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The Economics of Vocational and Technical
Education: Do the Benefits Outweight the Costs?

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Outweigh the Costs?

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ABSTRACT

This is an economic analysis of that education that is specific to a particular profession or vocation, but not specific to a particular firm. It therefore is new in relation to Becker's analysis, which distinguishes only between firm - specific training and general training without addressing this in-between case.

The basic issue is the optimum degree of vocationalization of the curriculum. The evidence is that a proper balance between vocational and general curricula is efficient. But there are growth-related criteria for different rates of expansion for each. Criteria for the most efficient vocational-schooling/ OJT mix are also considered, as are the political and equity implications (and evidence) of overexpanding separately tracked schools.

THE ECONOMICS OF VOCATIONAL AND TECHNICAL EDUCATION:

DO THE BENEFITS OUTWEIGHT THE COSTS?

Walter W. McMahon

The resource allocation decisions in human resource development planning involving vocational and technical education face three basic problems to be considered in this paper:

1. The degree of vocationalization of the curriculum at each educational level in the system,
2. The appropriate mix of vocation-oriented education in school relative to the amount of learning on the job, and
3. Equity, and political democracy considerations surrounding VOTEC which often also influence the final decisions on these matters.

This is a new analysis in relation to Becker's (1983) in that it deals with the case in which education is specific to a vocation, or field, but not specific to a particular employer. It therefore lies between general education, which embodies many basic skills that are productive such as literacy, numeracy, adaptability, the ability to think analytically and creatively, all of which are highly correlated with the amount of learning that occurs on the job later (e.g. Mincer, 1974), and the case of skills that are specific to a particular employer and not transferable.

This analysis is also new in relation to Becker's and Mincer's in that it focuses on vintage capital, or the embodiment of new technology and occupation - specific skills in human

beings, thereby bringing the new technology and/or occupation - specific skills to bear on production. In this way, vocational and technical education whether done in school settings or on the job makes a contribution over and above the contribution of general education that must be evaluated.

The primary themes in this article therefore are the efficiency considerations relevant to the optimum VOTEC - general education investment mix, and to the optimum school - OJT mix. The merits (or lack thereof) of the equity argument sometimes used to support vocational and technical education (i.e. helping the kids from poor families and the lowest ability kids) and also the political keeping-the-lid-on argument for vocational and technical education (don't give them general education least they begin to think about democracy), which in less developed countries is sometimes part of the hidden agenda, will also be briefly considered. Each analysis of these vocationalization, privatization, and equity issues will be followed by consideration of the empirical evidence including the benefits in relation to the costs of the alternatives.

I. The Degree of Vocationalization

The economic efficiency of vocation-specific and of technical applied courses in the curriculum at any given education level, whether secondary, 2 year community college, bachelareate, Masters, or PhD, depends on the presence of supplementary economic returns to the vocationally-oriented specialized skills. These specialized courses cost more, so the

question is whether or not the returns at any given level are sufficiently above the returns to general education to justify the additional costs. If so, the social rates of return (to the extent that earnings measure the full returns) will be higher, and the degree of vocationalization in question would be cost-effective.

In addition to the returns in relation to the costs, which will be analyzed in greater depth in the first section to follow, the degree of vocationalization also depends upon the percent of the students who are expected to be terminal at that level. More vocationally-oriented and technical courses normally characterize the capstone stage in every students' curriculum. So where the students are terminating is relevant. Finally, this section will also consider the riskiness of narrower specialist technical training when technical change causing structural economic shifts occurs. These shifts cause redundancy of some narrow specialities whereas general education may have lower return but is less risky because it is more adaptable. This risk-insurance effect of general education limits the degree of vocationalization.

The Returns to Vocational and Technical Education

All education embodies skills that are productive in the workplace. In vintage capital model terms, vocational and technical skills are usually putty-clay. That is, up-to-date technical education embodies the most recent results of research and development in each field in students as they receive their


education. At this stage the technologies and their capital intensities are "putty". After graduation it is very difficult for most students to change fields, expertise, or technologies, and the embodied knowledge-capital is more inflexible "clay".

An absolutely key point however is that it is not just vocation-specific skills that are "productive". This is because general education is highly correlated with the amount of further learning that occurs on-the-job later (Mincer, 1974), as well as with learning-by-doing (see Arrow, 1962, as extended by Bartel and Lichtenberg, 1985). Productive skills embodied through general education include basic and advanced literacy, needed for most jobs, as is numeracy. These provide the basis for learning more on the job later, as does the ability to analyze and to think creatively, and greater adaptability and willingness to explore new situations. Beyond this, these are vocational skills for certain types of occupations (e.g. many types of civil service and some kinds of teaching). But critically important is that they are also highly correlated with further learning on the job of more specific technical skills, especially where there are technical cadres in place. It is partly for this reason that the age-earnings profiles of general education graduates are more "peaked". They have lower starting salaries than VOTEC graduates, but typically have higher salaries later. The use of starting salaries alone, therefore, as a guide to the economic value of the education can be very misleading, unless properly qualified. For this reason, if a cadre of vocation-specific skills already exists in industry, less vocationalization of the

curriculum may be needed. However these skills do not exist in the labor force in a developing country in the earlier stages such as Nepal. Here virtually all skills have to either be imported or created by a few technical institutes.

Nature of the Additional Returns to Specialized Skills.

Vocation - specific skills that are not employer - specific, and yet are in addition to the general education base that yield returns include:

- 1) A stock of specialized skills specific to the vocation but
 not to the firm that yield economies of scale due to
advantages of the division of labor based on specialization, recognized by economists since Adam Smith,
- 2) Knowledge of new technologies and new techniques if the VOTEC institution is up to date created by investment in research and development in all fields. This includes agriculture, management at all levels, and improvements in the design of social and economic programs, for example, and not just machine design improvements, and,
- 3) Knowledge complementary with physical capital needed to operate and maintain physical capital goods. Some of this knowledge can be acquired through learning-by doing (e.g. Arrow, 1962 and Bartel and Sichtenberg, 1985), but some requires prior formal instruction.

To determine the optimum degree of vocationalization, Figure 1 illustrates the determination of the optimum mix and the relation of rate-of return measures to this optimum. The problem is not a dichotomous one of choosing either severely tracked separate vocational and technical schools or alternatively no vocational and technical education whatsoever. It is instead a problem of what mix of vocational and technical courses to use in a total curriculum dominated by prior general education, that is, what mix is most conducive to economic growth, industrialization and economic development.

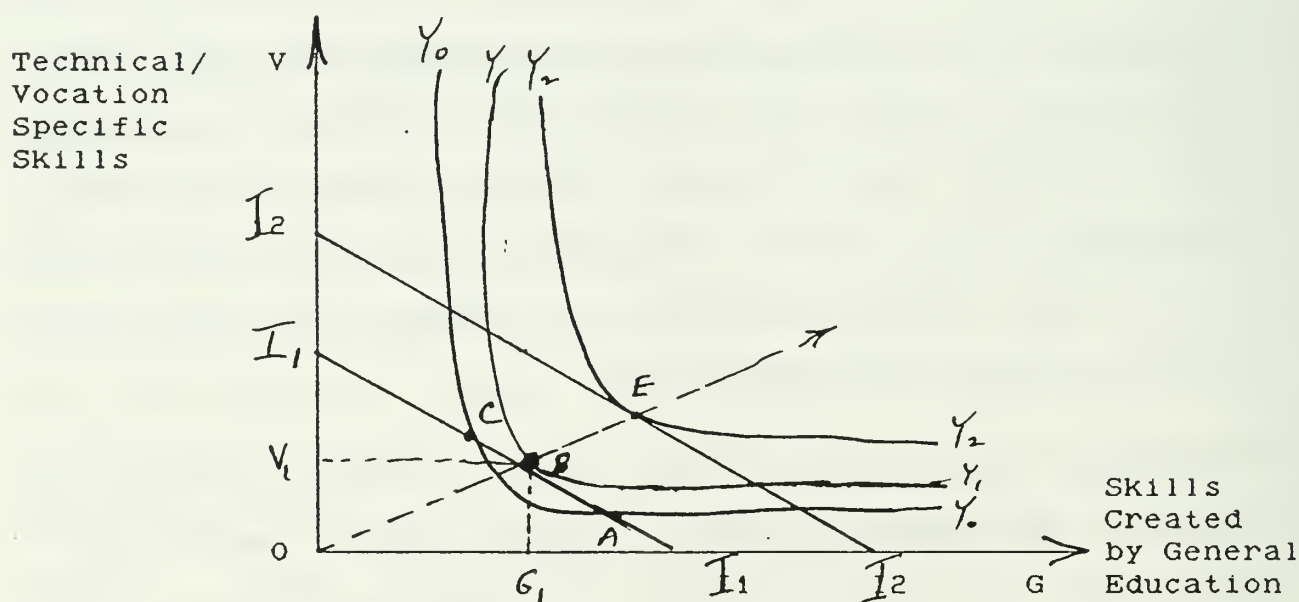


Figure 1. The Optimum Degree of Vocationalization at Any Given Educational Level at Time t

For this purpose, technical and vocational education that embodies these specialized skills, V , is measured in course years on the vertical axis in Figure 1. General education, G , is measured in a similar fashion on the horizontal axis. The isoquants measure successively higher levels of benefits, or earnings, from $Y(k) = Y(0)$ to $Y(1)$ to $Y(2)$ in Figure 1 as well as on the left in Equation (1) below. The isoquants measured in terms of their discounted present values are given by the constant elasticity of substitution (CES) function shown on the right for any given year t . The elasticity of substitution

$$= \sigma = \frac{1}{1 + \beta}.$$

$$(1) \quad \sum_{t=0}^L \frac{Y_{kt}}{(1+r)^t} = \sum_{t=1}^L A [\alpha V_t^{-\beta} + (1-\alpha)G_t^{-\beta}]^{-1/\beta}$$

The elasticity of substitution, σ , is low since technical curricula V and general education G can reasonably be assumed to be complements, and hence distant substitutes. Here k is merely an index level of output used to describe a particular isoquant. L is the length of the life cycle after graduation, or approximately 43 years, during which there are returns in the form of productivity differentials or net earnings differentials resulting from the investment in the education of each age group.

Successively higher levels of returns can be measured either by earnings as discussed for vocational and technical education

by Hunting, Zymelman, and Godfrey (1986, pp 17-18) and/or in terms of pure marginal productivities by methods discussed by McMahon (1987), Selowsky (1969), and Lockheed (1987). These net returns reflect the productivity of simultaneous increases in general education skills, such as literacy, numeracy, and ability to solve problems which are highly correlated with additional learning on the job, and of vocational/technical skills. These vocational/technical skills are complementary with general education since illiterates with no general education, for example, can only be given very limited job-specific skills and have limited potential. Conversely, students with only a general education in the humanities have not mastered complex technical material such as that in engineering, for example, and are also limited in their capacities to learn on the job later and to advance within engineering fields. The short term disadvantage when there is a lack of entry level skills, such as in accounting for example, is even more obvious. But this lack can be quite misleading since persons with general education frequently have higher peaked age-earnings profiles and advance further later.

The amount to be invested in either vocational or general education or both is given by the budget constraint^t $I(K, t)$, $K = 1, 2, \dots, n$ as shown in Figure 1 and Eq. (2) below. Its flatter slope in Figure 1 reflects the fact that the price or cost of vocational and technical education is usually considerably above the price or cost of general education courses, i.e. $P_V > P_G$. This is largely because teachers of specialized courses have outside firms that are more eager for their services. They

therefore command higher salaries, as well as using machinery for instruction that is more expensive than that required in general education curricula.

$$(2) \sum_{t=-j}^0 I_{kt} / (1+r)^t = \sum_{t=-j}^0 \frac{(P_{vt} V_t + P_{Gt} G_t)}{(1+r)^t}$$

This defines the multiperiod budget constraint. P_{vt} does not include room and board costs, although vocational schools in developing countries are sometimes also schools where room and board is publically supported which vastly increases the costs. Methods of measuring these costs for vocational programs are discussed in Hunting Zymelman, and Godfrey (1986, pp. 13-15).

To find the optimum, a La Grangian can be formed and prospective returns that are given by Equation (1) can be maximized subject to the investment costs given by Eq. (2). The first order conditions define the quantity of vocational courses, V_1 and the quantity of General education courses, G_2 , in the curriculum that is the optimum mix.

The optimum degree of vocationalization illustrated at point B in Figure 1 (i.e. OV_1/G_1) is also that point where the discounted present value of the stream of expected future returns given by Eq. (1) are at a maximum relative to the present value of the investment costs as given by Eq. (2). In other words, the benefit/cost ratio is largest for this particular mix. Benefits are lower at point A, the classical general or liberal arts

education, in relation to the costs which are on the same budget line. Similarly, the benefits at B are larger (on a higher isoquant) than the benefits at C where there is a larger proportion of the higher cost vocational/technical courses in the curriculum.

Rather than choosing the degree of vocationalization that maximizes the net present value (and thereby finding point B), it is often preferable to compute the internal rate of return because the net present value approach is sensitive to the choice of the social rate of discount, r , in equations (1) and (2) above. Therefore in the review of empirical evidence that follows, the social rate of return will be used. It is computed using the IRR option in LOTUS for example, and as described in the chapter by McMahon in McMahon and Geske (1982) or in Psacharopoulos and Woodhall (1985 pp. 54-69). The social rate of return r is a pure internal rate of return^{as} calculated from Eq. (3) below:

$$(3) \quad \sum_{t=-j}^0 I_t / (1 + r^*)^t = \sum_{t=0}^T Y_t / (1 + r^*)^t$$

Wherever the net benefits, Y , are high in relation to the cost, as at point B for example in relation to point A or C in figure 1, the social rate of return will be higher, and the mix of vocational courses in the curriculum will be closer to the optimum.

As the educational system expands, the expansion path defining the optimum ratio of vocational/technical courses to general education courses is given by the line OBE in Figure 1. Any deviation from that mix will display a lower rate of return.

A wise government in a developing country with limited resources to invest given by I, I, (or in any other country for that matter) will choose to expand faster whatever curriculum mix has higher rates of return, assuming that when returns are measured by earnings, the appropriate adjustments are made and/or the results are interpreted judiciously. Note that the social rate of return at B is greater than the social rate of return to more general education at A in spite of the fact that each VOTEC course normally costs at least twice as much as each general education course. However, at C, VOTEC is too costly and the returns do not justify the additional costs.

Finally, it needs to be added somewhat parenthetically that the optimal degree of vocationalization of the curriculum also depends on the percentage of the students who are expected to be school leavers at the level of education being considered. That is because virtually all vocational and technical courses tend to be capstone courses coming at the terminal stage, a course such as vocational agriculture, for example, may be appropriate in rural high schools before the student leaves school but is not appropriate earlier before basic literacy and numeracy has been attained. In a developing country therefore where over 90% of the students do not go beyond secondary school level, the degree of

vocationalization of the curriculum needs to be somewhat larger than in an industrialized country where only 50% of the students do not go on to college. At the college level, the Land Grant act in the United States vastly expanded the degree of vocationalization at that level. It created colleges of agriculture, business administration and engineering, anticipating that as colleges expanded, the vast percentage of students would not be going into postgraduate study, or civil service careers. In developing countries as a larger percentage of each age group ^{go to} college, there will be more school-leavers at that level, and the role of the universities increasingly must expand beyond just serving the needs for teachers and civil servants to also serve the needs of the private sector. So in interpreting the results of rate of return studies, this dynamic dimension of fewer school leavers at younger ages and hence needs for more general and less vocational education at these lower levels needs to be taken into account in planning.

Measurement of the Returns to Vocational and Technical
← Education. Net increments to earnings over the life cycle is the most readily available measure of the value of the education to the individual and to the economy. There are some obvious cases however where earnings overstate or understate the true returns to vocational/technical and to general education.

First, starting salaries for graduates with vocation - specific formal training at all levels virtually always exceeds the starting salaries of those with general education. This initial earnings difference is very misleading however because

the age-earnings profiles of general education graduates normally overtake these starting salaries and peak later. Any rate of return or cost benefit study that does not use the discounted present value of the entire earnings stream over the life cycle, or the rate of return, in place of just starting salaries is likely to be very misleading and not worth much attention.

A second case, but one in which earnings understate the true returns, is the case of using money earnings to measure the returns to education in agriculture in developing countries. The problem is that the market prices of agricultural commodities are frequently deliberately depressed by policy in developing countries. This is done in part by keeping the currency overvalued, which limits farm exports, thereby, depressing their price while further benefiting urban dwellers by making manufactured imports less expensive. However this keeps the returns to both general education and vocational agricultural curricula low. The remedy is either to avoid comparisons to the returns in urban settings, or to measure the returns in terms of increments to physical output of bushels of wheat, rice, or maize as reported in detail by Lockheed (1987). Both of these approaches take into account the understatement of earnings due to depressed agricultural prices.

A third case where earnings comparison⁵ can be misleading is in the case of civil service and teaching careers. In these cases general education often is the appropriate vocational preparation. But also there can be benefits that are long

delayed, before the new teachers' students enter the labor force for example, and therefore not fully captured in current earnings.

A final case arises where technical education is necessary if a nation is to develop strategic industries where it may have a longer run comparative advantage. When there is little or no industry currently in existence, limited earnings may seriously understate the longer run return. Hydroelectric power engineers and irrigation technicians in the Hymalayas of Nepal who can help to get something started are one example. Much publically supported Research and Development is recognized to involve long run externalities and spillover benefits not fully captured by current earnings. The same effect can be present for technical education that embodies the results of this research through technical and vocational education.

The Evidence: When Do the Benefits Outweight the Costs?

Using this theoritical framework, the evidence relevant to the degree of vocationalization, as well as to the cost effectiveness of different types of vocational/technical education will now be considered.

Table 1

Returns to Vocational/Technical vs General Secondary Schools
Social Rates of Return

		<u>General</u>	<u>Vocational/ Technical</u>
Developing Countries as a Whole: *		16%	12%
<u>Industrialized</u>			
France	1970	10.1%	7.6%
<u>Upper Middle Income</u>			
Cyprus	1979	6.8%	5.5%
Taiwan	1970	26.2%	27.4%
<u>Lower Middle Income</u>			
Colombia	1981	9.1%	10.0%
Indonesia Clark	1978	32.0%	18.0%
McMahon	1982 **	23.0%	19.0%
Liberia	1983	20.0%	14.0%
<u>Lower Income</u>			
Tanzania	1982	6.3%	3.7%

Sources: * Psacharopoulos (1985 p. 589).

** McMahon, Millot, and Eng (1986, p. 306).

These countries are at any different stages of economic development. However, the way these rates of return are measured (whether Mincerian regressions or IRR calculations), the students included in the calculation are those that are school leaver^s at the secondary level.

The result is that the social rates of return to general secondary education of 16% are higher than the rates return to vocational/technical of 12% at the secondary level. This pattern is repeated for all of the other countries shown except Columbia, where the vocational/technical rates of return are slightly higher.

These results do not suggest that it is wise to expand vocational and technical secondary education so rapidly as secondary general where the returns and growth pay-offs are larger. This is true even in Tanzania, although there virtually all graduates go into agriculture where the earnings are artificially depressed. Although other evidence such as that developed by Yamada and Ruttan (1980) find relatively higher returns to technical education in agriculture, the trickle down effect to agriculture from whatever industrialization may be occurring is often quite small.

From an important broader perspective, the 12% rate of return to investment in vocational and technical secondary education is essentially equal to the 11 - 13% rates of return to investment to physical capital shown in Table 2 below. Investment in vocational and technical education therefore is proceeding at an efficient rate vis a vis investment in physical capital. The

Table 2

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

<u>Country Group</u>	<u>Rates of Return to Education*</u>			<u>Rates of Return***</u>
	<u>Primary</u>	<u>Secondary</u>	<u>Higher</u>	<u>To Physical Capital</u>
Industrial Market Economies (10 countries)	15%**	11%	11%	11%
Developing Countries (26 countries)	28%	12%	11.4%	13%

* Source: Arithmetic means of the 125 studies reported in Psacharopoulos (1985, pp. 598-9). Only the latest year observations are used for each country.

** Based on the intermediate countries. The lack of a control group of illiterates in the advanced countries prevents a direct computation there.

*** Source: Psacharopoulos (1985, p. 591).

underinvestment is in general secondary education, where social rates of return are higher. A more efficient growth strategy would be to expand general secondary education at a higher percentage rate than either the rate of increase in gross private domestic investment in physical capital or the rate of increase in vocational and technical education curricula.

More specific information about the rates of return to different types of vocational curricula for countries for which more detailed comparisons are available is given in Table 3. There are no generalizable patterns that can be drawn from this small sample of programs and of countries. But the results do illustrate how the returns as measured by earnings tend to be lower and understated in vocational agriculture (Columbia, 7.2%), civil services (Indonesia ^{14%} and Columbia ^{7.1%}) and in home economics (U.S., B/C= .30) all for the reasons discussed above. In vocational and technical programs where the costs are higher the benefits tend to be lower in relation to the costs, but ⁱⁿ Columbia, the ~~con~~^{ex}ception to this is where vocational/technical courses therefore should be expanded somewhat more rapidly. The returns in Business and Commercial education programs in relation to the costs are relatively high as indicated by the 17 - 21% rates of return in private sector employments in Indonesia, 9.3% returns in Columbia, and relatively high benefit/cost ratios at least in one city in the U.S. This is partly because the cost of business education curricula is not appreciably above the cost of general education courses.

Table 3

Benefits in Relation to Costs of Specific Types
of Vocational/Technical Secondary Schools

	<u>Social Rates of Return by</u> <u>Type of Employment *</u>			
	<u>Self**</u> <u>Employed</u>	<u>Self Employment**</u> <u>Family Enterprises</u>	<u>Employee in ***</u> <u>Civil Service, etc.</u>	
<u>Indonesia: Senior Secondary Schools</u>				
General Education	16%	21%	14%	
Vocational/Technical	13%	9%	12%	
Commercial	17%	21%	13%	
Teacher Training	16%	21%	12%	
<u>Columbia: Secondary Schools</u>				
		<u>Social Rates of Return</u>		
General Education		9.3%		
Vocational/Technical		9.9%		
Commercial		9.3%		
Agricultural		7.2%		
Social Services		7.2%		
<u>United States: Secondary Curricula</u>				<u>Benefit/Cost Ratios****</u>
Business Education in a Comprehensive High School				2.20
Marketing & Distribution, Comprehensive High School				2.45
Trade and Industrial Vocational School				2.02
Occupational Home Economics Vocational School				.30

Footnotes to Table 3

-
- * Males only. Some of the cells for females only contain too few cases to permit significant comparison.
- ** The non-formal sector.
- *** Not including the military.
- **** The study cited did not include foregone earnings costs. So these were added to high school program costs based on the 3.35 per hour federal minimum wage used in the study times the average number of hours worked per year. This is equivalent to assuming that a student who leaves school after approximately 6th grade earns only a minimum wage.

These benefit/cost ratios provide a meaningful comparison among programs, but are not precise with respect to their absolute level. This is because the present value of the net earnings differential (discounted back at a 6.5% interest rate) was calculated by the study cited for only 5 years, and related to only one year of schooling costs. Both numerator and denominator would need to be increased by 7 or 8 fold a similar factor to capture the net earnings differential for the entire 40 year age earnings profile and 7-8 years of educational investment costs.

Sources:

- a) Indonesia : Developed by McMahon and Eng, and described in detail in McMahon, Millot, and Eng (1986b, Sec 2.6.6)
- b) Columbia : Psacharopoulos and Loxey, in Psacharopoulos and Woodhall (1988, p. 63)
- c) United States : Navaratnam and Hillison (1985, p. 8) in a tracer study of comprehensive high schools and vocational schools in Roanoke, Virginia.

Higher Education. At the bachelors' level, the returns to vocationally-oriented curricula for school leavers are as shown in Table 4 for the curricula in engineering, business and economics, and agriculture. (The latter again is probably an underestimate for the reasons discussed earlier). Law and Medicine are also intensely vocational, although at a somewhat more advanced level. The average social rate of return in all of these vocation-oriented curricula is 11.4%, about the same as the 11% in the non-vocation specific social science, physical science, math and humanities general education curricula. The latter are followed by the learning of vocation-specific skills on the job, and just because starting salaries are lower and job search time is longer, it would be erroneous to conclude that the economic productivity of these curricula are significantly lower.

Table 4

Social Rates of Return to Vocational/Technical
and General Curricula

<u>Vocational/Technical Curricula (14 countries)</u>	<u>Rate of Return</u>
Engineering	12%
Business and Economics	13%
Agriculture	8%
Law	12%
Medicine	12%
Vocational/Technical Average	11.4%
<u>General Education, Not Vocation-Specific</u>	
Social Sciences	11%
Math Physical Sciences	8%
Humanities	14%
	11%

Source: Based on Psacharapoulos (1985), p. 590 and Appendix
Table A - 3, p. 603

It is clear that based on what evidence there is, even though the vocation-specific curricula cost more, (e.g. for engineering), the returns usually do merit the higher cost. There is no case for expanding investment in vocational education or in physical capital however more rapidly than the rate at which investment in general education is expanded. In fact the rates of return to investment in general education at the secondary level are often somewhat higher. And investment in improving the access to and quality of primary education, which has far less political support, has almost everywhere a far higher rate of return than

investment in secondary education, higher education, or in physical capital.

II. Adaptability, Risk: General v. s. Specific Skills

Another factor that influences the degree of specialization or vocationalization that is optimum for the individual (or the society) is the risk that very specific skills will become obsolete. With putty - clay vintage human capital, if very job specific skills get frozen in as training occurs, the elasticity of substitution with respect to skills used by other vocations (e.g. skills of Type B in Fig. 2 in relation to the skills of Type A developed for the vocation in question) is low. At the limit, no substitution of vocational skills later is possible, the elasticity of substitution, σ , approaches zero as β in the CES function given by Eq (1) above approaches infinity, and the isoquants become right angles as shown by VV'_1 in Figure 2. This lack of substitution among vocation specific skills is typical of linear production functions and technical coefficients of the type usually employed in manpower planning models.

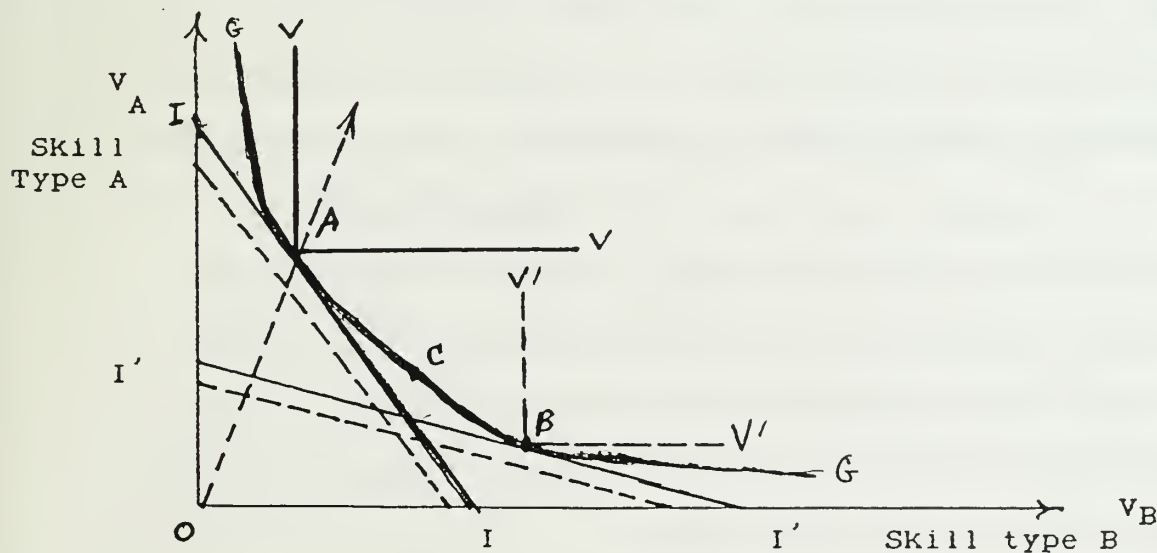


Figure 2.

General education however involves more basic skills that are less vocationally specialized, and therefore more adaptable among skill areas when the relative costs change from II to I'I', or when the usefulness of the output changes due to structural shifts or to technical change from point A to V'V' at point B. Then the Vocation-mix defined by the expansion path OA becomes economically inefficient. Some of the workers at point A become economically redundant, or underemployed. The skill mix at point B becomes economically more efficient, displaying a higher rate of return, and conducive to faster economic growth, whereas the skill-mix at point A displays underutilized workers and a lower rate of return.

General education has a higher elasticity of substitution as shown by the smooth isoquant GG in Figure 2. However this assumes that a basic cadre with these job specific skills exists so that some learning of these skills can occur on the job. There is normally therefore an additional cost of OJT for general education graduates that is shown by the size of the shift from the two dashed budget constraints in Figure 2 to the corresponding solid budget constraint lines II and I'I'. This cost of OJT may be borne by the employee (in the form of a lower starting or training salary), by the taxpayer (if the OJT is subsidized as in Germany, or under the 1984 Vocational Education Act in the U.S., or by tax credits as in Korea), or by the employer if the OJT is employer-specific as in the Becker (1983) case. In any event whoever bears the costs, this cost of OJT must be part of the total cost to society, as shown, and therefore should be included in computing the overall social rate of return.

Workers with a general education therefore can adapt from point V to point B when B becomes more efficient with only the cost of the increment of OJT to consider. This reduces the risk of economic redundancy upon graduation or later. It is a risk-averse strategy chosen at the cost of a somewhat lower starting salary plus a somewhat larger OJT cost, although the latter may not be borne by the employee but instead by the employer in company training programs or by the society in OJT VOTEC training later.

The result is that either general education, which is more adaptable, or technical change which increases adaptability (smooths out the isoquants from VV and V'V' to GG) has an economic benefit in that it increases adaptability. This therefore is a refinement of T. W. Schultz's (1975) case where all education increases the ability to deal with disequilibria, in that Vocational/Technical and General education confer differing degrees of adaptability. The elasticity of substitution, σ , is given by:

$$(4) \quad \sigma = \frac{\partial \ln (A/B)}{\partial \ln (MP_A/MP_B)} = \frac{1}{1 + \beta}$$

At the limit as β approaches zero, σ approaches unity in Eq. (4) and the CES function becomes a Cobb-Douglas function which is a special case of the CES function where $\sigma = 1$.

In terms of social rates of return, the most relevant economic cost/benefit comparison is between point A (Vocational and technical education which contains an appropriate general plus vocational/technical formal education mix) and point B which is formal general education plus job-specific OJT. A and B then would have the same social rate of return, and the same cost effectiveness.

The Evidence: When Do the Benefits Outweigh the Costs

There are very few existing studies that meet this rigorous standard of comparing the cost effectiveness of formal VOTEC to the cost effectiveness of OJT added to the cost (and returns from) general education.

Metcalf (1985) finds social returns to on the job training in developing countries to be high enough to justify such training, presumably as a supplement to general education. But no general conclusion can be drawn on the relative merits of Vocational education in formal schools and general education plus OJT on the job.

Similarly, studies of the cost effectiveness of comprehensive modern secondary schools that contain both general and vocational/technical curricula of the type found throughout the United States and also expanded in Britain before Margaret Thatcher reversed the trend are inconclusive. A recent tracer study of comprehensive secondary schools in Columbia, for example, by Psacharopoulos and Loxley does not find the social rates of return to vocational/technical curricula to be significantly different as between comprehensive and separately tracked vocational schools as shown in Table 5.

Table 5. Social Rates of Return by School Type

<u>Subject</u>	<u>Type of School</u>	
	<u>Comprehensive Modern</u>	<u>Separate VOTEC and Gen. Ed. Schools</u>
Vocational (Agriculture, Commercial, Social Sciences, Industrial)	8.8%	8.3%
General Education	7.7%	9.3%

Source: Psacharopoulos and Woodhall (1985, pp. 61-63).

The comprehensive schools tend to allow the student to switch more freely at later stages between general education college preparatory curricula and vocational courses. The student who is not doing as well in academic courses or who for other reasons chooses not to go on to college can switch freely to more vocationally oriented courses without changing schools. He can graduate successfully, with the self-esteem that that conveys and leave school, without the stigma of ending his academic high school years basically as a failure on the college entrance exams. Conversely, the severely tracked separate technical schools tend to be much higher cost. They were found to be many fold the cost of secondary general schools in a forthcoming educational sector assessment in Nepal, and 127.2 thousand rupiahs per student in Indonesia compared to 82.2 thousand rupiah per student for general education (see McMahon, Millot, and Eng, 1982b, Ch. 2, Table 2.6.4-3). To this cost must be added the risk to the student and to the nation that the over-expansion of over-specialized training illustrated in Figure 2 (by VV and V'V') will almost inevitably lead to unemployed graduates as economic structural shifts and technical change occur. In contrast, the comprehensive modern curriculum with internal vocational/technical and further-education preparatory choices has greater potential for passing the baton from the macro planner to the student and his family.

III. The Political Economy of Vocational and Technical Education

Vocational and technical education frequently has political support outside of the Ministry of Education that primary and secondary

general education does not have. This in turn can contribute to an economically inefficient over-expansion of separately tracked vocational and technical schools. The point is that although some vocational and technical curricula appear to be economically efficient at each school leaving level, an over-expansion is likely to encounter underemployment and diminishing returns to vocational/technical vis a vis general education curricula. (For examples see Psacharopoulos and Woodhall, 1984, p. 89.)

Some of this political support often comes from ministries of labor and from ministries of technology, even from the NSF (1985). It arises partly because their scope of responsibility is narrower than that of allocative efficiency in human resource development planning as a whole. But it also arises because of a lack of understanding of how general education is productive in the economy; that is, its correlation with the amount of learning on the job later, e.g., M. J. Bowman (1974), its more sharply peaked age-earnings profiles following lower starting salaries and longer job search, the ways in which basic literacy and numeracy are productive on the job, and so forth.

A second source of usually unspoken support arises where the leadership in the government in developing countries which can be somewhat less democratic than in the industrialized countries feels that vocational secondary education will orient students to the "world of work," and thereby contribute to political stability. The problem with this is that persons with narrowly defined skills who cannot adapt easily and are underemployed as conditions change are not likely

to be very happy. The second more basic problem is that more education of farmers is necessary for democratization, as was stressed by Jefferson. Some regimes may regard this as de-stabilizing, but it is likely to be because they do not care much about greater democratic participation in government.

A third source of support for vocational and technical education, in this case at the secondary level, is on grounds of equity. As shown in Figures 3a and 3b respectively below, in the United States, a much larger proportion of the students in vocational curricula are both from the two lowest academic ability quartiles and from the two lowest family income or SES quartiles. Vocational and technical education indisputably helps these students.

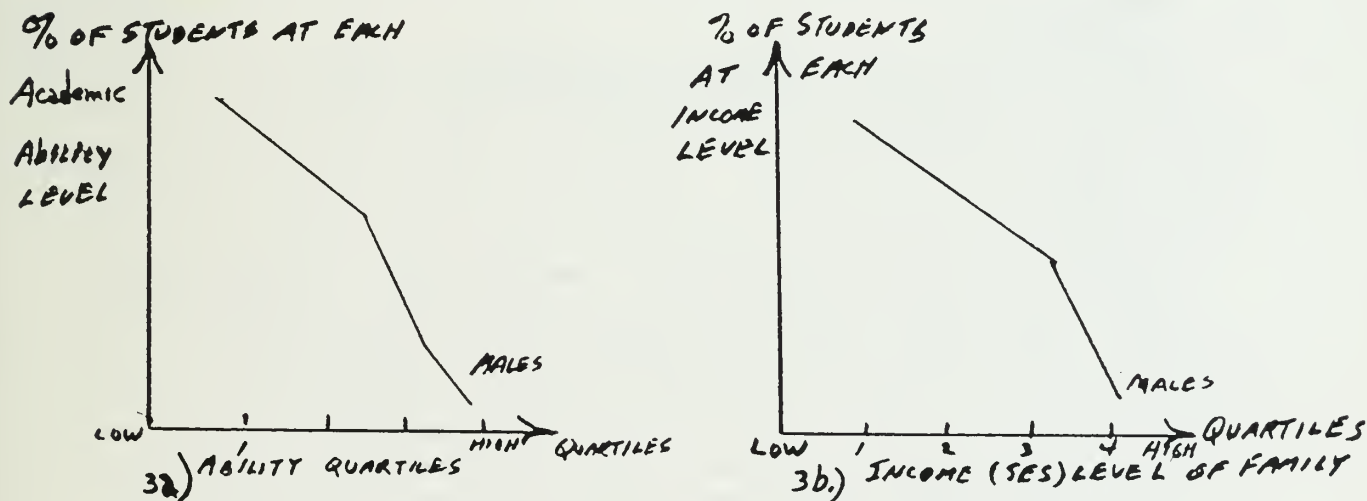


Figure 3. Academic and Economic Characteristics of Vocational Students

Source: Cheney-Stern, R. N. Evans, and M. G. Helgesen (1987, pp. 5532-5).

The problem with this argument, especially when it is applied to support creation of separate vocational schools in developing countries, is that these separate VOTEC schools contribute directly to

the creation of dual labor markets. The gap that exists between these trades-oriented labor markets and government official, business, and profession labor markets is a source of polarization in society created by the severe tracking in the educational system and a source of inequity in its own right. The second problem with this argument is that there are alternative uses for these resources. In a developing country where universal primary education of reasonably good quality has not been achieved, expanding access and strengthening primary education is very likely to be much more effective than is expanding vocational/technical education at the secondary level of equity is the objective.

IV. Conclusions

Are the benefits worth the costs? The evidence suggests that under certain conditions they definitely are; under other conditions they are not.

Clearly the vocational and technical education must be internally efficient. Where high room and board costs are included, drop out rates and time to complete the program are high, or where there are outdated programs or other sources of internal inefficiency, vocational and technical education is not likely to be very cost effective.

Beyond this, the analysis of the optimum degree of vocationalization and the evidence suggests that if there are no vocational and technical courses for students who are leaving school at each level, capstone vocationally-oriented courses complementary with the general education can be quite productive and the benefits are likely to outweigh the costs. Similarly, to develop endogenous skills where none

exist but that are basic to a nation's development of its longer run comparative advantage, some formal technical education embodying the relevant technology would appear to be essential even when the longer run returns are not fully reflected in current earnings. But where vocational/technical education overexpands in relation to general education or in relation to the primary education base, there is likely to be underemployment, emigration, lower social rates of return, and other symptoms of diminishing returns setting in.

One special case is the excessive expansion at the secondary level of severely tracked separate vocational/technical schools, which encounters a range of problems. It is likely to not only contribute to dual labor markets and greater polarization in the society in this regard, but it also is conducive to less equity in the income distribution in the next generation than could be achieved with the same resources invested in primary education. The comprehensive modern curriculum permits greater decentralization of decisions to students and their families. These are not purely economic grounds, but there are the risks of economic overspecialization if more than basic cadres are trained in each vocational skill, with the resulting lower elasticities of substitution and attendant costs when shifts in the structure of demand and technical change occur.

In conclusion, it is suggested that if vocational/technical courses are expanded in an efficient balance with general education, OJT, and primary education, then the benefits do exceed the costs. Where this balance is distorted due to external forces or internal inefficiencies within vocational/technical curricula, then greater attention needs to

be given to the economic returns to general education and its relation to learning on the job, and the rate of vocational/technical education expansion slowed down.

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