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AUTHOR	Honig, Benson; Ramirez, Francisco
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ABSTRACT

Although the relationship among education, science, technology, and economic development is nearly universally accepted, the link among education, infrastructure, and economic growth has yet to be empirically demonstrated. A multivariate analysis of cross-national data regarding 48 countries was performed to document relationships between technical education and economic development. A multivariate time series regression model was used to analyze national enrollment in secondary and tertiary education and labor force participation statistics from the United Nations Educational, Scientific, and Cultural Organization annual yearbook and Organization for Economic Cooperation and Development indicators to determine the relationship between technical education and economic development as measured by gross domestic product per capita growth rates. Although it was acknowledged that accounting for economic growth of a nation/state requires consideration of factors beyond the study's scope (including natural resources, geographic location, and political climate/stability), it was concluded that the analysis clearly demonstrated the importance of postsecondary technical education, specifically at the two-year college level, to economic development. Government educational policies in Korea, France, and Germany were cited as examples of how careful attention to technical engineering education at the two-year college level represents a coherent, effective mechanism for national economic development. (Contains 27 references.) (MN)

Technicians, Technical Education, and Global Economic Development:

A Cross National Examination

AERA 1996 Annual Meeting

Benson Honig **Francisco Ramirez**

School of Education

Stanford University

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Internationally, educational objectives have historically focused on the relationship between education and development. The primary justification for these educational investments has relied upon neo-classical economic models, as promulgated by multilateral organizations such as the World Bank and UNESCO. Such models rely upon fundamental assertions of the principles of modern economics: "laws" of supply and demand, individual maximum utilization, and general equilibrium theory (Schultz 1959; Becker 1964). The customary analysis of educational investments at national levels consists of a series of aggregated individual cost-benefit equations, that compare social rates of return to alternative investments in capital markets. A wealth of research has been conducted analyzing these models in both developed and developing countries, where, in the latter case, favorable rates of return to primary school are asserted to be universal and virtually immutable (Haddad, et al. 1990). Such massive confidence in the value of primary education has gained worldwide credence, most clearly expressed in the Jomieten conference in 1990, whereby representatives from more than 150 different countries affirmed the goal of universal access to basic primary education for all children by the year 2000.

Much of the empirical literature examining the effects of education on economic development rely upon an aggregation of individual levels incomes, and so are subject to critiques that maintain such outcomes are the result of status-competition, not increases in labor productivity (Rubinson & Browne 1994). Wages and income are known to vary considerably due to gender, ethnicity, and race . While there appears to be significantly greater agreement upon the relevance of investment at the primary levels, industrialization may actually increase the demand for labor, and so compete with mass schooling .

The question of the most effective expenditures in higher education is still a matter of considerable debate. In the immediate post-colonial era, many countries scrambled to assemble elite higher educational institutions that were often heavily subsidized, relying on manpower modeling that indicated a growing demand for highly educated labor. Costs per student rose, and in some cases, University students were earning higher living stipends than the wages garnered by government employees and teachers. In many cases, highly skilled formal sector jobs failed to materialize, leaving a politically sensitive and potentially destabilizing predicament for policy makers to negotiate. Despite labor market gaps, and the mounting costs of higher education, the establishment of tertiary institutions and enrollment has continued at a rapid pace. For example, between 1975 and 1990 world tertiary enrollments have increased from 10.2 to 12.7 percent, with gains of 10.4 percent in the developed countries and an increase of 2.9 percent in the developing countries. During the same period, North American enrollments have dramatically increased by 24 percent to a world leadership enrollment ratio of 77.3 percent (Unesco 1992).

At higher educational levels, the emphasis has migrated toward the promotion of *science and engineering* education for development . This is partly a result of an extensive literature that demonstrates reduced returns to education at the higher and secondary levels, as compared to primary education, particularly for developing countries (Hicks 1987). However, in the political domain, the faith in the importance of science and technology for national economic development remains so well entrenched as to be virtually incontestable. For example, President Clinton is on record with the following statement:

> " It is essential to recognize that technical advances depend on basic research in science, mathematics, and engineering. Scientific advances are the wellspring of the technical innovations whose benefits are seen in economic growth, improving

health care and many other areas .

Further, as the world "shrinks", and global competition increases, there is a heightened confidence in the assertion that Science and Engineering are the keys to economic development. This thesis, promoted by both multilateral and governmental agencies, such as the UN, UNESCO, World Bank, USAID, and the NSF, to name just a few, has been a driving force regarding international efforts at improving basic education in Science and Math. It has also been the source for extensive analysis of educational structures at the tertiary, research, and engineering levels, many of which attempt to explain global competition and success in terms of a national scientific and engineering capability .

The science for development perspective has produced a wealth of comparative statistics, including the analysis of research and development expenditures, numbers of scientists and engineers, relationships between government, business, and Universities, as well as comparative statistics regarding mathematics and science achievement (Mansi: .968). There has also been considerable research on the quality of the "mass" labor force - for example, the TIMSS and SIMSS studies, that attempt to compare general education cross-nationally. The implications here are that a more highly trained labor force is necessary due to technological paradigm shifts and the rise of the post-industrial economy . The motivations for conducting such studies typically focus on preparing the nation's youth with a greater competence in science and math. These efforts examine the competitiveness of the labor force, where an emphasis on expanding literacy and math is purported to provide economic advantages (or disadvantages) in terms of human capital. Here the focus is most often on the blue collar factory worker, whose relative "flexibility" in the post-industrial era of high technology, computers, and rapid change is said to account for much of the advantage or disadvantage held by various nation-states.

Recognizing that the overall labor force will be growing slowly, due to the simultaneous effects of demographics and downsizing, policy makers are interested in expanding technical skills at the professional level. However, this view is not without controversy, as some predictions suggest the professional labor force will actually grow very slowly, and that a "demand push" strategy will yield an unnecessary surplus of college graduates . A more sophisticated variant of this discourse relies upon the complementarity of physical capital, human capital, and technical progress, and helps to explain why various inputs seem to have different effects, depending upon the stage of national development (Lau 1994).

In the United States, the increasing emphasis on the examination of the relationship between education, science, technology, and economic development, reflects how the US is collectively situated in the world order. Historically, the U.S. was able to maintain considerable technological supremacy in the immediate postwar era. This dominance may have had more to do with historical good fortune than with any educational policy or attributes, as education in the United States has taken a rather cyclic themes (Tyack 1995). When challenged, for example, by the launching of the Sputnik satellite in the late 1950s, a renewed concern and investment in science education immediately followed (Tyack 1995). More recently, as other economic players, such as Europe and Japan, have emerged to contest US technological leadership, we can observe considerable effort extended toward the study and evaluation of educational investments.

A further justification for science development at the global level reflects the economic successes enjoyed by the Asian "tiger" countries of Singapore, Korea, Maylaysia,Taiwan, and Thailand. Following this line of reasoning, nations are thought to embody environments whereby they provide comparative advantage through the provision of a specialized highly trained labor force. Investment by government, as well as business, in the research and development of University level training is said to enhance this comparative advantage, benefitting both specific industries and national economies alike (Porter 1990; Nelson 1992).

Although the relationship between education, science, technology, and economic development is nearly universally subscribed to, empirical evidence of the phenomenon remains in much shorter supply. Rubinson and Ralph examined the contribution of technical efficiency (total factor productivity) in the United States, over time, to predict enrollments in primary and secondary education (Rubinson & Ralph 1984). The hypothesis, that the demand for more technical labor would result in increasing enrollments, was only partially confirmed, as early growth occurred independently of economic change. Even those most committed of functional theorists recognize the importance of historical advantage, linkages, and timing (Nelson 1992; Haddad, et al. 1990). The relationship between education and productivity, when measured as income, has not consistently been found positive (Berry A. 1980; Honig 1996). Further, cross national studies agree that the expansion of tertiary education does not appear to account for economic growth (Firebaugh 1983). Ramirez and Lee found that tertiary science enrollment increased economic growth, however, there was no apparent relationship between the expansion of scientific infrastructure and economic growth. No effect was found regarding the numbers of scientists and engineers in research and development and national economic development (as expressed in GDP growth) . Thus, the link between education, infrastructure, and economic growth has yet to be empirically demonstrated.

What has not been studied cross-nationally, and what this article examines, is the impact of educational programs that produce *technicians*. Post industrial production and organization is said to require large numbers of individuals to employ increasingly higher levels of technology in the workplace (Porter 1990). Scientists and engineers, however, exist in a separate sub-culture replete with their own codified language and syntax, normally incomprehensible to the "lay" population who are required to employ this technology. Although technical jobs have been expanding rapidly, little attention has so far focused on the implications of the applied knowledge and training of technology. Technicians, for example, play a critical role in the favorable adaptation and employment of technologies, as they are the interpreters that stand between both occupational clusters, acting as "buffers" and "brokers" between two distinct groups: producers and users of technology (Barley 1993). From an organizational perspective, technicians can be considered specialized entrepreneurs, gathering resources and information, which they translate and utilize for the benefit of a "lay" consumer. Rather than value formal education and degrees, technicians seek tacit knowledge that can immediately be transferred into practical application. Barley refers to "contextual knowledge," and calls for educational programs to incorporate apprenticeship, internship, and other "hands-on experience."

The policy implications of the importance of technicians and technical education for the labor force are enormous. In the USA, standardized technical proficiency levels are virtually nonexistent. Professional certification is available through a wide range of alternatives, from home study to proprietary and governmental tertiary institutions, with little or no specificity as to their relative value or complexity. Should a direct relationship between technicians and economic development be identified, considerable resources are likely to be earmarked for the improvement and standardization of vocational/technical education.

In other developed countries, apprenticeship programs, such as those in Germany, have been particularly well regarded, and considered possible models for the USA and other countries (Hamilton 1993). However, the strain of unification on the German economy has upset the delicate relationship between labor and management, throwing the entire system into disarray (Waterkamp 1995). In Germany today, secondary education is rapidly transforming into the comprehensive high school model, whereby the majority of students attempt to gain access to higher education, formerly reserved for the elite graduates of the "gymnasium". Access to higher education through a vocational track is an increasing characteristic of the educational systems of many other countries, including the US, Finland, and the Netherlands (Waterkamp 1995).

Newly industrialized countries have also historically focused on the importance of vocational education. In Korea, to encourage "low status" vocational education, the government provided scholarships, exempted graduates scoring above 50% on the national skills licensing examination from military service, and permitted the top 10% of secondary graduates to enter college .The government implemented a national system for accreditation of post-secondary junior colleges, to enforce standards on public and private schools. Korea also developed multi-functional agencies and support units for curriculum development and certification, including the Korean National Vocational Training Management agency, and the Korean Institute for Research in Vocational Training.

Evidently, the examination of vocational education at the junior college level is relevant for a large number of countries today. In the U.S., for example, technicians represent a somewhat larger percentage of the U.S. labor force than do either engineers or scientists , and this is further compounded by the fact that many individuals who assume the title of "engineer" have little or no formal tertiary education (Hayton 1987). Despite their numbers, **there is virtually no available research regarding the education, growth, and significance of this highly technical component of the labor market to economic development, on a cross-national basis.** Technicians have been almost completely overlooked in the literature . A demonstration of a causal relationship between the number of technicians, the extent and quality of technical education, and economic development, over time, will be of particular interest to a large number of policy makers, both at the national and institutional levels.

Methodology:

National enrollments and labor force participation statistics are compared with cross section multivariate analysis, over time, to analyze relationships between technical education, designed to produce "hands-on" knowledge, and economic development, as measured in GDP per capital growth rates . Data is obtained from the UNESCO annual yearbook, as well as the OECD indicators, reporting raw enrollment data by subject category for secondary and tertiary enrollment . Cohort size is determined with the UN Statistical Yearbook, providing population estimates by age cohort for all UN member counties .

Equations for Comparative Analysis:

The study employs a multivariate time series regression model.

The basic model is as follows:

$$Y=f(L_h,K),h=1,2...$$

where Y is for output, in GDP per capita growth, L for labor with qualifications for educational level, and K for capital. Because of the difficulty in obtaining the required labor market specification, this equation is transformed to examine labor as a function of overall productivity with a demand function as follows:

$$\frac{L_H}{L}=f(\frac{Y}{L}/\frac{K}{L})$$

The procedure utilizes the development of time series data for both the dependent and independent variables, with a lagged independent variable of five years. The education specification H is examined according to primary and secondary participation rates, and two year tertiary (by subject) and four year tertiary (by subject) completion rates (degrees granted). The period analyzed is the post war era - 1965-1992. In mathematical form, the equation looks as follows:

$$P80-92=LnK_t+aLnL_t+bLnEDsec_{t-x}+cLnEDsecvoc_{t-x}+dLnEDTerASE_{t-x}+flnEDTerAS_{t-x}+gLnEDTerBA_{t-x}+hLnEDTerE$$

where average annual GNP Per Capita Growth , 1980-1992 is the dependent variable

K is capital formation (gross domestic investment)

EDsec is the ratio of secondary educational participation per age appropriate cohort (1970).

EDprm is the ratio of primary educational participation per age appropriate cohort (1965).

EDTerASE is the number of degrees granted, two year post secondary engineering technology (1975)., per capita (1975)..

EDTerBA is the number of degrees granted, two year post secondary, per age appropriate cohort (1975).

IND is the percentage of the workforce engaged in industrial production (1975)

ASC is a dummy variable for East or South Asia

e is the error term

t is the time and X the number of years of lagged independent variables.

The lagged dependent variables of education are to allow the economic effects of education to filter through the labor market. The educational variables are separated into segments to reduce multicollinearity. Average annual growth rates for the 1980-1992 period were utilized for the dependent variable in order to reduce heteroscedasticity - the result of a skewed dependent variable producing large error terms among the variables with larger units.

Findings:

Accounting for economic growth of a nation-state requires detailed model sophistication well beyond current social scientific methodology. Factors influencing growth rates include natural resources, geographic location, political climate and stability, regional characteristics, human and economic capital base, and technological political and social infrastructure, and a myriad of other equally complex factors. Rather than attempting to specify a complete model, the objective of this study is to empirically examine relationships between various educational inputs or investments that, under certain specific conditions, accelerate economic growth, as defined by GNP per capita.

Table one shows a series of panel regressions that provide insight into the effects of various levels and types of education for all forty eight countries that provide data to UNESCO regarding two and four year college degrees, by subject.[1] Equation (1) shows the effects of economic development on 48 countries, controlling for the exceptionally high growth areas of East and South Asia during this period (1980-1992). Countries in this region performed exceedingly well during this era, and a control for these outlyers was deemed important in order to identify generalizable patterns and trends. The strong and significant beta in equation one (3.30) represents a constant throughout the panel series, and is included to control for an important historical advantage (Asian prosperity) that might otherwise overshadow the subtle effects of education measured here.

As mentioned previously, estimates of rates of return to primary education have been found nearly universally to be the highest in cross national studies, easily exceeding that of tertiary levels (Meyer, et al. 1979; Denison E.F. 1967; Psacharopoulos 1989; Psacharopoulos &

[1]While most countries reported data for 1975, following and lagging years were included when 1975 was not reported. Because economic growth was measured over a 12 year period that followed by at least five years, this was not considered to be a serious limitation of the study.

Woodhall 1985; Denison 1985).[2] This is particularly true of developing countries, which make up the majority of this data set. As characterized by the World Bank the majority of the countries of the world are lower middle income and low income economies. Primary education is said to lead to critical elements of social development, that results in higher labor productivity, particularly as a result of mass literacy and numeracy. In this study, primary enrollment was lagged by fifteen years, in order to more closely evaluate the comparative education that terminates at a later age level, thus following, to some extent, a single cohort. So, for example, the individual who finished primary school in 1965, may be expected to finish secondary approximately five years later (1970), and tertiary in five more years again (1975). By comparing each lagged level, we can expect to see the relative contribution for economic development over time for one population set. Such a modeling technique is based on a linear maturation hypothesis - that countries economic growth experiences phases by which the demands for an increasingly sophisticated environment require matching enhanced educational and technical manpower (Lau 1994). As can be seen in equation one, the beta for the primary school enrollment ratio is significant and positive, at .036. This finding parallels a number of other studies, which confirm the importance of primary education to economic development, particularly for less developed countries (Meyer, et al. 1979). Equation one also includes measures for two specific types of higher education: Engineering graduates (in 1975) with two year post- secondary degrees, and engineering graduates (1975) with four year post secondary degrees. This particular comparison is designed to test the relative contribution of two very different educational and labor market activities: engineering, and technicians.

[2] Due to multicollinearity, primary and secondary education are examined separately.

We hypothesized that while engineering graduates may be loosely coupled with economic growth, technicians, by the very design of the educational program, are far more likely to be closely coupled.[3] The results of the analysis bear this out, as two year engineering graduates demonstrate a positive and significant coefficient (6.92) while four year graduates have a negative and very weakly significant effect on economic development (-.595). Four year degree holders are much more likely to reflect the institutional autonomy of higher education world-wide - the distance between economic activity and scholarly production is often quite wide among traditional elitist based Universities. For example, Garnier and Hage found no relationship between higher education and economic growth in France, a highly centralized and elitist independent public system, quite removed from industrial and economic relationships (Garnier & Hage 1990). Meyer et. al. also consistently found negative and insignificant effects of tertiary education on economic development (Meyer, et al. 1979). Casual observation in the U.S. and elsewhere suggests that many engineers are employed in marketing, management, and as technical specialists and sales specialists, activities that may be only weakly related to economic development. Technicians, on the other hand, appear more likely to be engaged in production and development, less likely to be promoted into management and sales, and so are in a position to both demand higher relevance from education, and make greater use of the technological components. Thus, this finding, confirming the applicability of selective post secondary education, highlights the importance of the role that junior colleges, and their cross national equivalent, played in economic development during the period of this study.

Equation (2) on table one shows the relationship between the tertiary enrollment ratio in

[3] See on the importance of coupling in higher education.

1975 (enrollments divided by the 18-22 age cohort in the population) and two year and four year engineering degree earners. Tertiary education is not found to be statistically significant, although the relationship for two year engineering graduates continues to hold weakly positive results. The correlation between tertiary education and engineering degrees awarded was quite high: .63 for four year degrees, and .60 for two year degrees, suggesting that these independent variables may be canceling each other out in the equation. With such high correlations, relatively weak effects of two year technical degrees (statistical significance at .12) are even more surprising. In light of other findings that suggest weak and negative relationships between tertiary education and economic development, the positive coefficient of applied technical education demonstrates the importance of examining tertiary education more closely, perhaps according to subject, quality, and time period.

Equation (3) examines secondary school enrollment ratios in 1970, where it is found to be both positive and statistically significant. Again, this finding is confirmed in a number of independent studies (Meyer, et al. 1979; Hage, Garnier & Fuller 1988) In many countries secondary education may also be considered applied technical education, particularly when closely coupled vocational streams are maintained, such as in Germany and Korea during this period. When secondary education is included in the analysis, two year post secondary education is longer found to be statistically significant (although it continues in a positive direction), mirroring the findings of Garnier and Hage in Germany (Garnier & Hage 1990). The comparability between secondary and two year post secondary education is probably due to the high correlation (and multicollinearity) between the two variables: the correlation coefficient between the two was found to be .71.

Equation (4) incudes both the primary enrollment ratio (1965) found to be weakly positive and statistically significant, and the tertiary education enrollment ratio (the number of tertiary students as a percentage of the 18-24 year old age cohort in the population), which is weakly positive and not found to be statistically significant. This lends further support to the argument that primary education remains an excellent national investment, enjoying high "rates of return" as compared to higher education. Other coefficients regarding the relationship between four year and two year degree holders is maintained, although the previously negative and very weak statistical significance for four year graduates is no longer maintained. Thus, while four year education, as well as four year technical education, do not appear to precipitate economic growth, the case for two year technical graduates is weakly maintained.

We turn now to examine other independent variables that may lead to economic development, and contrast them with our findings regarding technician and engineering education. Equation (5) table 2, includes the number of scientific publications by country, in 1973. An argument can be made that certain economies are more likely to benefit from specific types of technical labor, depending on their historical industrial evolution (Rubinson & Browne 1994). This variable provides a proxy for technical sophistication or integration into global normative trends that include publication and scientific activity. While we found the variable weak, it is statistically significant, suggesting that countries with more formalized scientific exchange have higher growth rates. Technical graduates at the two year level was quite strong and statistically significant in this equation, while primary education was weak and insignificant. Five cases were dropped due to insufficient data, and so presuming that these countries represent the lower end of the scientific publication spectrum, we suspect the model to bias in favor of countries requiring higher levels of manpower training, than would be indicated by primary education alone.

Equation (6) examines the influence of tertiary (four year) science and medical enrollment in 1970 (the last year for which we currently have data). It was not found to be significant. Thus, pure science, as well as medical science, appear to more closely parallel the coefficients of tertiary education. Science and medical enrollment ratios do not, controlling for other factors, appear to promote economic development. We think this is a result of the rather loose coupling of research and science to economic development, rather, the relationship between the two may actually be inverted (Rubinson & Browne 1994). Note, however, that the strength and direction of technical graduates is maintained in this equation.

Equation (7) utilizes percentage of the labor force in industry, for the year 1975. Although we lost ten countries that do not report this data, we found the measure to be statistically significant, and a positive indicator of economic growth. Such a finding is quite predictable, as industrialization typically leads to economic growth, with the exception of resource rich oil exporting countries. The four year engineering graduate coefficient maintains a negative direction, and is statistically significant, while the two year graduates are positive and not statistically significant. We interpret these initial findings to indicate that countries which maintain a fairly tight hold over both industrial policy and educational linkages, such as technical training, that lead to industrial efficiency, result in higher levels of economic growth.

The final equation, (8) examines gross domestic capital formation in 1975, calculated at gross domestic investment divided by real GDP in 1975. This variable fails to be statistically significant. We believe this is due to the identification of a single year's capital formation. Future analysis is necessary to examine effects over a range of years.

Discussion:

The relationship between education and economic development continues to be a subject of debate, despite considerable isomorphism regarding the structure and commitment to education worldwide. Rather than focusing exclusively on broad enrollment patterns, we have endeavored to examine the role of a specific sub-set of higher education - technical post-secondary degrees.

We found considerable variability across the 48 countries studied, regarding their reported graduates of two year post secondary engineering education (See table 3). Singapore, Finland, Netherlands, Norway, and Sweden were all in the 90th percentile. All can be characterized as being relatively centralized, highly planned and regulated environments, with extensive public support of the higher educational and vocational education structure. We could make a similar argument for the 80th percentile as well, which includes Canada, Israel, Belgium, Ireland, Poland, Spain, and Yugoslavia.

Our preliminary research suggests the importance of taking a comprehensive perspective in developing an efficient educational program aimed explicitly for industrial/economic development. We have clearly demonstrated the importance of both primary and secondary education as leading to economic development, a finding in agreement with a number of other studies cited. Where this work differs is in the importance allocated to post secondary technical education - specifically, at the two year college level. The implications for this finding are considerable. The government of Korea, for example, utilized a number of techniques to encourage efficient post secondary vocational education. For instance, to encourage low status vocational education, the government provided scholarships, exempted graduates scoring above 50 percent on the national skills licensing examination from military service, and permitted the top 10 percent of secondary graduates to enter college (Middleton & Demsky 1989). Korea implemented a national system for accreditation of post-secondary junior colleges, to enforce standards on public and private schools. Korea also developed multi-functional agencies and support units for curriculum development and certification, including the Korean National Vocational Training Management agency, and the Korean Institute for Research in Vocational Training. Likewise, both France, which has a highly centralized educational policy, and Germany, well known for its industrial education, have previously been identified in terms of providing efficient post secondary education leading to economic development (Hage, Garnier & Fuller 1988; Garnier & Hage 1990). Our findings strongly suggest that careful attention toward technical engineering education, at the post secondary two year college level, represents a coherent and effective mechanism for national economic development.

Table 1.
The Effects of Technical Human Resources on National Economic Development 1980-1992

Equation Number:	(1)	(2)	(3)	(4)
Independent Variables				
Asian Country	3.30***	3.97***	3.694***	3.42***
Primary School Enrollment Ratio 1965	.036***			.033*
Secondary School Enrollment Ratio 1970			.032*	
Tertiary School Enrollment Ratio 1975		.059		.015
Technican Graduates 1975 Two Year Post Secondary Engineering Per Capita	.692*	.703†	.414	.635†
Engineering Graduates 1975 Four Year Post Secondary Engineering Per Capita	-.595†	-.518	-.531	-.672
R-Squared	.47	.42	.45	.48
Number of Cases	48	48	47	47

Notes: (1) † Significant at the .15 level
* Significant at the .10 level
** Significant at the .05 level
*** Significant at the .01 level

Table 2.
The Effects of Technical, Labor, and Human Resources on National Economic Development 1980-1992

Equation Number:	(5)	(6)	(7)	(8)
Independent Variables				
Asian Country	2.98***	3.199***	3.694***	3.27***
Primary School Enrollment Ratio 1965	.017	.011		.033*
Number of Scientific Publications, 1973	.0001*			
Tertiary School Science and Medical Enrollment Ratio 1970		.260		
Technican Graduates 1975 Two Year Post Secondary Engineering Per Capita	.857***	.629*	.394	.726*
Engineering Graduates 1975 Four Year Post Secondary Engineering Per Capita	-.580†	-.570	-.665*	-.600
Workforce % in Industry, 1975			.090*	
Gross Domestic Capital Formation				.007
R-Squared	.51	.47	.54	.45
Number of Cases	43	39	37	44

Notes: (1) † Significant at the .15 level
* Significant at the .10 level
** Significant at the .05 level
*** Significant at the .01 level

TABLE 3

Country	4YR ENG	2YR ENG	PRIM65	SEC70	TERT75	GNP8092
GHANA	.04	.03	69	14	1.10	-.10
KENYA	.04	.07	54	9	.80	.20
MADAGASC	.09	.35	65	12	1.30	-2.40
MALAWI	.00	.03	44	2	.50	-.10
MALI	.05	.00	24	5	.60	-2.70
MAURITIUS	.02	.36	101	30	1.40	5.60
MOROCCO	.05	.	57	13	3.20	1.40
NIGERIA	.04	.00	32	4	.80	-.40
SENEGAL	.02	.07	40	10	1.90	.10
SOMALIA	.03	.01	10	5	.70	.
SUDAN	.05	.03	29	7	1.50	.
TUNISIA	.12	.02	91	23	4.20	1.30
UGANDA	.02	.05	67	4	.60	.
ZAMBIA	.05	.49	53	13	2.10	.
CANADA	1.22	.95	105	65	39.30	1.80
EL-SALVA	1.09	.11	82	22	7.90	.00
GUATEMA	.47	.03	50	8	4.30	-1.50
HAITI	.04	.06	50	6	.70	.
HONDURAS	.82	.00	80	14	4.60	-.30
MEXICO	2.52	.	92	22	10.60	-.20
PANAMA	.68	.63	102	38	17.30	-1.20
BOLIVIA	1.82	.01	73	24	11.70	-1.50
BRAZIL	.65	.	108	26	10.70	.40
CHILE	4.18	.	124	39	16.20	3.70
COLOMBIA	.88	.10	84	25	8.00	1.40
PERU	2.28	.45	99	31	14.60	-2.80
URUGUAY	.73	.	106	59	16.00	-1.00
VENEZU	2.91	.48	94	33	18.10	-.80
BANGLAD	.05	.15	49	19	.	1.80
CHINA	.35	.04	.	24	.60	7.60
INDIA	.14	.33	74	26	8.60	3.10
INDONES	.20	.09	72	16	2.40	4.00
IRAN	.30	.41	63	27	4.90	-1.40
IRAQ	1.06	.31	74	24	8.90	.
ISRAEL	2.03	1.48	95	57	23.90	1.90
JAPAN	2.99	.37	100	86	24.60	3.60
JORDAN	.08	.32	95	33	5.30	-5.40
KOREA-R(S)	1.26	.79	101	42	10.30	8.50
KUWAIT	.13	.11	116	63	9.00	.
MALAYSIA	.12	.39	90	34	2.80	3.20
NEPAL	.13	.07	20	10	2.30	2.00
PAKISTAN	.10	.08	40	13	1.90	3.10
PHILIPPI	1.53	.03	113	46	18.40	-1.00
SA-ARABIA	.29	.01	24	12	4.10	-3.30
SINGAPOR	.43	2.88	105	46	9.00	5.30
SRI-LAN	.09	.11	93	47	1.30	2.60
THAILAND	.14	.02	78	17	3.40	6.00

TURKEY	1.29	.72	101	27	9.30	2.90
AUSTRIA	1.69	.	106	72	18.90	2.00
BELGIUM	.63	1.46	109	81	22.70	2.00
BULGARIA	5.09	.13	103	79	19.20	.
CZECHO	3.52	.	99	31	12.10	.
DENMARK	.67	.74	98	78	29.40	2.10
FINLAND	1.98	4.13	92	99	27.20	2.00
GERM-DR(E)	2.75	.	109	92	29.50	.
GERM-FR(W)	1.99	.65	131	.	24.50	2.40
GREECE	.85	.83	110	63	18.30	1.00
HUNGARY	.	1.72	101	63	11.70	.20
IRELAND	.72	1.14	108	74	18.80	3.40
ITALY	1.70	.	112	61	25.10	2.20
MALTA	.43	.	121	50	4.60	.
NETHERL	.49	2.41	104	75	25.20	1.70
NORWAY	.07	1.73	97	83	22.10	2.20
POLAND	1.65	.96	104	62	16.80	.10
ROMANIA	2.97	.	101	44	9.20	-1.10
SPAIN	.90	1.04	115	56	20.40	2.90
SWEDEN	1.74	2.78	95	86	28.80	1.50
SWITZERL	.56	.96	87	.	13.60	1.40
UN-KING	.80	.88	92	73	18.90	2.40
YUGOSLAV	2.78	1.54	106	63	20.00	.
AUSTRAL	1.29	.25	99	82	24.00	1.60
MEAN	**.98**	**.83**	**84.1**	**39.1**	**11.6**	**1.27**
STD DEV	**1.12**	**1.12**	**28.2**	**27.1**	**9.69**	**2.53**

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