976, Higher, Rodriguez [71], Table 6. 1981, Psacharopoulos and Zabalza [68], average of all secondary school subjects; Costa Rica: based on Baldares-Carazo [6], Table 7.19: Cyprus-1: regression derived rates (1979), private rates, House and Stylianou [32], Table VI-4, 1975, private rates, Psacharopoulos [58], Table 1; Cyprus-2: rates refer to males, House and Stylianou [32], Table VI-3; France: 1962, Riboud [70], 1969 and 1976, Mingat and Jarousse [45], social and private rates not comparable for 1969 as estimation in each year based on different methodologies, see Jarousse [34]; Germany: 1978, Clement, Tessaring, and Weiss (16); Great Britain: Adamson and Reid [1]; Table 5: Greece: Psacharopoulos [63], Table 8; Hong Kong: Hung [33], Table 6; India: 1978, Tilak [79], Table 6.3; Indonesia: Psacharopoulos [60], Table 7.1; Iran: Armand [3], Table 5.7; Iran-I: Henderson and Scully [31], Table 1; Iran: Pourhosseini [55], Table 9.2; Japan: higher education from Okachi [51], Table 12; other levels from Okachi [50]. Tables 17 and 10; Kenya: 1980, Armitage and Sabot [4], Table 3; government schools: South Korea: 1969, Morgan [49], 1971, social, Jeong [35], 1971, private, Lee [39], Table 4, both sexes, col. B, 1973, Park [52], 1980, Park and Park [33]; Lesotho: Gebre-ab [24], Table 12; Liberia: Liberia Ministry of Planning/USAID [41], Table 2-26; Malawi: Mingat, Tan, and Hoque [46], Table 5; Pakistan: 1975, Hamdani [27], Table 3, 1979 based on mean earnings in urban areas, Population and Labour Migration Survey, kindly supplied by Shahrul Rafa Khan; Paraguay: based on income and cost data supplied by Ernesto Schieffelbein; Peru: Psacharopoulos [61], Table 3.4; Philippines: 1977, University of Nueva Ecija [19], p. 161; Puerto Rico-2: Cunoy [1], Tables 2 and 4, average of males and females in urban areas; Somalia: Somalia Ministry of National Planning [76], Table 2-36; Spain: Quintas [69], Table 2.3; Sudan: Berhanu [7], Table 4.12; Taiwan: Juang [36], Tables 6-U-36 and 6-44; Tanzania: Psacharopoulos [67], average of all secondary school subjects; Thailand: Sethasathien [75], Table 9; Upper Volta: Psacharopoulos [62], Table 2.6; Venezuela: 1984, Steier [77], short-cut method. average for males and females. For the original source of all other countries and survey years not explicitly mentioned above, see Psacharopoulos [58], Table 1. Note: Private rates to primary education in excess of 100 percent have been set to 99.0.