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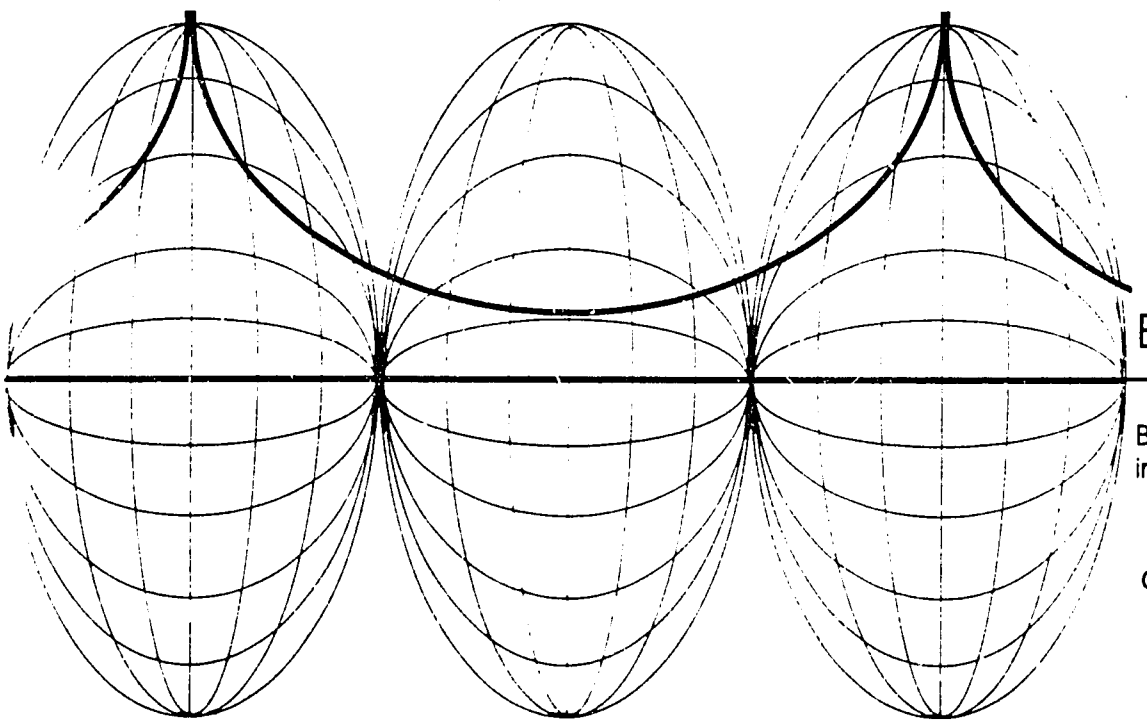

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EDUCATIONAL ATTAINMENT BY SECTOR OF ECONOMIC ACTIVITY: Compilation and Analysis of Data from Seven Pacific Rim Countries, 1960-1987

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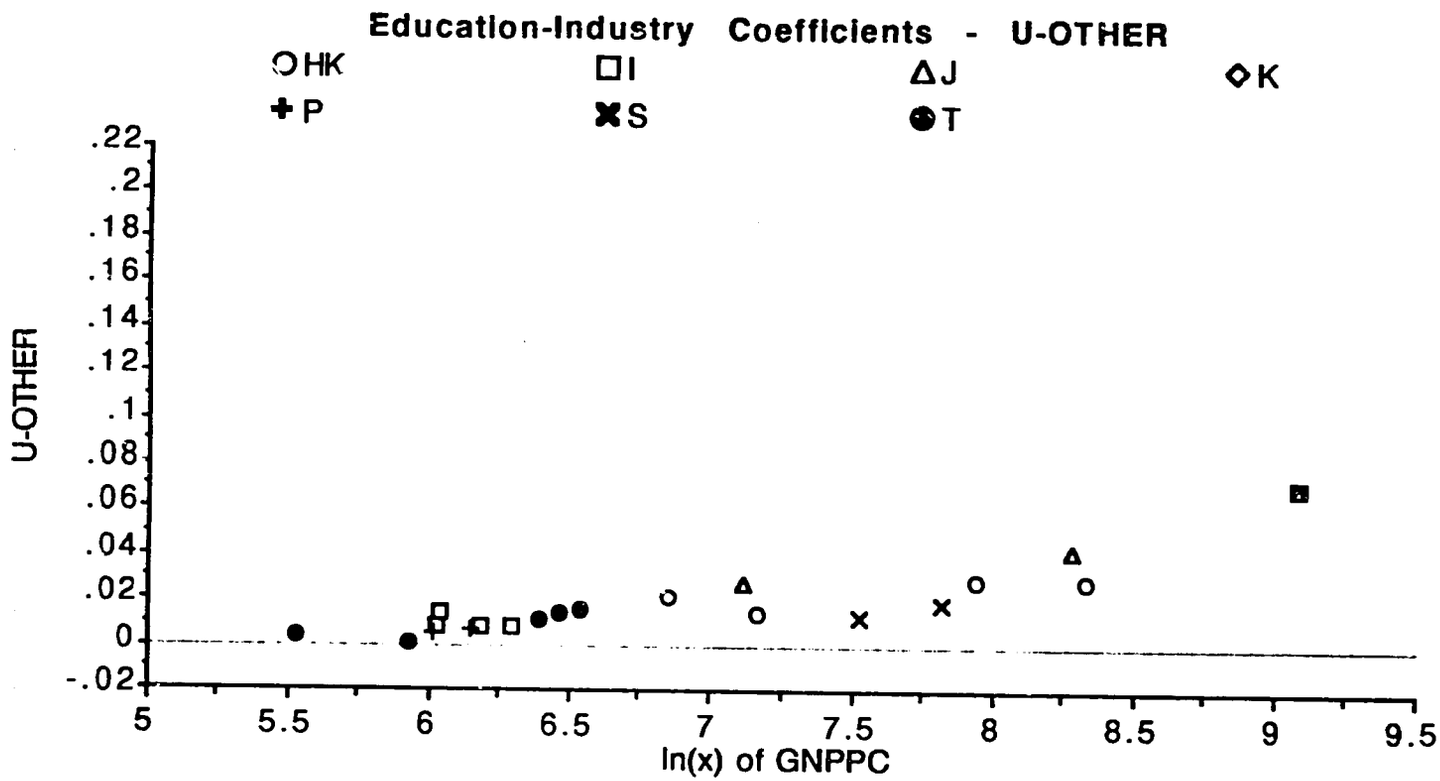
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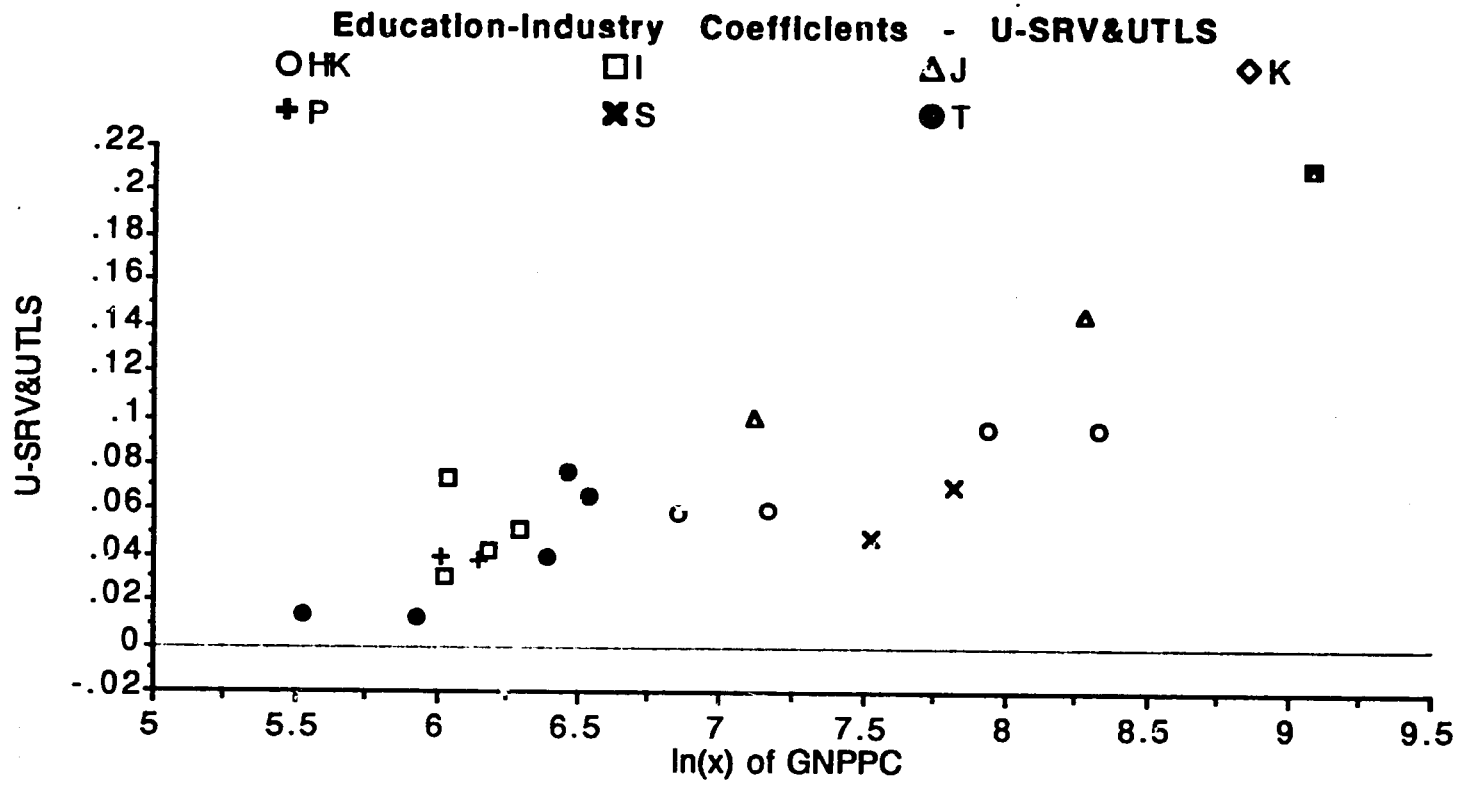
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I. INTRODUCTION

One of the pieces of information needed to advance the policy dialogue on educational investment issues is the requirements for manpower of different educational levels. In order to prepare five-year and 25-year plans, officials in the Indonesian Ministry of Education have identified the need to develop a system for forecasting the educational composition of the labor force. This report suggests elements of such a framework based on the educational structures and development patterns in other Pacific Rim countries. An international comparisons approach is used.

Data on educational attainment of the labor force by industry are assembled for seven Pacific Rim countries (Hong Kong, Indonesia, Korea, Japan, Philippines, Singapore and Thailand). The data are taken from census and labor force survey reports over the period 1960 to 1987. For each observation point, the data are arranged in an industry-education matrix showing, for a given country in a particular year, the proportion of the labor force in each of nine major industry groupings (sectors) with educational attainment at the below primary, primary, secondary or university levels. Twenty-three such matrices are constructed. Several models are suggested to explain differences in the industry-education coefficients.

A. Previous Work

Projections of manpower requirements by education level have been made by educational planners since the late 1950s and early 1960s (Hollister, p. 60). In addition to judgmental forecasts based on rules of thumb, a variety of formal techniques have been used. The dominant method, known as the manpower requirements approach, generates projections of the educational composition of the labor force in terms of ratios. The ratios most commonly encountered are those for occupation-industry (i.e the proportion of the labor force in a given industry involved in a particular occupation),

occupation-education (the proportion of persons in a given occupation with a particular level of educational attainment) or industry-education (the proportion of the labor force in a given industry with a certain level of education).

In the early applications of the manpower requirements approach, these ratios were computed from available data and projections were made based on the assumption that the ratios would remain fixed. Subsequent efforts attempted to adjust the ratios based on factors such as employers' estimates of future manpower requirements, productivity trends from international comparisons, or economy-wide labor supply conditions (Psacharopoulos and Woodhall, p 78; Dougherty). More recent applications adjust the ratios based on independent projections of demand and supply of manpower by education level incorporating models for labor market adjustments (Cohen).

The international comparisons approach for adjusting manpower requirements ratios received a substantial amount of attention in the late 1960s and early 1970s (Layard and Saigal; Horowitz, Zymelman, and Hernstadt; OECD). These studies adopted a static, production function framework for the analysis where differences in the educational composition of the labor force among countries are attributed to technical aspects of production. For example, in the major study undertaken by the Organization for Economic Cooperation and Development (OECD), labor productivity was used as the appropriate indicator of technology, i.e. as the variable best "reflecting the economic result of a state of knowledge as embodied in the factors of production and their combination" (OECD, p. 47). Statistical analysis was then used to estimate parameters showing how differences in manpower ratios among countries could be explained by differences in labor productivity. Manpower requirements were then projected based on estimated changes in labor productivity.

B. Structural Change

Because data from both the advanced and the less-developed countries are used

in the international comparisons analysis, it has been argued that this approach embodies the explicit assumption that less developed countries should copy the educational structures found in higher income countries in order to achieve faster economic growth (Psacharopoulos and Woodhall, p. 80). However, this criticism ignores the substantial body of evidence that suggests that less-developed countries can expect predictable patterns of structural change to accompany their economic development (Chenery, Chenery and Syrquin).

These structural changes are motivated by market forces associated with the transformations in commodity supply and demand and factor usage that typically occur as economies modernize. One of the more familiar aspects of this transformation is the declining proportion of food consumption in GDP and the fall in the relative contribution of the agriculture sector to aggregate production. However, in addition to changes in the composition of demand and output, the levels of investment in capital goods and educational attainment of the labor force increase in a predictable manner as the accumulation of physical and human capital proceeds.

Unlike previous studies using international comparisons, the approach adopted in this study explicitly adopts a structural change perspective. Market adjustments are accounted for in the context of long term development patterns thus avoiding one criticism often raised about manpower planning approach (i.e. that it is rigid and inflexible and does not take account of market forces (Lyons, p. 425).)

II. COMPARATIVE DATA ON EDUCATIONAL ATTAINMENT

Accurate data on the educational composition of the labor force are fundamental for the international comparison approach. Thus, substantial effort was devoted to the assembly of data from a number of sources. This section describes the data sources used and discusses some of the problems encountered in adapting those data to a comparative framework.

A. Data Sources

Data on the educational level of the labor force by sector of economic activity (for the nine sectors of the one-digit ISIC classification) were obtained from several sources. The major sources were published documents from population censuses (Hong Kong, Japan, Korea, Singapore) and labor force survey reports (Indonesia, Thailand, Philippines). References for the documents are as follows:

Hong Kong:

1966 Hong Kong Census and Statistics Department, Report on the 1966 By-Census: Text, Appendices and Index, volume I, 1968, Table I65.

1976 Hong Kong Census and Statistics Department, Hong Kong By-Census 1976: Main Report, volume II, 1978, Table VI 5, pp. 76-79.

1981 Hong Kong Census and Statistics Department, Hong Kong 1981 Census: Main Report, volume II, 1982, Table C6, pp. 68-69.

Indonesia:

1976 Central Bureau of Statistics, "Labor Force Situation in Indonesia: Main and Summary Tables for September-December 1976," May 1978, Table O3.9, p. 27.

1978 Central Bureau of Statistics, "The Labour Force Situation in Indonesia, 1978: Average for the Months February, May, August and November," February 1981, Table VIII.9.

Japan:

1960 Bureau of Statistics, 1960 Population Census of Japan, volume 2 (One Percent Sample Tabulation), Part 1 (Age, Marital Status, Legal Nationality, Education and Fertility),Table 8, pp. 236-237.

1970 Bureau of Statistics, 1970 Population Census of Japan, volume 5 (Twenty Percent Sample), Part 1 (Whole Japan Division 1), Table 6, pp. 68-72.

1980 Statistics Bureau, Prime Minister's Office, 1980 Population Census of Japan, volume 4 (Twenty Percent Sample Tabulation, Part 1 (Whole Japan, Division 2), Table 7, p. 124.

Korea:

1970 Economic Planning Board, 1970 Population and Housing Census Report, vol. 2 (10 percent Sample Survey); 4-2 Economic Activity, Table 10, pp. 202-203.

1975 National Bureau of Statistics, Economic Planning Board, 1975 Population and Housing Census Report, vol. 2 (Five Percent Sample Survey), 3-1 Economic Activity, Table 8, pp. 328-329.

1980 National Bureau of Statistics, Economic Planning Board, 1980 Population and Housing Census Report, vol. 2 (Fifteen Percent Sample Survey),3-1 Economic Activity, Table 10, p. 476.

Philippines:

1961 Bureau of the Census and Statistics, "Labor Force: Including Educational Attainment Data, May 1961" Philippine Statistical Survey of Households Bulletin, Series No. 9, Table 37, p. 39.

1965 Bureau of the Census and Statistics, "Labor Force: Including Educational Attainment Data, October 1965," The BCS Survey of Households Bulletin, Table 38, pp. 40-41.

Singapore:

1970 Department of Statistics, Report on the Census of Population 1970, Singapore, volume II, Table 229, p. 496.

1980 Department of Statistics, Report on the Census of Population, 1980, Singapore, Table 46.

Thailand:

1967 National Statistical Office, "Final Report of the Labor Force Survey: Bangkok-Thon Buri Municipal Areas, 1966-67" and "Final Report of the Labor Force Survey: Rural Areas, 1966-67," Table 10.

1978 National Statistical Office, "Report of the Labor Force Survey: Whole Kingdom," Round 2, July-September 1978, Table 14.

1983 National Statistical Office, "Report of the Labor Force Survey: Whole Kingdom," Round 2, July-September 1983, Table 6, pp. 12-13.

1987 National Statistical Office, "Report of the Labor Force Survey: Whole Kingdom," Round 2, May 1987, Table 5, pp. 18-19.

Additional data for **Ecuador** 1962, **Hong Kong** 1961, **Syria,** 1960, **Thailand** 1960, the **United States** 1960, **Uruguay** 1966, and **Zambia** 1960 were obtained from a 1969 OECD study. The reference for that data is:

Organization for Economic Cooperation and Development, Statistics of the Occupational and Educational Structure of the Labor Force in 53 Countries, Paris, 1969.

Some of the data for **Indonesia** (1980, 1982 and 1985) were supplied by the Research Triangle Institute. These data were taken from the Indonesian National Labor Force Sample Survey known as SAKERNAS.

B. Comparability, Classification and Aggregation of Data

International comparisons of data from heterogeneous sources are complicated by differences in definitions, classifications, and choice of measures. For the data assembled in this study, bias can be attributed to differences in the definition of the labor force, in the industrial classification, and in measures of educational attainment of the labor force.

Labor Force - All of the data defined the labor force according to economically active population (as opposed to "persons engaged"). Thus, the size of the labor force is determined by the reported work activity in a set time period preceding the survey. Because seasonal fluctuations can affect these data, attempts were made when possible (especially for the labor force survey data in Thailand) to obtain measures for similar seasonal periods.

Another source of bias is differences in definition of the working age population. For **Indonesia, Philippines** and **Singapore** this population included all persons 10 years and older. For **Thailand** it includes all persons 11 and over; for **Korea**, 13 and over; for **Hong Kong**, 14 and over; and for **Japan** 15 and older. No adjustments to the data were made to account for these differences.

Industrial Classification - This aspect of the data showed the highest degree of consistency among countries. Virtually all countries organized their sectoral classifications according to the International Standard Industrial Classification (ISIC) which, since 1948, has served as a basis for the United Nations National Accounts Statistics. At the highest level of aggregation (the "one-digit" level) that classification defines nine sectors: Agriculture, Mining, Manufacturing,

Construction, Utilities, Trade, Transportation (and Communication), Banking (Finance), and Services. In some cases (e.g. Japan and Hong Kong) more than 9 sectors were reported but they could be combined to conform to the 9 sector ISIC. For the Philippines, Singapore, and Thailand data on the finance and services sectors were combined and only 8 sectors of industrial activity could be defined. Even though sector classifications appear to be relatively consistent across countries, a problem still remains about whether economic activity classified under the same heading is really comparable among countries.

Educational Attainment - There are two major problems in comparing the data on educational attainment. First, there is no generally accepted international standard classification of education levels. Second, reported data on educational attainment can either refer to the number of people in the labor force having completed requirements of education at certain level ("highest attainment") or to those who have attended school at that level ("level of studies reached").

For the purpose of this study, the standard of classification for educational attainment is modelled on the U.S. pattern of 6-3-3-4 cycles, i.e. a six year cycle of primary school, followed by six years of secondary school (three years of middle school and three years of high school). A four year period of study is then assumed for a university degree. This educational pattern has been adopted in the postwar period in **Japan** and **Korea.**

The educational systems of the other countries included in this study do not conform so closely to the U.S. system. A brief description of the educational system for the other Asian countries follows. This information is taken from the British Council's International Guide to Qualifications in Education.

Indonesia - The pattern of education at the primary and secondary levels in Indonesia follows the 6-3-3 American pattern, but the upper secondary cycle is more specialized. Also, until just recently there has been no clear equivalent to the

bachelor's degree at the post secondary level in Indonesia. The sarjana muda degree requires a three year cycle of study. An additional two year period of study including the preparation and presentation of a thesis is required for the sarjana which carries the title of "doctor".

Thailand - Since 1978, the educational system in Thailand has included a six year cycle of primary followed by six years of secondary, but the secondary cycles include a four year cycle of lower secondary followed by a 2 year cycle of specialized upper secondary schooling. A bachelor's degree generally takes four years. (Prior to 1978 the Thai system was patterned on a 7-3-3-4 cycle.)

Philippines - Primary schooling begins at the age of 7 in the Philippines and lasts 6 years (at government schools) or 7 years (at private schools.) Education at the secondary level includes one four year cycle and the usual bachelor's degree requires four years of post-secondary schooling.

Singapore - The educational system in Singapore is complicated, in part, by the availability of instruction in all of the four official languages (Chinese, Malay, English and Tamil). Primary schooling is divided into two cycles. After the first three years, students are assigned to a second primary course of instruction taking from three to five years. Admittance to secondary school is by exam. The lower secondary cycle can last from 4 to 5 years and the upper secondary (pre-university) cycle from 2 to 3 years. Various options for post-secondary education are available, but the normal university degree requires four years.

The educational systems described above appear to conform most closely to a classification system based on four levels of educational attainment: 1) none, i.e. less than primary; 2) primary ; 3) secondary; and 4) university. Comparison across countries requires that the labor force be divided among these four categories in a consistent manner. The procedure most commonly used in the data sets obtained for this study was based on "highest attainment." This procedure groups labor force

participants into categories based on the highest level of schooling completed, not attended. For example, those employees classified in the "primary" education category may have attended secondary school for a number of years without completing all requirements for secondary education. Thus the range of years of education for four categories can be approximated as follows: 1) none - less than six years; 2) primary - six to 11.9 years; 3) secondary - 12 to 15.9 years and 4) university - 16 or more years.

C. Construction of Industry-Education Matrices

The basic unit of comparative analysis is a matrix of coefficients, L_{ik}/L_i, where L_{ik} is the number of employees in the labor force of sector i (i=1,...9) with highest educational attainment at level k (k=N-none (i.e. less than primary), P-primary, S-secondary, or U-university) and L_i is the total number of employees in sector i. The nine sectors are those included in the one-digit ISIC codes as described above.

Cumulative coefficients, $L_{ik}{}^c/L_i$, were also computed. These coefficients reflect the percentage of the labor force having attained a certain education level <u>or higher</u>. Thus, the secondary cumulative coefficient, $L_{iS}{}^c/L_i$, gives the percentage of the labor force in sector i having finished secondary education. Its value equals the sum of the simple coefficients for secondary and university attainment levels. These coefficients are useful because they will always increase as educational attainment increases in the general population. They were also the one of the main units of analysis in the OECD's international comparison work in the 1960s. (See OECD and Layard and Saigal).

In some cases adjustments to the data were necessary for calculation of the coefficients. The various data sources, as described above, generally divided the labor force in a consistent manner among industries, but there was diversity in the division of the sectoral labor force among educational attainment categories. Table 1 shows, for the relevant countries and years, the groupings used to assign reported educational categories to the four attainment levels defined in this study.

The data reported in the **Singapore** censuses were the most closely comparable. "Highest attainment" had been used to categorize the labor force and the reported educational attainment categories corresponded to the four used here. The one exception was for 1970 where there is no breakdown for the labor force with less than secondary education into those with primary education completed and those without. Approximations of this breakdown were made based on the 1980 proportions of those with less than secondary education who had completed primary education.

The data from the **Korea** censuses used the highest attainment criteria and divided the labor force into four educational categories: none, primary, secondary and college. The first three of these educational categories correspond to those adopted in this study. However, the category for "college" refers to junior college (i.e. two years of post-secondary education attainment or higher). Because there were no other data for Korea available to make an estimated adjustment, observations for Korea had to be excluded from the analysis for the secondary and university attainment levels.

In **Japan** highest attainment was used but the educational categories included those from both pre- and post-war educational systems. Of these the most problematic was the pre-war category for "Youth Training School." Employees with that level of attainment were assumed to have highest educational attainment equivalent to the current primary level.

Table 1. Attainment Level Groupings Used in Constructing Industry-Education Matrices

	Hong Kong 1961	Hong Kong 1966	Hong Kong 1976, 1981	Indonesia 1976, 1978	Indonesia 1980, 1982, 1985	Japan 1960, 1970, 1980
NONE	None Private Tutor	None Private Tutor Lower Primary	None	No School Some Elementary	No School Some Elementary	Never Attended
PRIMARY	Primary Junior Secondary	Upper Primary Junior Middle Lower Secondary	Primary Lower Secondary	Elementary Junior General Junior Vocational	Elementary Junior General Junior Vocational	Elementary Higher Elementary (old) Youth Training (old) Junior High
SECONDARY	Senior Secondary Post Secondary	Senior Middle Senior Secondary Post Secondary Attending University	Upper Secondary Matriculation Post Secondary Poly Technical	Senior Vocational Senior General	Senior Vocational Senior General	Middle School (old) High School Junior College Higher School (old)
UNIVERSITY	University	University	University	Academy University	PT-D3 PT-S1	University College Graduate Course

Table 1. Attainment Level Groupings Used in Constructing Industry-Education Matrices

Korea 1970, 1975, 1980	Philippines 1951, 1965	Singapore 1970	Singapore 1980	Thailand 1960	Thailand 1967	Thailand 1978, 1983, 1987
Never Attended	No School Grades 1-5	*Less Than High School	No Qualification	None *Primary	None *Primary	None Less then 4 Lower Elementary
Primary	Grade6-7 Grades 8-11	*Less Than High School	Primary	*Primary *Secondary	*Primary *Secondary	Upper Elementary Lower Secondary
Secondary Junior College	College 1-4	High School Upper Secondary	Secondary Upper Secondary	*Secondary *College	*Secondary Vocational Upper Vocational Tech Teacher Training *College	Upper Secondary Vocational Secondary Vocational Tech Teacher Training
	College 5	University Post Graduate	University Post Graduate	*College	*College	College

Note: * preceding an attainment category name means that adjustments were made to reallocate part of the category to a different attainment level

For the labor force survey data from the **Philippines**, educational attainment was reported by number of grades completed and years of university completed. The Philippine system requires only 4 years of schooling for completion of secondary education after primary school. Thus, to make attainment statistics more comparable, one year of post-secondary education was required to reach the secondary attainment level. Likewise 5 years of post-secondary education were required for the university attainment level.

The census data from **Hong Kong** are based on attainment level. For 1966, levels for both the Chinese (Junior Middle and Senior Middle) and English system (Lower Secondary and Senior Secondary) schools are included.

In **Thailand** the system of educational attainment reporting was changed in 1976 from that of "level of education reached" to the "highest attainment" method. In order to use the 1960 and 1966 Thai data, approximations of the percent of those educated at the primary and secondary levels who completed all requirements were made based on trends extrapolated from the 1978, 1983, and 1985 data.

The **Indonesian** data separately report those having some primary education from those who have completed. For secondary education two cycles are reported and reporting is based on completion of requirements. The same appears to be true at the university level. The only available data from the 1976 labor survey were from the May survey, whereas the other labor survey data from 1978-1987 were annual averages. The 1976 data were therefore not used in any of the analysis.

Plots of the calculated coefficients are presented in Appendix A. To facilitate interpretation of the coefficients the industry-education matrices were reduced in size to include only five sectors (i=1,...5). Agriculture (**AG**), manufacturing (**MANU**), and trade (**TRDE**) are as defined by the one-digit ISIC codes. The ISIC sectors for finance, services and utilities are aggregated into a single sector (**SRV&UTLS**), and mining, construction, and transportation are also

combined (OTHER). These charts illustrate several interesting features of the data set. Specifically, they show that there are consistent patterns of change in the coefficients as GNPPC levels change. Also they show that education levels of the labor force are lowest in the AGRI sector and highest in the SRV&UTLS sector. In some cases, Japan and Korea have unexpectedly low levels of the labor force with attainment below the primary level.

II. ANALYSIS

Using the structural change perspective, it was hypothesized that the industry-education coefficients change in a consistent pattern as economies undergo a process of economic development and structural change. Specifically it was expected that the proportion of the labor force with educational attainment below the primary level (L_{iN}/L_i) declines with economic development and the proportion with complete secondary and university education (L_{iS}/L_i and L_{iU}/L_i) increases. As for those with highest attainment at the primary level (L_{iP}/L_i), it was expected that this would increase in the early levels of development, but then later decline at the highest stages of development as more primary school graduates also complete secondary and university levels. The cumulative coefficients, $L_{ik}{}^{c}/L_i$, are expected to uniformly increase with development. These hypothesized trends reflect the pattern of increasing school enrollments associated with the accumulation of human capital. They have been identified as a universal dimension of structural change (Chenery, pp.9-11).

Although the expectation of increasing educational attainment holds for all sectors of economic activity, there may be sectoral differences. For example,

agriculture (a predominantly rural sector) will most likely lag in educational development while banking, finance and services (predominantly urban activities) can be expected to lead. Differences can also be associated with the degree of public vs. private involvement in a given sector.

A. Explanatory Variables

In order to statistically explore these differences in patterns, a small data set representing the levels of economic development (i.e. the stage of the structural transformation), type of structural transformation, and level of development in educational infrastructure was constructed. Additionally, a variable to control for different definitions of the labor force was defined.

The two variables chosen to represent the level of economic development were: 1) the level of GNP per capita (**GNPPC**) and 2) the percent of the economically active population employed in agriculture(**LAGRI**). The variables chosen to represent the level of development of the educational infrastructure were the UNESCO estimates of gross enrollment ratio at the primary school level (**GERT**).

The set of countries included in the analysis was restricted to those belonging to the Pacific Rim region in order to maintain some degree of geographic and cultural homogeneity. However, within the set of countries included, there is diversity in the types of economic specialization. Despite the fact that certain developmental processes are uniform across all economy types, alternative sequences of structural change can be identified based on differences in size, natural resources, and government policies.

One typology of development strategies based on deviations of export and production orientation from the average pattern categorizes economies into one of four strategies: primary specialization; import substitution; balanced development;

and industry specialization (Chenery, pp. 26-45). For the countries in this study, Indonesia falls in the primary specialization; Thailand and the Philippines in the balanced development category; and Hong Kong, Japan, Korea and Singapore in the industry specialization.

To account for differences in educational attainment that might be attributed to differences in development strategy, dummy variables were used for those economies following the primary (**PRIM**), and industrial specializations (**INDUS**). Inclusion of these dummies allows consideration of how these structural types differ relative to the balanced growth category. For the industry specialization category dummy variables were used to define a further breakdown to account for the predominantly urban character of the Hong-Kong and Singapore economies (**HK-S**), vs. the more economically diversified economies of Korea and Japan (**J-K**).

Observations on GNP per capita (**GNPPC**) were obtained from the World Bank's World Tables. These are reported on an annual basis from 1967 and on five year intervals from 1960. The World Tables report these data in current $U.S. The U.S. overall GDP deflator was used to convert the estimates to constant 1980 $U.S. Where necessary in the 1960-65 period, extrapolations were made based on the assumption of a constant growth rate between the two endpoints. The data on the percent of the labor force in agriculture (**LAGRI**) were obtained from the same data sources as those used to estimate the industry-education matrices.

The UNESCO gross enrollment ratios are reported on five year intervals from 1960 and annually after 1975 in the World Bank's World Tables. They are reported on five year intervals from 1950 in the UNESCO Statistical Yearbooks. However, the two data series are not directly comparable because the World Bank used a different procedure to adjust the denominator of the ratios for school age population. The World Bank's data were used for the period after 1960.

UNESCO's data were used for the prior period, but it was rescaled so that the UNESCO 1960 estimate matched the World Bank 1960 ratio. Because it is the level of educational development in earlier periods that most affects the current educational attainment of the labor force, the gross enrollment ratios from five years prior (**GERT-5**) and ten years prior (**GERT-10**) were used. Where necessary, extrapolations were made based on the assumption of constant growth rate between endpoints.

Finally, a variable (**WFAGE**) was used to help correct for measurement errors due to different definitions of the labor force. For each country the variable takes on the value of the age level which demarcates the lower bound of the labor force definition.

The correlation matrix for these explanatory variables is shown in Table 2. Regarding the level of development variables, there is a strong positive correlation between **LAGRI** and the inverse of **GNPPC** (.852) and negative correlation with the natural log form of **GNPPC** (-.837). The dummy variable for the industrialization specialization, **INDUS**, also shows strong negative correlation with **LAGRI** (-.843) and positive correlation with **ln(GNPPC)** (.771) and with **WFAGE** (.757) .

B. The Model and Results

After some preliminary exploratory analysis, the following models (**A, B, C** and **D**) were chosen for estimation.

(1) -A- L_{ik}/L_i, L_{iS}^{c}/L_i = f(GNPPC) (i=1,..5, k=N,P,S,U)

(2) -B- L_{ik}/L_i, L_{iS}^{c}/L_i = f(GNPPC, WFAGE) (i=1,..5, k=N,P,S,U)

Table 2. Correlation Matrix - Full Sample

	GNPPC	LAGRI	1/GNPPC	GNPPC-SQRD	ln(GNPPC)	GERT-5	GERT-10	WFAGE	PRIM	INDUS	J-K	HK-S
GNPPC	1.00											
LAGRI	-0.608	1.00										
1/GNPPC	-0.666	0.852	1.00									
GNPPC-SQRD	0.944	-0.39	-0.454	1.00								
ln(GNPPC)	0.89	-0.837	-0.913	0.707	1.00							
GERT-5	0.336	-0.325	-0.475	0.184	0.473	1.00						
GERT-10	0.389	-0.222	-0.389	0.253	0.459	0.809	1.00					
WFAGE	0.58	-0.566	-0.624	0.465	0.664	0.135	0.077	1.00				
PRIM	-0.263	0.278	0.357	-0.165	-0.372	-0.097	-0.262	-0.473	1.00			
INDUS	0.54	-0.843	-0.804	0.343	0.771	0.34	0.304	0.757	-0.479	1.00		
J-K	0.394	-0.157	-0.379	0.384	0.393	0.286	0.355	0.639	-0.273	0.569	1.00	
HK-S	0.22	-0.802	-0.535	0.007	0.484	0.101	-0.009	0.222	-0.273	0.569	-0.353	1.00

(3) -C- L_{ik}/L_i, L_{iS}^c/L_i = f(GNPPC, J-K) (i=1,..5, k=N,P,S,U)

(4) -D- L_{ik}/L_i, L_{iS}^c/L_i = f(GNPPC, WFAGE, PRIM, J-K, HK-S) (i=1,..5, k=N,P,S,U)

From the preliminary analysis, the indicator of the level of economic development which appeared to perform best was **GNPPC** per capita. Thus **LAGRI** was not included in any of the models. The set of structural variables performed best when the separate variables (**J-K** and **HK-S**) were used to distinguish alternate modes of industrial specialization. It is possible that the correlations of **INDUS** with other explanatory variables discussed above was a source of multicollinearity. The control variable for the age limits used to define the labor force, **WFAGE**, added explanatory power in some instances. Finally, indicators for the level of development of the educational structure, **GERT-5** and **GERT-10**, were not included because they also depend on the level of economic development as indicated by **GNPPC**. To have included them would have introduced a specification problem.

Regressions for the simple coefficients (L_{ik}/L_i) were estimated for all education levels (N, P, S, U), but for cumulative coefficients (L_{ik}^c/L_i) it was only necessary to estimate regressions for secondary level and above. The cumulative coefficients for the university level (L_{iU}^c/L_i) are exactly equal to the simple coefficients (L_{iU}/L) so the estimated regressions are the same. As for the cumulative primary coefficients (L_{iP}^c/L_i), regression results from the simple coefficients for below primary level can be used because

(5) $L_{iP}^c/L_i = 1.0 - L_{iN}/L_i$

Also, there is no need to estimate regressions for the cumulative coefficients for the

below primary level (L_{iN}/L_i) since by definition they must equal 1.0. (The entire labor force must have achieved educational attainment of below primary or higher.)

The functional forms differed among the regressions. For the below primary category (L_{iN}/L_i) the inverse of GNPPC was used to allow estimation of a hyperbola with the expectation of a zero asymptote at high income levels. For the primary attainment level (L_{iP}/L_i) both the level of GNPPC and GNPPC-squared were included to model a quadratic relationship between primary level education and level of development. The remaining regressions for the simple and cumulative coefficients used a semi-logarithmic functional form with ln(GNPPC) included.

Ordinary least squares regression was used to obtain parameter estimates for the four model types for simple coefficients in the five sector industry-education matrices and cumulative coefficients for the secondary level and above. The results are presented here in Tables 3-7. In general the signs are as expected.

In Table 3 it is evident that the level of GNP per capita (GNPPC) is inversely associated with the proportion of the population with less than primary education and the relationship is significant at the five percent level or better in 18 of the 20 regressions. The estimated intercepts from model A can be interpreted as the asymptote for infinitely high development levels. Except for the AGRI sector, where over 25 percent of the population is predicted to have attainment below the primary level, the estimated limits are low. For MANU it is less than one percent, for SRV&UTLS two percent, TRDE four percent and OTHER, six percent.

Additionally the results in Table 3 suggest that Japan and Korea (J-K) tend to have significantly smaller proportions of their labor force with below primary attainment even after controlling for differences in GNPPC, the workforce age adjustment (WFAGE) and the other structural variables. The workforce age variable (WFAGE) is

Table 3. Regression Results - Below Primary Level

SECTOR	BETA COEFFICIENTS								ELASTICITIES	
	Intercept	1/GNPPC	WFAGE	PRIM	J-K	HK-S	Adj. R-Squared	F-Statistic	Sample Avg.	Indonesia 85
AGRI										
A	0.266	212.001 *					0.495	22.59	-0.24	-0.74
(t-Value)		4.75								
B	1.283	121.214 **	-0.07418 *				0.633	20.01	-0.14	-0.43
(t-Value)		2.49	2.99							
C	0.475	141.109 *			-0.41232 *		0.849	62.85	-0.16	-0.50
(t-Value)		5.35			7.09					
D	0.807	102.916 **	-0.01839	-0.11636	-0.45627 *	-0.1004	0.855	27.02	-0.12	-0.36
(t-Value)		2.5	0.88	1.63	4.33	1.02				
MANU										
A	0.007	253.069 *					0.64	40.12	-0.44	-1.22
(t-Value)		6.33								
B	0.828	179.747 *	-0.05991 **				0.717	28.85	-0.31	-0.86
(t-Value)		3.96	2.59							
C	0.16	201.083 *			-0.30236 *		0.803	45.90	-0.35	-0.97
(t-Value)		6.3			4.29					
D	0.471	76.430 **	0.00471	-0.08239	-0.57689 *	-0.39029 *	0.896	38.88	-0.13	-0.37
(t-Value)		2.07	0.25	1.28	6.09	4.39				
TRDE										
A	0.04	232.892 *					0.63	38.96	-0.40	-1.07
(t-Value)		6.24								
B	0.946	152.025 *	-0.06607 *				0.75	33.92	-0.26	-0.70
(t-Value)		3.95	3.28							
C	0.184	184.13 *			-0.28361 *		0.801	45.29	-0.32	-0.84
(t-Value)		6.2			4.32					
D	0.634	79.374 ***	-0.01497	-0.5019	-0.43885 *	-0.27508 *	0.862	28.50	-0.14	-0.36
(t-Value)		2.02	0.75	0.47	4.35	2.91				
SRVC & UTLS										
A	0.021	160.97 *					0.603	34.38	-0.41	-1.71
(t-Value)		5.86								
B	0.287	137.25 *	-0.01938				0.606	17.92	-0.35	-1.46
(t-Value)		3.92	1.09							
C	0.125	125.528 *			-0.20614 *		0.801	45.29	-0.32	-1.34
(t-Value)		5.68			4.23					
D	0.026	118.332 *	0.01527	-0.11343 ***	-0.31462 *	-0.09503	0.808	19.49	-0.30	-1.26
(t-Value)		3.6	0.92	1.99	3.73	1.2				
OTHER										
A	0.062	202.38 *					0.505	23.44	-0.37	-1.16
(t-Value)		4.84								
B	0.893	128.2[illegible]	-0.06059 **				0.602	17.64	-0.23	-0.73
(t-Value)		2.6[illegible]	2.47							
C	0.218	149.57 *			-0.30718 *		0.715	28.62	-0.27	-0.86
(t-Value)		4.36			4.06					
D	0.646	46.48	-0.00888	-0.17939 **	-0.52679 *	-0.32579 *	0.812	20.02	-0.08	-0.27
(t-Value)		1.05	0.39	2.33	4.64	3.08				

Significance Levels of Beta Coefficients Indicated by * for .01, ** for .05 and *** for .10

Table 4. Regression Results - Primary Level

SECTOR	BETA COEFFICIENTS									ELASTICITIES	
	Intercept	GNPPC	GNPPC-SQRD	WFAGE	PRIM	J-K	HK-S	Adj. R-Squared	F-Statistic	Sample Avg.	Indonesia 85
AGRI											
A	0.179	1.63E-04 *	-1.16E-08					0.374	7.57	0.54	0.21
(t-Value)		2.72	2.72								
B	-0.384	9.32E-05	-6.83E-09	0.054 * *				0.488	7.98	0.31	0.12
(t-Value)		1.51	1.02	2.33							
C	0.134	1.41E-04 *	-1.26E-08 *			0.039 *		0.753	23.35	0.44	0.18
(t-Value)		3.71	2.84			5.63					
D	0.075	1.10E-04 * * *	-9.57E-09	0.002	0.115	0.396 *	0.101	0.755	12.28	0.34	0.14
(t-Value)		1.91	1.55	0.09	1.59	4.04	1.04				
MANU											
A	0.265	1.52E-04 *	-1.55E-08 *					0.275	5.18	0.40	0.14
(t-Value)		3.13	3.13								
B	0.066	1.28E-04 * *	-1.38E-08 * *	0.019				0.269	3.7	0.32	0.12
(t-Value)		2.29	2.28	0.91							
C	0.257	1.49E-04 *	-1.57E-08			0.053		0.256	3.53	0.38	0.14
(t-Value)		3.00	2.69			0.7					
D	0.309	1.31E-05	-1.96E-09	-0.01	0.077	0.238	0.32	0.432	3.79	0.03	0.01
(t-Value)		0.20	0.28	0.23	0.93	2.12 * *	2.87 *				
TRDE											
A	0.269	1.02E-04 * *	-1.14E-08 * *					0.173	3.29	0.29	0.10
(t-Value)		2.57	2.44								
B	0.255	1.00E-04 * *	-1.13E-08	0.001				0.129	2.09	0.28	0.09
(t-Value)		2.15	2.24	0.081							
C	0.261	9.81E-05 * *	-1.16E-08 * *			0.058		0.168	2.48	0.27	0.09
(t-Value)		2.45	2.46			0.94					
D	0.516	2.83E-05	-4.07E-09	-0.03	0.076	0.244 * *	0.233 * *	0.313	2.67	0.07	0.03
(t-Value)		0.51	0.68	1.24	1.08	2.57	2.48				
SRVC & UTLS											
A	0.291	1.78E-05	-3.06E-09					-0.04	0.58	0.04	0.02
(t-Value)		0.58	0.85								
B	0.421	3.39E-05	-4.17E-09	-0.01				-0.05	0.69	0.11	0.04
(t-Value)		0.97	1.10	0.95							
C	0.294	1.93E-05	-3.00E-09			-0.021		-0.083	0.44	0.05	0.02
(t-Value)		0.61	0.81			0.67					
D	0.458	-1.29E-05	5.83E-10	-0.02	0.091	0.107	0.144 * * *	0.074	1.29	-0.06	-0.01
(t-Value)		0.29	0.12	1.1	1.63	1.41	1.92				
OTHER											
A	0.322	9.17E-05 * * *	-8.69E-09					0.114	2.41	0.24	0.07
(t-Value)		2.02	1.63								
B	0.271	8.54E-05	-8.26E-09	0.005				0.07	1.55	0.22	0.07
(t-Value)		1.61	1.44	0.25							
C	0.315	8.827E-05 * * *	-8.84E-09			0.051		0.091	1.74	0.23	0.07
(t-Value)		1.91	1.63			0.71					
D	0.365	3.29E-05	-3.11E-09	-0.01	0.146 * * *	0.191	0.19	0.179	1.8	0.09	0.03
(t-Value)		0.49	0.43	0.36	1.74	1.68	1.68				

Significance Levels of Beta Coefficients Indicated by * for .01, ** for .05 and *** for .10

Table 5. Regression Results - Secondary Level

SECTOR	BETA COEFFICIENTS								ELASTICITIES	
	Intercept	ln(GNPPC)	WFAGE	PRIM	J-K	HK-S	Adj. R-Squared	F-Statistic	Sample Avg. (excl. Korea)	Indonesia 85
AGRI										
A	-0.35938	0.05991 *					0.702	45.80	1.13	5.16
(t-Value)		6.77								
B	-0.39017	0.03555 *	0.01681 *				0.824	45.37	0.67	3.06
(t-Value)		3.73	3.66							
C	-0.2515	0.0424 *			0.08381 *		0.833	48.55	0.80	3.65
(t-Value)		5.30			3.90					
D	-0.37579	0.03841 *	0.01369 **	0.01173	0.03537	-0.01614	0.863	25.01	0.73	3.31
(t-Value)		3.07	2.54	0.71	0.90	0.62				
MANU										
A	-0.77941	0.13514 *					0.819	87.13	0.90	1.57
(t-Value)		9.33								
B	-0.82556	0.09865 *	0.02519 *				0.879	70.29	0.66	1.14
(t-Value)		5.97	3.16							
C	-0.68877	0.12044 *			0.07043		0.832	48.21	0.80	1.40
(t-Value)		7.15			1.56					
D	-1.08052	0.12452 *	0.03376 *	0.03825	-0.0775	-0.06717	0.885	30.19	0.83	1.44
(t-Value)		5.15	3.24	1.20	1.02	1.34				
TRDE										
A	-0.90481	0.16058 *					0.75	58.12	0.80	2.42
(t-Value)		7.62								
B	-1 0013	0.08427 *	0.05268 *				0.938	143.96	0.42	1.27
(t-Value)		5.73	7.42							
C	-0 7514	0.13569 *			0.11919 ***		0.78	34.74	0.68	2.04
(t-Value)		5.68			1.86					
D	-1.13595	0.09849 *	0 05731 *	0.00674	-0.0522	-0.03784	0.928	49.92	0.49	1.48
(t-Value)		4.16	5.62	0.22	0.70	0.77				
SRVC & UTLS										
A	-0 4949	0.12078 *					0.716	48.84	0.36	0.34
(t-Value)		6.99								
B	-0.51678	0.10347 *	0.01195				0.716	25.02	0.31	0.29
(t-Value)		4.29	1.03							
C	-0.43799	0.11154 *			0.04422		0.709	24.19	0.33	0.32
(t-Value)		5.28			0.78					
D	-0.89688	0.14387 *	0 02424	0.04095	-0.1244	-0.1087	0.722	10.88	0.43	0.41
(t-Value)		4.03	1.58	0.87	1.11	1.47				
OTHER										
A	-0 7376	0.13095 *					0.798	75.87	0.96	1.38
(t-Value)		8.71								
B	-0.79286	0.08725 *	0.03017 *				0.891	78.73	0.64	0.92
(t-Value)		5.66	4.06							
C	-0.68136	0.12183 *			0.04369		0.795	37.89	0.89	1.28
(t-Value)		6.66			0.89					
D	-0.1.08192	0.10983 *	0.04304 *	0.05461 ***	-0.1034	-0.04546	0.908	38.72	0.80	1.15
(t-Value)		5.20	4.72	1.95	1.56	1.04				

Significance Levels of Beta Coefficients Indicated by * for .01, ** for .05 and *** for .10

Table 6. Regression Results - University Level

SECTOR		BETA COEFFICIENTS							ELASTICITIES	
	Intercept	ln(GNPPC)	WFAGE	PRIM	J-K	HK-S	Adj. R-Squared	F-Statistic	Sample Avg. (excl. Korea)	Indonesia 85
AGRI										
A	-0.0144	0.00239 *					0.64	34.75	1.17	4.83
(t-Value)		5.89								
B	-0.01339	0.00318 *	-0.00055 * *				0.704	23.59	1.56	6.42
(t-Value)		6.20	2.21							
C	-0.0162	0.00268 *			-0.0014		0.643	18.09	1.31	5.41
(t-Value)		5.50			1.07					
D	-0.0067	0.00243 *	-0.00076 * *	-0.00027	0.00249	0.00207	0.68	9.09	1.19	4.91
(t-Value)		3.05	2.21	0.26	0.99	1.25				
MANU										
A	-0.11015	0.01861 *					0.642	35.05	1.04	2.31
(t-Value)		5.92								
B	-0.11435	0.01529 *	0.00229				0.645	18.29	0.85	1.90
(t-Value)		3.50	1.09							
C	-0.06227	0.01084 *			0.0372 *		0.9	86.79	0.60	1.34
(t-Value)		5.41			6.90					
D	-0.08935	0.01688 *	-0.00075	-0.00146	0.02623 * *	-0.0123 * * *	0.914	41.61	0.94	2.09
(t-Value)		5.26	0.54	0.34	2.60	1.85				
TRDE										
A	-0.12407	0.0218 *					0.577	26.97	0.84	6.39
(t-Value)		5.19								
B	-0.13572	0.01259 * *	0.00636 * *				0.678	21.00	0.49	3.68
(t-Value)		2.46	2.57							
C	-0.08415	0.01532 *			0.03102 * *		0.681	21.30	0.59	4.49
(t-Value)		3.48			2.62					
D	-0.17987	0.02078 *	0.00633 * *	-0.00754	-0.0129	-0.0284 * * *	0.746	12.17	0.80	6.09
(t-Value)		3.06	2.16	0.84	0.60	2.02				
SRVC & UTLS										
A	-0.20384	0.03959 *					0.695	44.38	0.58	0.54
(t-Value)		6.66								
B	-0.21357	0.03189 *	0.00531				0.709	24.14	0.47	0.43
(t-Value)		3.93	1.36							
C	-0.13091	0.02775 *			0.05666 *		0.832	48.00	0.40	0.38
(t-Value)		5.20			3.95					
D	-0.29941	0.04593 *	0.00543	0.0132	-0.0047	-0.047 *	0.891	32.14	0.67	0.62
(t-Value)		6.19	1.70	1.34	0.20	3.06				
OTHER										
A	-0.08091	0.0144 *					0.74	55.07	0.56	1.05
(t-Value)		7.42								
B	-0.08523	0.01098 *	0.00236 * * *				0.774	33.59	0.43	0.80
(t-Value)		4.35	1.93							
C	-0.05744	0.01509 *			0.01823 *		0.853	55.97	0.59	1.10
(t-Value)		6.00			3.84					
D	-0.11214	0.01533 *	0.00244 * *	0.00339	-0.0024	-0.0145 * *	0.893	32.84	0.60	1.12
(t-Value)		5.90	2.18	0.99	0.30	2.69				

Significance Levels of Beta Coefficients Indicated by * for .01, ** for .05 and *** for .10

Table 7. Regression Results - Secondary Level and Above

SECTOR	BETA COEFFICIENTS								ELASTICITIES	
	Intercept	ln(GNPPC)	WFAGE	PRIM	J-K	HK-S	Adj. R-Squared	F-Statistic	Sample Avg.	Indonesia 85
AGRI										
A	-0.35033	0.06101 *					0.526	25.38	0.89	5.04
(t-Value)		5.04								
B	-0.40475	0.02969 * *	0.02254 *				0.703	26.99	0.43	2.45
(t-Value)		2.31	3.67							
C	-0.23957	0.04085 *			0.106 *		0.861	69.19	0.60	3.38
(t-Value)		5.73			7.19					
D	-0.25954	0.02913 *	0.00817	0.00796	0.09922 *	0.01242	0.863	28.83	0.42	2.41
(t-Value)		2.75	1.50	0.44	3.92	0.55				
MANU										
A	-0.79558	0.14832 *					0.394	15.32	0.67	1.57
(t-Value)		3.91								
B	-0.93192	0.06986	0.05646 * *				0.528	13.32	0.31	0.74
(t-Value)		1.56	2.64							
C	-0.46943	0.08896 *			0.31214 *		0.77	37.86	0.40	0.94
(t-Value)		3.50			5.95					
D	-0.24455	0.04538	0.00166	0.0136	0.38948 *	0.12264	0.765	15.34	0.20	0.48
(t-Value)		1.18	0.08	0.21	4.24	1.48				
TRDE										
A	-0.9464	0.17675 *					0.53	25.85	0.66	2.53
(t-Value)		5.08								
B	-1.13359	0.06902 * *	0.07752 *				0.792	42.94	0.26	0.99
(t-Value)		2.23	5.24							
C	-0.66012	0.12465 *			0.27399 *		0.795	43.72	0.47	1.78
(t-Value)		4.99			5.31					
D	-0.68387	0.05388	0.04213 *	-0.0167	0.23645 *	0.07173	0.867	29.78	0.20	0.77
(t-Value)		1.79	2.72	0.32	3.29	1.11				
SRVC & UTLS										
A	-0.6191	0.15529 *					0.48	21.32	0.35	0.37
(t-Value)		4.62								
B	-0.71854	0.09807 * *	0.04118 * *				0.549	14.41	0.22	0.23
(t-Value)		2.34	2.06							
C	-0.35268	0.1068 *			0.25498 *		0.75	33.93	0.24	0.25
(t-Value)		4.21			4.86					
D	-0.32358	0.09656 * *	0.00164	0.03336	0.27946 *	0.03632	0.711	11.83	0.22	0.23
(t-Value)		2.37	0.08	0.48	2.86	0.41				
OTHER										
A	-0.7233	0.13921 *					0.389	14.98	0.60	1.28
(t-Value)		3.87								
B	-0.86677	0.05665	0.05942 *				0.562	15.10	0.24	0.52
(t-Value)		1.39	3.05							
C	-0.43561	0.08686 *			0.27534 *		0.712	28.21	0.37	0.80
(t-Value)		3.24			4.96					
D	-0.22761	0.0236	0.01347	0.0343	0.3511 *	0.1516 * * *	0.74	13.50	0.10	0.22
(t-Value)		0.62	0.69	0.52	3.84	1.84				

Significance Levels of Beta Coefficients Indicated by * for .01, ** for .05 and *** for .10

negatively associated with below primary attainment as expected. (When the lower bound for measuring the labor force is low, i.e. ten years, it is more likely that a larger proportion of workers in the sector have not finished primary schooling.) The relationship is statistically significant in only four of the eight regressions, however. As indicated by the adjusted R-squared and the joint F-statistic, the explanatory power of models C and D was best.

Regression results for the simple primary coefficients are presented in Table 4. In general a quadratic relationship between GNPPC and the proportion of the labor force with highest attainment at primary level was supported. With one exception, signs for the Beta coefficients associated with GNPPC were positive and negative for those associated with GNPPC squared. Significance levels were not high, however. The estimated coefficient associated with the WFAGE variable was positive, as expected, in half of the equations, and significantly so at the five percent level only in one. As for the structural variables, estimated coefficients indicated that Japan and Korea tend to have significantly higher proportions of their labor force with highest attainment at the primary level (after controlling for GNPPC) in the agriculture, manufacturing and trade sectors. Hong-Kong and Singapore had significantly higher levels in manufacturing, trade, and the service & utilities sector. The explanatory power of the equations was poor particularly for the SRV&UTLS and OTHER sectors where none of the joint F-tests for the regressions was significant.

This is not true for the secondary attainment level. As shown in Table 5 the adjusted R-square for all models is above .7 and F-statistics are uniformly high. The estimated coefficient for the natural log of GNPPC is positive and significant at the one percent level in all regressions. The coefficient associated with WFAGE is also positive in all regressions and significant at the one percent level in seven of the ten regressions. The structural variables do not appear to be important; few of the coefficients are significant and signs are inconsistent. One reason for these differences is that Korea

tends to be an outlier case and the Korean observations had to be eliminated from the data set used in these estimations. As previously mentioned, the most advanced attainment level in the Korean census data was junior college and above. Thus it was impossible to discriminate, for the population having completed secondary education, the proportion having completed less than university level from those with university level attainment or higher.

The Korean data were also eliminated from the regressions for the university attainment level reported in Table 6. For these regressions, the adjusted R-squared and F-statistics are also uniformly high. The estimated coefficient for **ln(GNPPC)** is positive and significant at the one percent level with one exception where it is significant at the five percent level. However, in these regressions the coefficient associated with the labor force age control variable (**WFAGE**) has the wrong sign in three cases and in the agriculture sector regressions it is significantly negative in both cases. The absolute value of the effect is small. As for the structural variables, the results suggest that the proportion of the labor force with educational attainment at the university level or higher is significantly higher in the Japanese manufacturing sector (**MANU**) and significantly lower (at the five percent level or better) in the **SRV&UTLS** and **OTHER** sectors of Hong-Kong and Singapore.

C. Elasticity Estimates

Tables 3-7 also show elasticities that were estimated for the sample average and the Indonesian situation in 1985. Specifically the elasticities for the ith sector $(i=1,\ldots,5)$ for the kth educational category $(k=N,P,S,U,S^c)$ were computed as follows:

$$(6) \qquad (\text{Elas-GNPPC})_{iN} = -\hat{\beta}_{iN}/(\text{GNPPC}*L_{iN}/L_i)$$

$$(7) \qquad (\text{Elas-GNPPC})_{iP} = (\hat{\beta}^a_{iP} + 2\hat{\beta}^b_{iP}*\text{GNPPC})*(\text{GNPPC}/(L_{iP}/L_i))$$

(8) $$(\text{Elas-GNPPC})_{ik} = \hat{\beta}_{ik}/(L_{ik}/L_i) \qquad (k=S,U,S^c)$$

where $\hat{\beta}_{ik}$ is the relevant beta coefficient estimated by regression. For the primary level regressions there are two beta coefficients for each sector; $\hat{\beta}^a_{iP}$ associated with GNPPC and $\hat{\beta}^b_{iP}$ associated with GNPPC-squared. To calculate sample average elasticities, the mean level of GNPPC and/or the average industry-education coefficients ($1/n\sum L_{ik}/L_i$) for all the cases included in the regression are used (n=23 except in the secondary and university regressions where the Korean data is excluded). As for the elasticities calculated specifically for Indonesia, it is the level of GNPPC and/or the L_{ik}/L_i from the 1985 Indonesian data series that are used.

In general, the elasticities for Indonesia are higher in absolute value than those for the sample average. For the below primary attainment level, this reflects Indonesia's low level of GNPPC relative to the sample average. For the secondary and university attainment levels, it is because Indonesia tends to have lower levels of educational attainment relative to the sample average. This pattern does not hold, for the service and utilities (SRV&UTLS) sector, however. For that sector, the proportion of the Indonesian labor force with educational attainment at the secondary and university level nearly equals the sample average. Thus the Indonesian elasticities approximate those of the sample average. (That is true even though GNPPC, at the sample average, is 3.7 times larger than the 1985 Indonesian level, indicates an unusually advanced educational structure in the Indonesian public service.)

With regards to the different model types, the absolute value of the elasticities tends to be highest in model A, where only GNPPC is included, and lowest for model, D, which includes all of the structural and control variables as well as GNPPC. Elasticities for all sectors tend to be lowest at the primary educational attainment level.

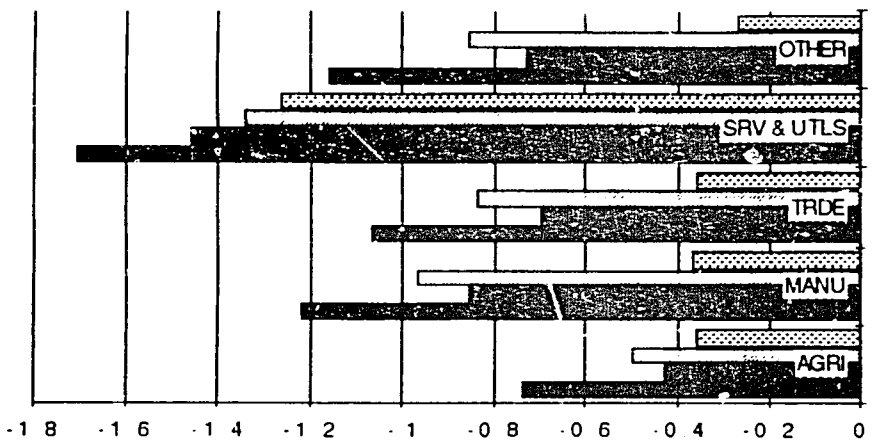
However, the regressions for the primary level accounted for a small proportion of the variation in the observations, and in eleven of the 20 regressions the model was not statistically significant.

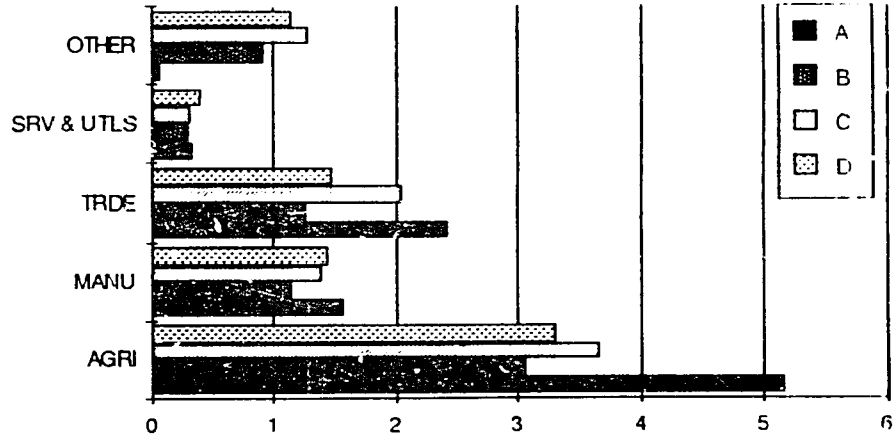
The sectoral differences in elasticities are evident as seen in Figure 1 where the Indonesian elasticities are graphed. The patterns are clearest at the secondary and university level where elasticities are lowest in the **SRV&UTLS** sector and the **OTHER** sector and highest in **AGRI**, **TRDE** and **MANU**. Interpretation of these elasticities should be made cautiously, however.

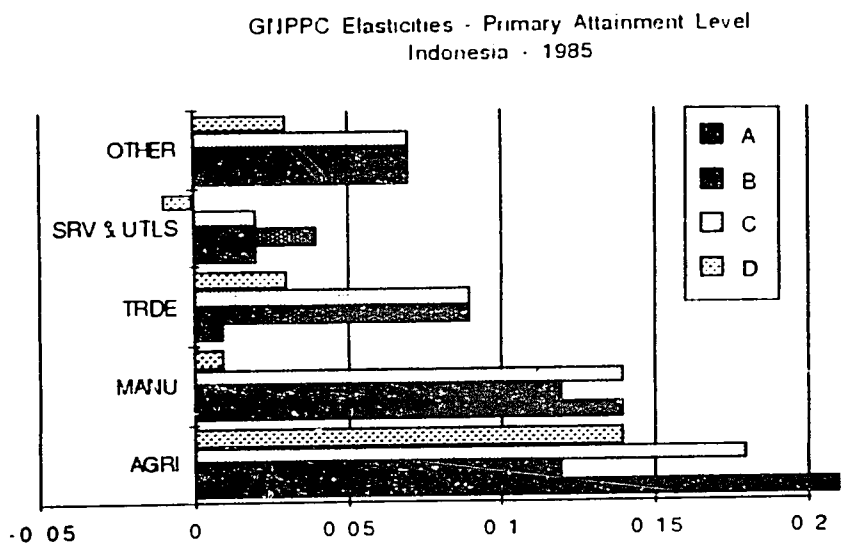
For example, the relatively high elasticity for the university attainment level in the **AGRI** sector (which averages about 5) does not necessarily indicate that a proportionately large growth in requirements for university graduates will come from that sector. First, the elasticity is high, in part, because such a low proportion of the labor force in agriculture has university attainment level. In Indonesia this proportion was less than 1/20 of a percent (.000495). Thus, given a ten percent increase in **GNPPC**, the proportion of the agricultural labor force with university education could be expected to rise by only 1/40 of a percent. However, in **SRV&UTLS** sector, where the university attainment elasticities average closer to .5, the same ten percent increase in **GNPPC** would increase the proportion of the of the labor force with a university education from .074 to .078 or 2/5 of a percent. Changes in the requirement for university educated workers also depend on the level of employment and on the rate of growth of the labor force in the different sectors. These factors are not accounted for in these elasticities.

In order to put the elasticity estimates in perspective, Table 8, presents some comparisons with elasticities from previous studies. Direct comparisons cannot be made because of numerous differences in the studies. For example, except for the services sector, the previous studies estimated the elasticities with respect to sectoral labor productivitiy, not **GNPPC**. The Layard and Saigal study also uses a different type of

Figure 1. Elasticities by Sector - Four Attainment Levels







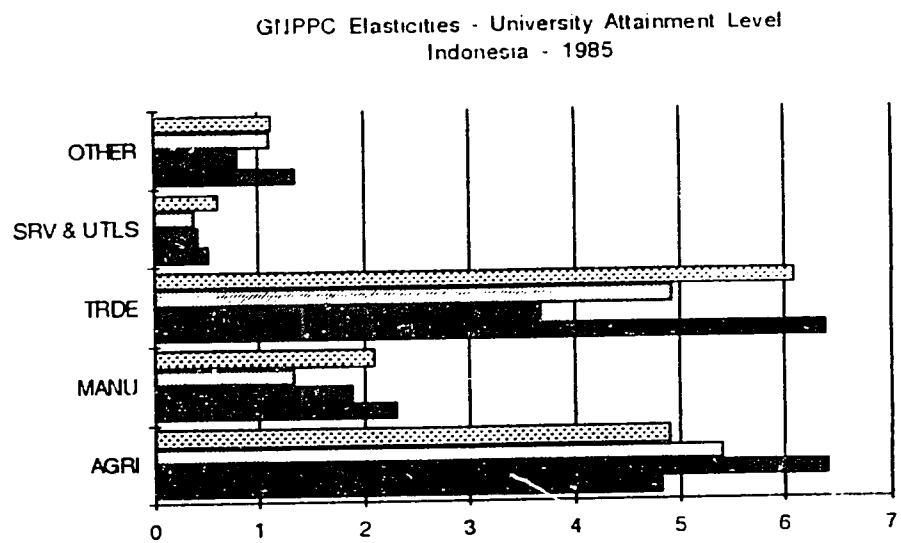


Table 8. Elasticities from International Comparison Studies

	Agriculture	Manufacturing	Trade	Services
University Level or Above				
Layard and Saigal				
OECD		0.63 (.56,.23)	0.21 (.20,.28)	0.23 c (.40,.13)
Table 6 (A)	1.17 c (.64, *)	1.04 c (.642, *)	0.84 c (.58,*)	0.58 c,e (.70,*)
Secondary and Above				
Layard and Saigal	0.99 (.35,.45)	1.02 b (.26,.57)	0.71 (.19,.49)	0.97 c,d (.63,.25)
OECD		0.9 (.61,.36)	0.61 (.45,.40)	0.41 c (.56,.18)
Table 7 (A)	0.89 c (.53,*)	0.67 c (.39,*)	0.66 c (.53,*)	0.35 c,e (.48,*)
Primary and Above				
Layard and Saigal	0.83 (.32,.38)	0.68 b (.19,.45)	1.09 (.54,.32)	1.03 c,d (.80,.16)
OECD		0.81 a (.84,.19)	0.85 a (.81,.22)	0.29 a,c (.68,.11)
Table 3 (A)	0.32 c (.50,*)	0.26 c (.64,*)	0.24 c (.63,*)	0.14 c,e (.60,*)

NOTES:

a - Eight years or above
b - Manufacturing and utilities
c - Elasticity with respect to GNPPC
d - Elasticty of Lik/L
e - Services, finance and utiltiies

coefficient for the services sector (L_{ik}/L where L is the total labor force.) Both previous studies used a double-log functional form in all the estimations. However, with these caveats expressed, there are some similarities. All the studies tend to show that at the secondary and above and university levels, elasticities are higher for agriculture and manufacturing than for trade and services. With two exceptions (one of which is an elasticity for L_{ik}/L from the Layard and Saigal study), the elasticities in the services sector are lower than those of the other sectors.

C. Suggestions for Further Refinements

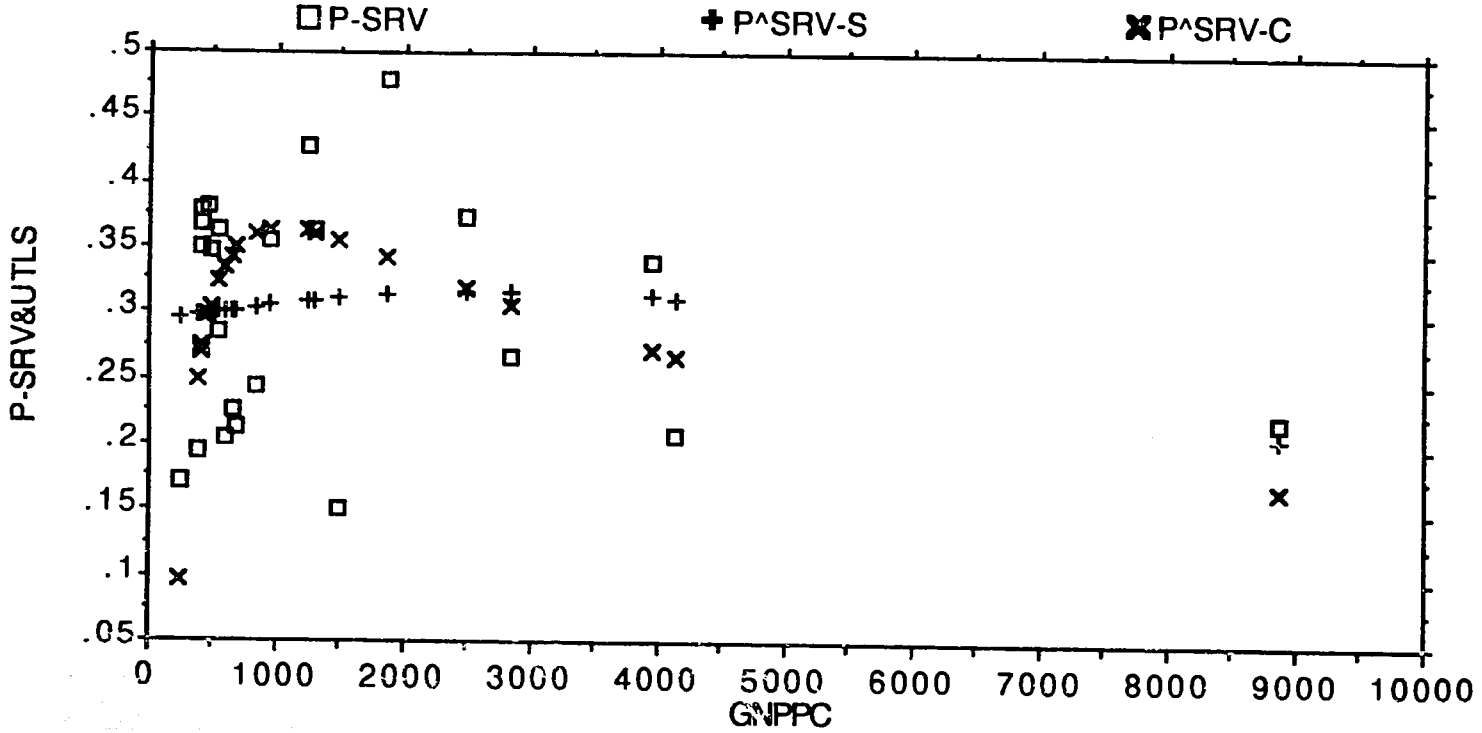
Because of the poor explanatory performance of the primary attainment level regressions in this study, an alternative approach was explored for predicting the pattern of change in primary attainment. Using the coefficients estimated from the regressions for below primary attainment, N, and those for the cumulative coefficients for secondary and above, S^c, the proportion of the labor force with primary education can be estimated by the following formula

$$(9) \qquad \hat{L}_{iP}/L_i = 1.0 - \hat{L}_{iN}/L_i - \hat{L}_{iS}{}^{c}/L_i$$

In Figure 2, the values predicted by this method (designated by the symbol x), are compared to predicted values from one of the previously discussed models (+).

The squares (labeled P-SRV) plot the actually observed values for the proportion of the labor force with highest attainment at the primary level in the **SRVC&UTLS** sector. The + symbol (labeled P^SRV-S) is used to plot the predicted proportions of the labor force as estimated from coefficients for model A reported in Table 4. The x symbol (labeled P^SRV-C) plots the predicted values from eq. 9 based on estimated coefficients for below primary from model A in Table 3 and estimated cumulative coefficients for secondary and above from model A in Table 7. Although the

Figure 2. Estimated and Obseved Values for P-SRV&UTLS



shape of the curve for the x values appears more appropriate than the quadratic curve defined by the + values, the mean absolute deviation of the predicted values from the actual values is lowest for the + values . (Similar comparisons were made for the four other sectors and in three of those cases the opposite result held, i.e. mean absolute deviations were lower for the x values estimated using the indirect prediction method.)

This analysis suggests that improvements in the prediction of coefficients for the primary level of attainment can be made by using the indirect method (either eq. 9 or a similar equation using regression results for the simple coefficients for below primary, secondary and university attainment levels). One way of viewing this approach is that it takes the primary attainment level as the residual in an estimation procedure which constrains the sum of predicted values (over the four attainment levels) to equal one. If for planning purposes this is undesirable, better results in predicting the simple primary coefficients might also be achieved by using a different functional form (i.e. a non-quadratic form) to model the relationship between GNPPC and the simple primary attainment coefficients. (The function defined by eq. 9 includes both the inverse and natural log of GNPPC.)

III. SUMMARY AND CONCLUSIONS

This report describes a new data set on the educational attainment of the labor force in Pacific Rim countries and suggests a framework for predicting patterns of change in the industry-education coefficients across time and across countries. A structural change approach was taken. Thus, all the countries in the sample were assumed to be involved in a similar process of structural transformation with predictable repercussions for the educational attainment of the labor force.

Several alternative models are proposed to quantify the relationship between the industry-education coefficients and the stage in the structural transformation. The level of GNP per capita was used as a proxy for position in the structural change continuum and control variables for type of economic specialization and for differing definitions of the labor force were used. Statistical analysis provided estimates of parameters that can be used to predict the proportion of the labor force with one of four educational attainment levels (below primary, primary, secondary and university) based on estimates of GNP per capita. Manpower requirements by level of education can then be generated from estimated levels of employment by sector.

Thus, the material in this report provides only a partial framework for manpower requirements planning. Further work in the development of macroeconomic, or structural transformation models, which can predict changes in GNP levels and in sectoral employment levels in Indonesia is necessary to complete a workable planning system appropriate to the expressed needs of planners within the Ministry of Education.

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APPENDIX A

Industry-Education Coefficients

LEGEND:

○ HK - Hong Kong

□ I - Indonesia

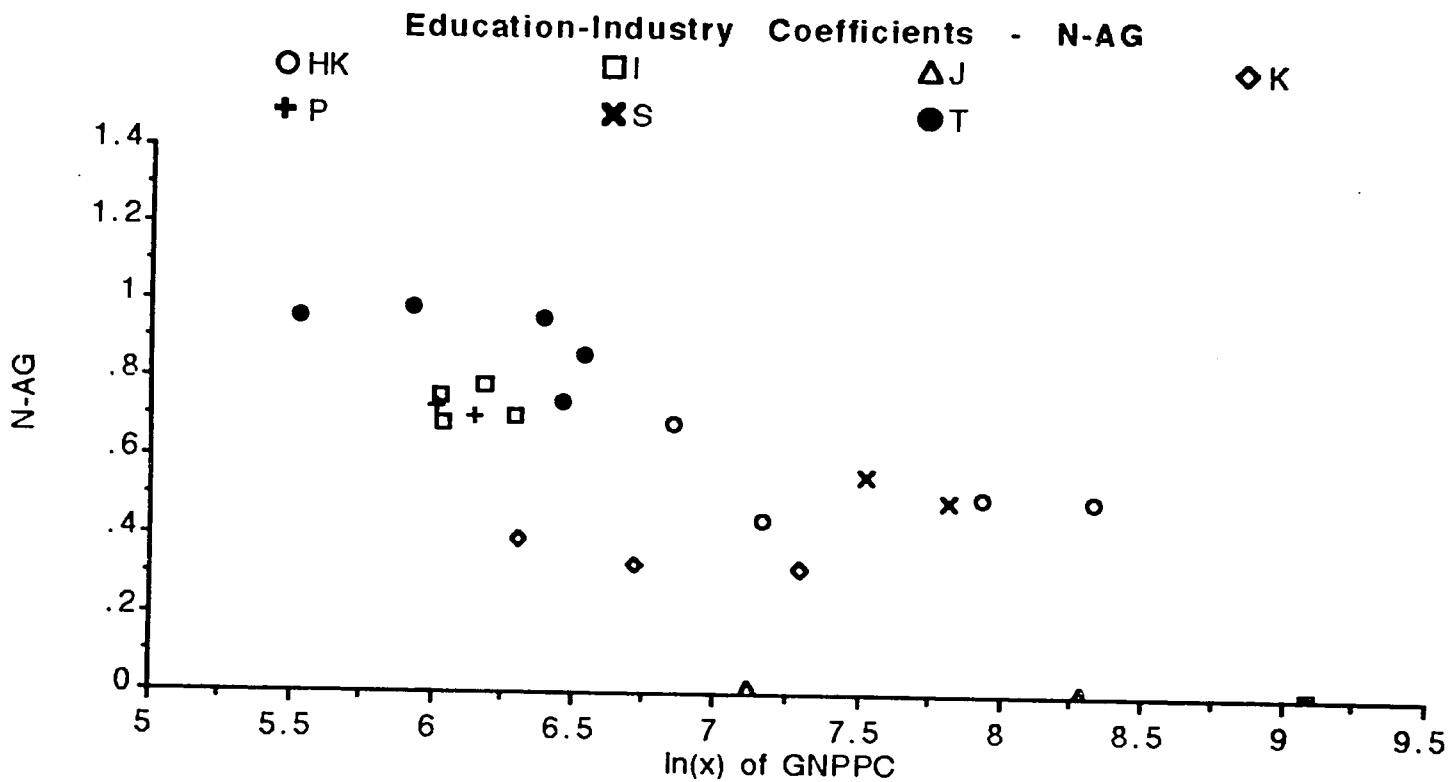
△ J - Japan

◇ K - Korea

✚ P - Philippines

✖ S - Singapore

● T - Thailand


Education-Industry Coefficients - N-AG
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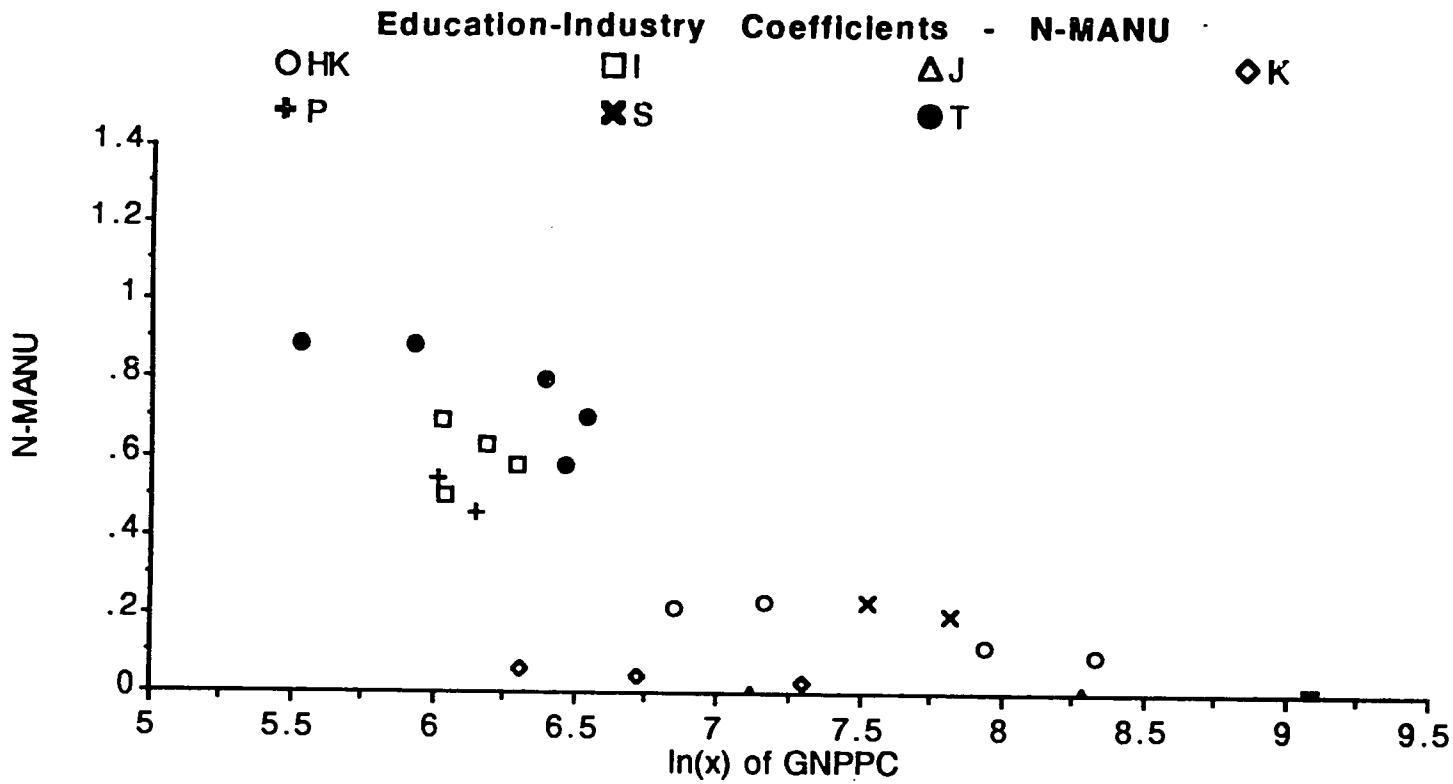
ln(x) of GNPPC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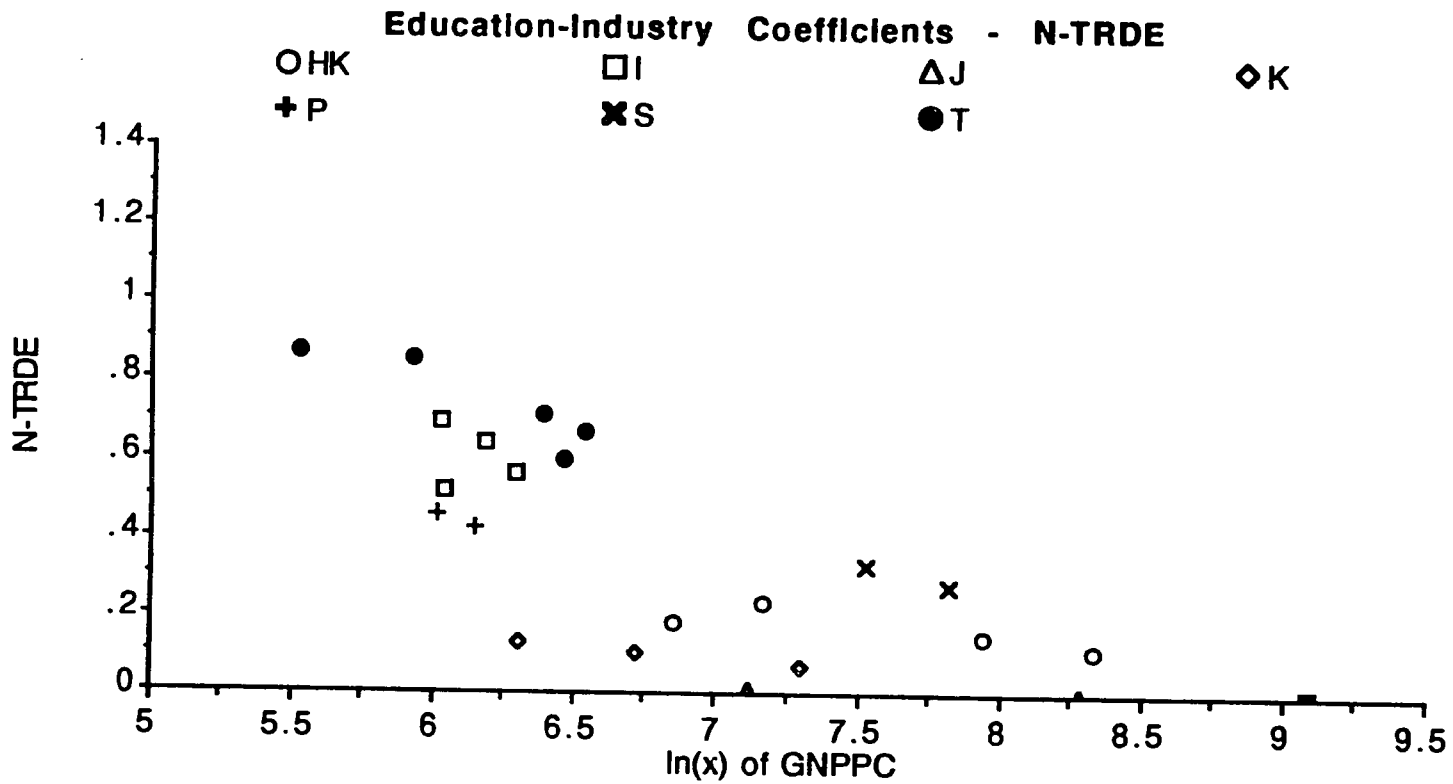
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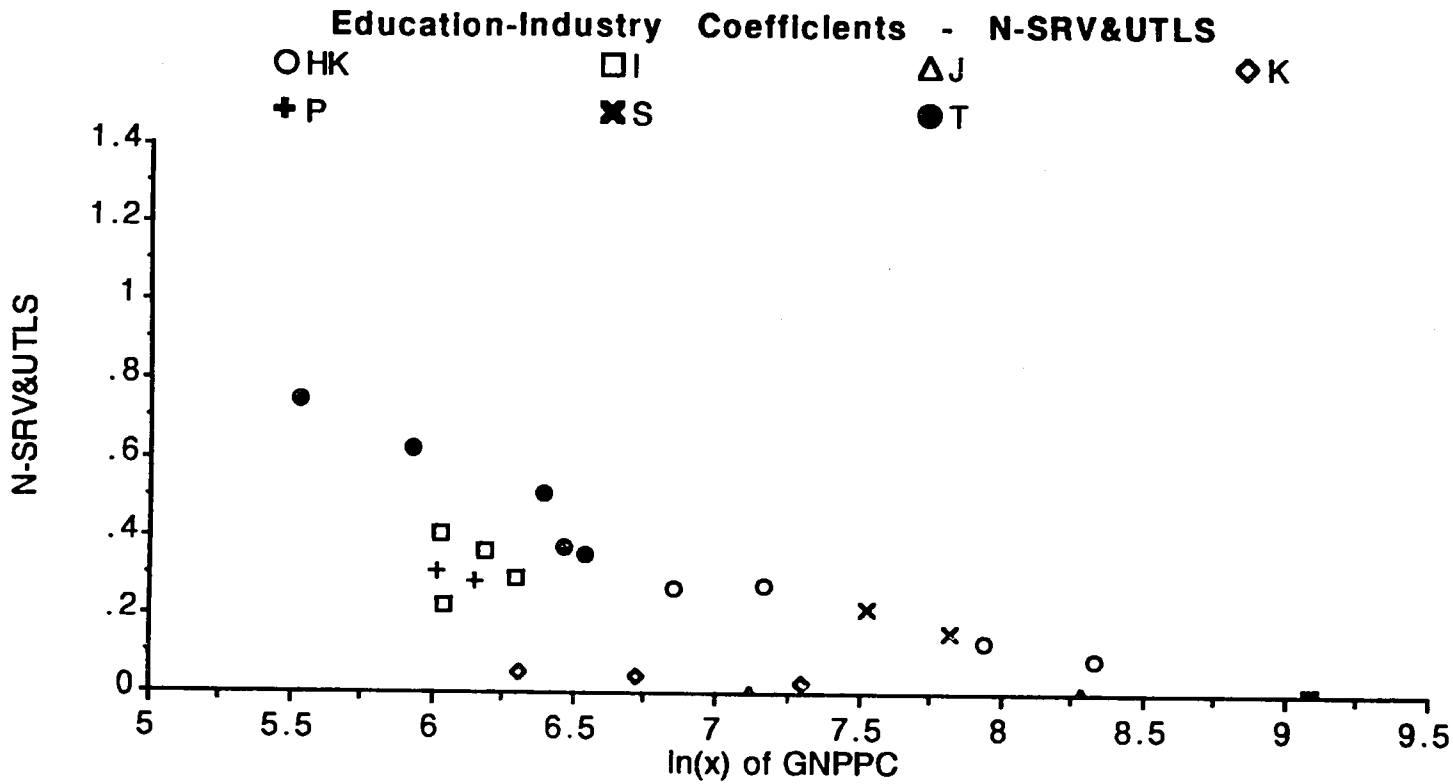
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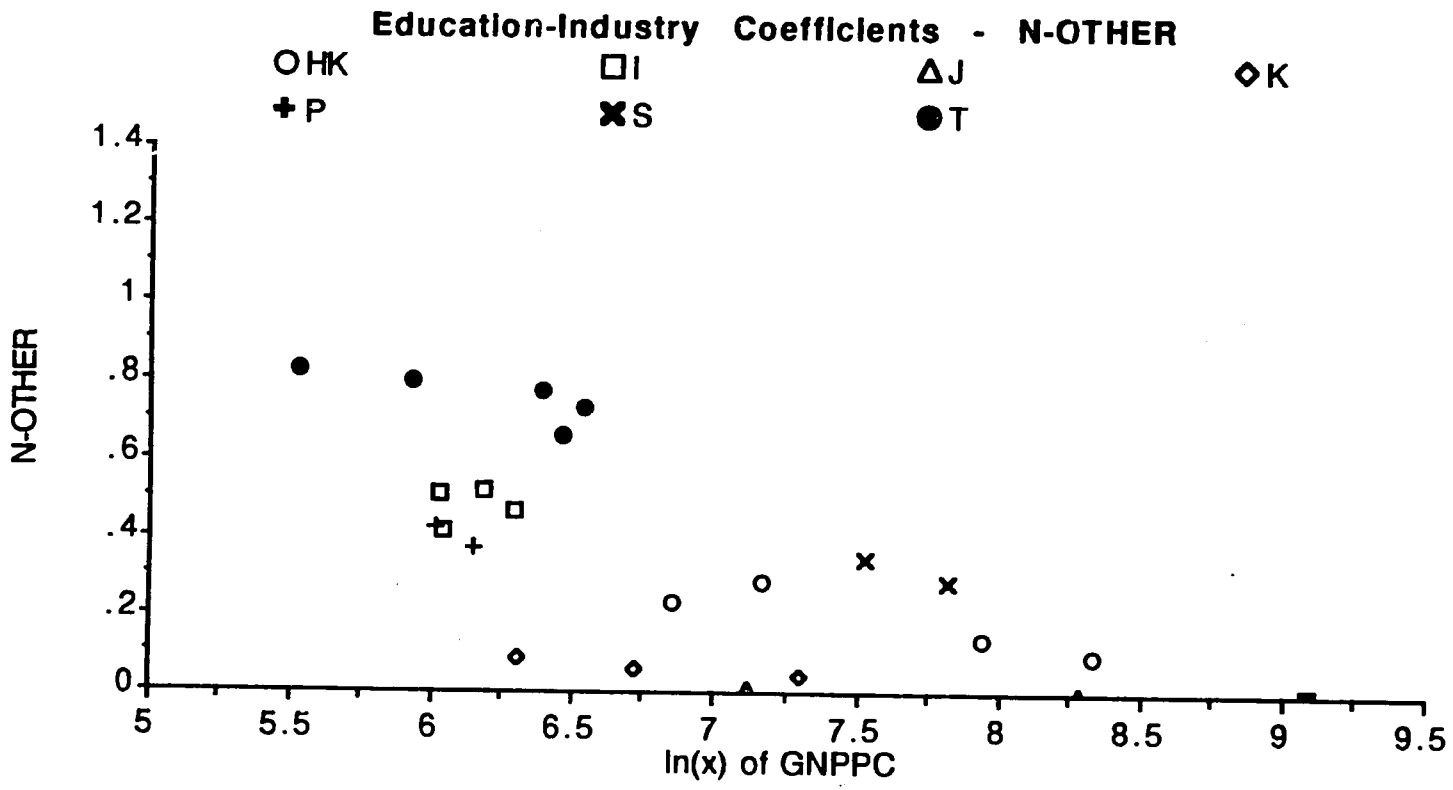
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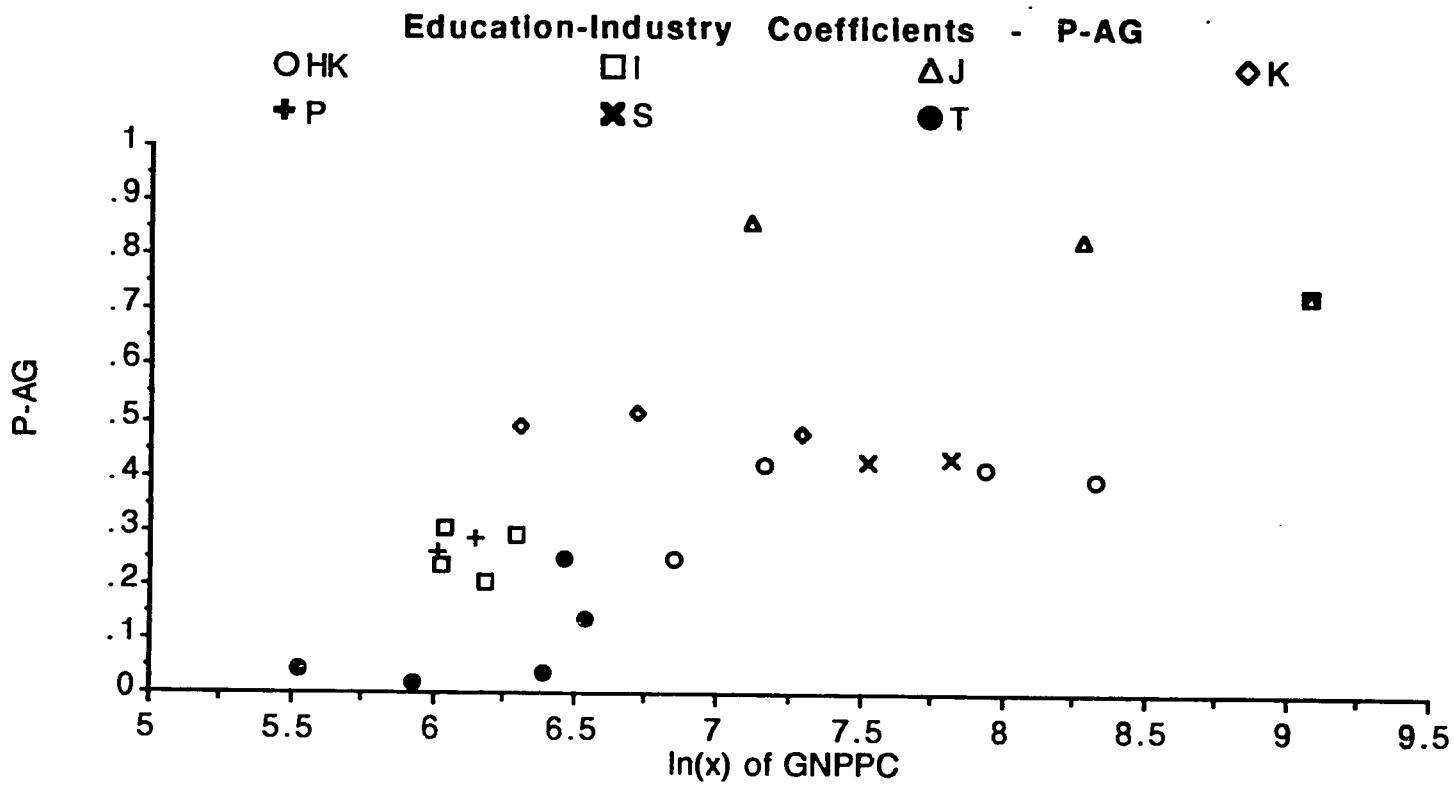
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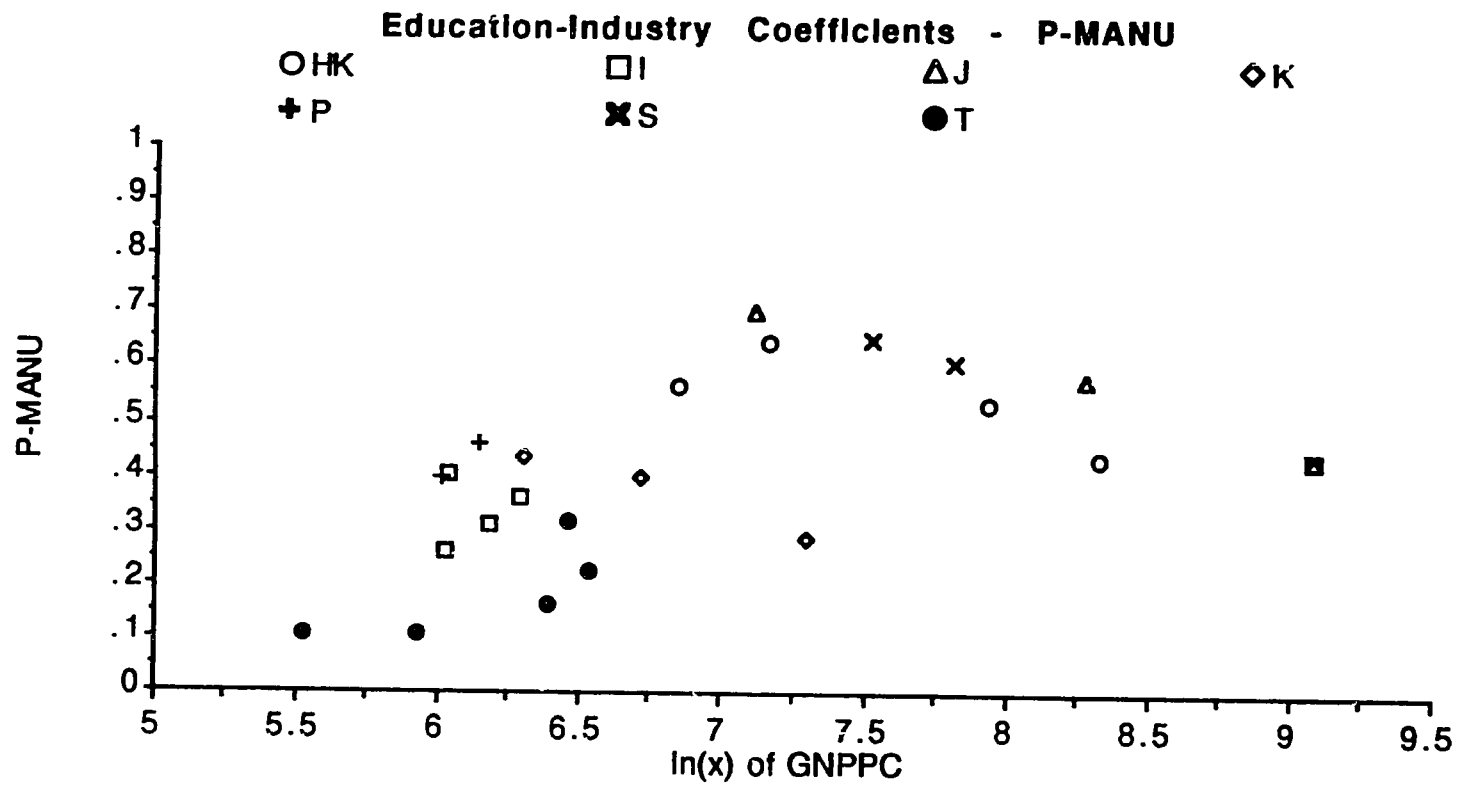
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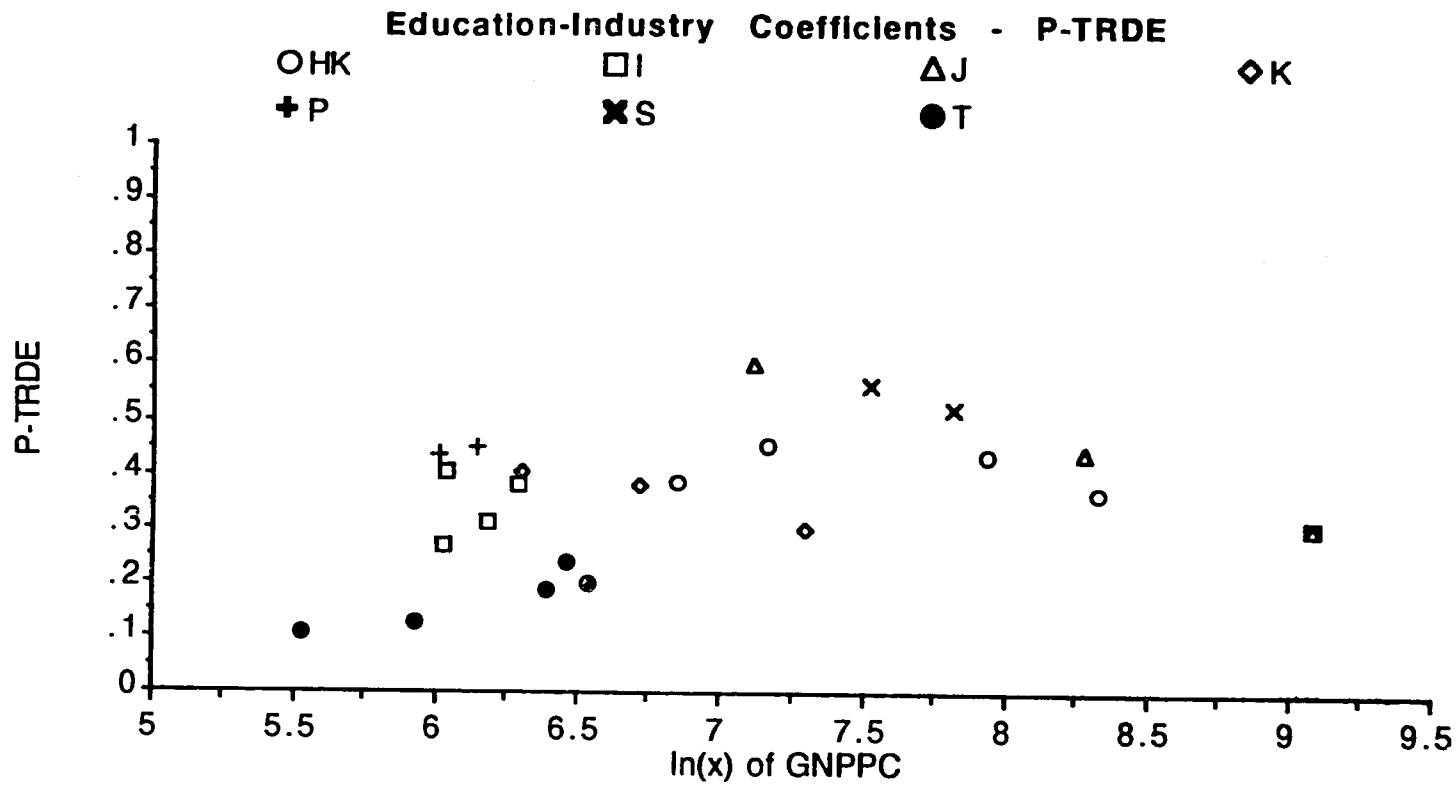
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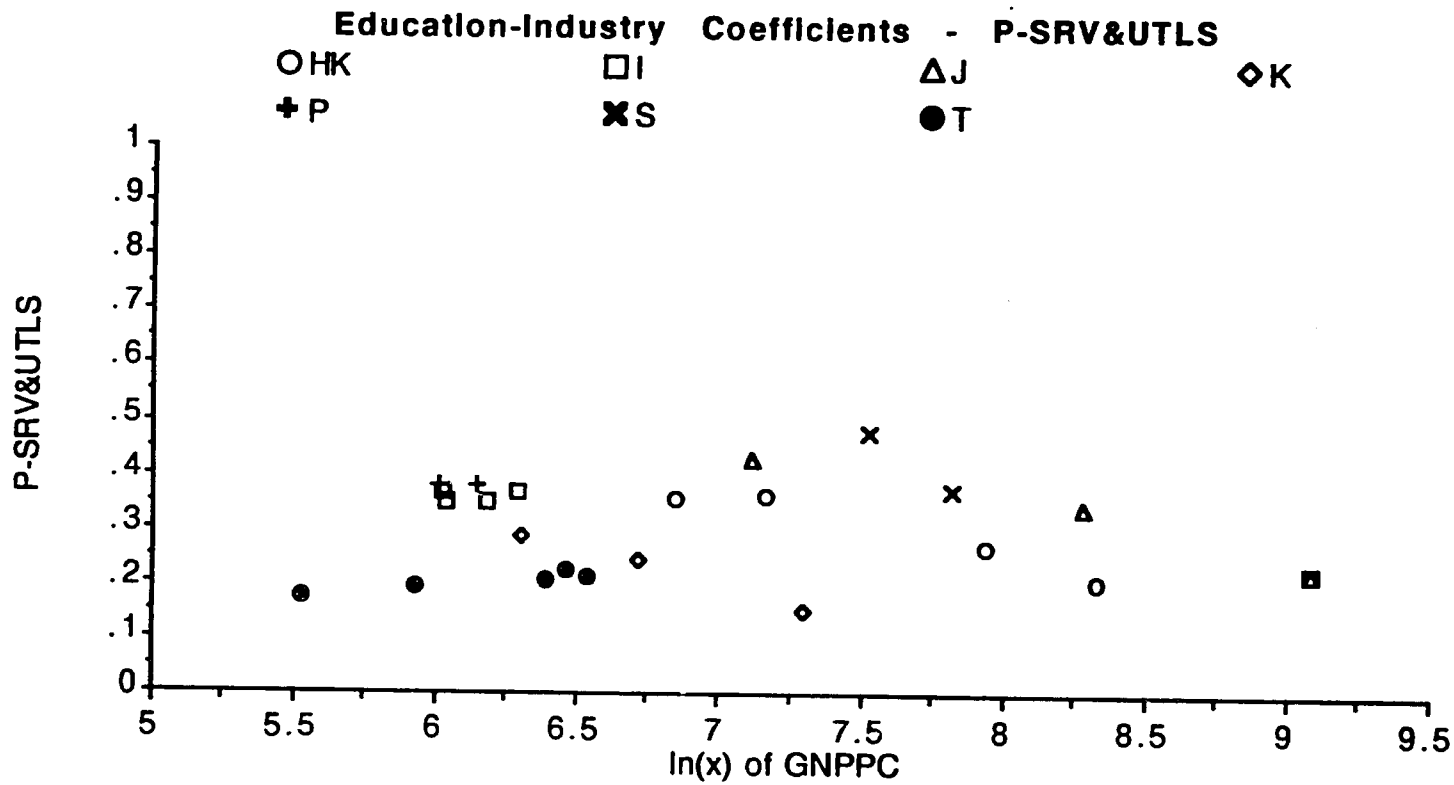
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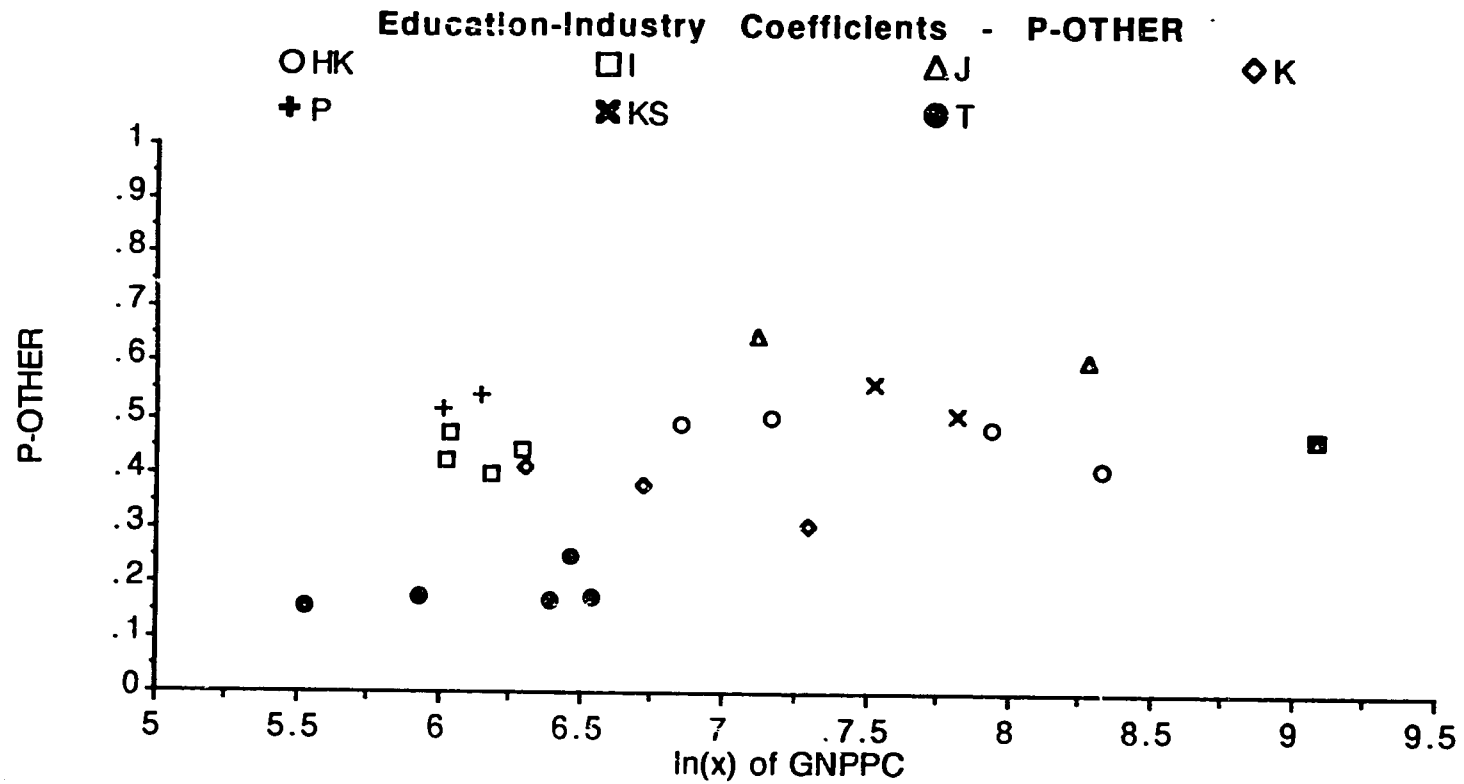
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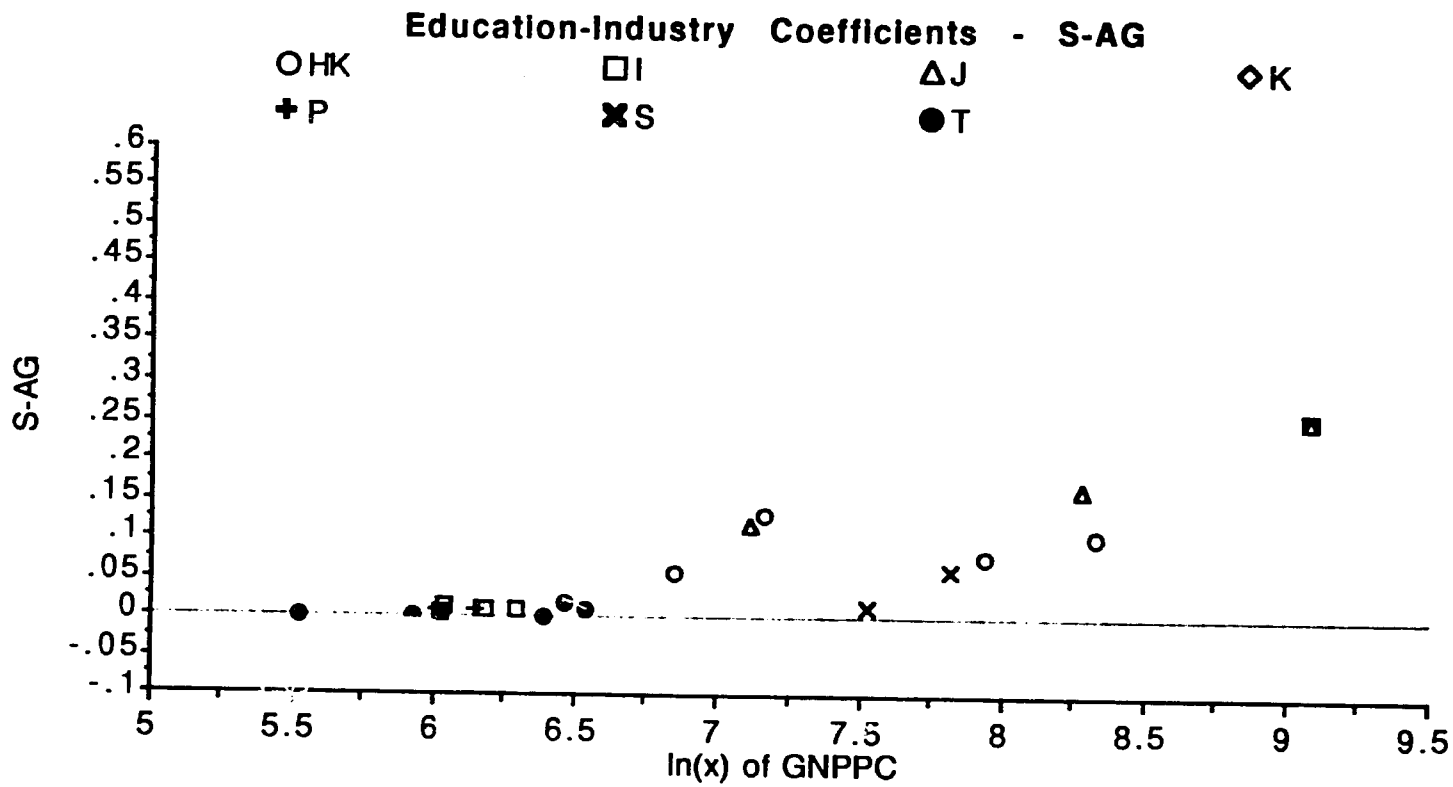
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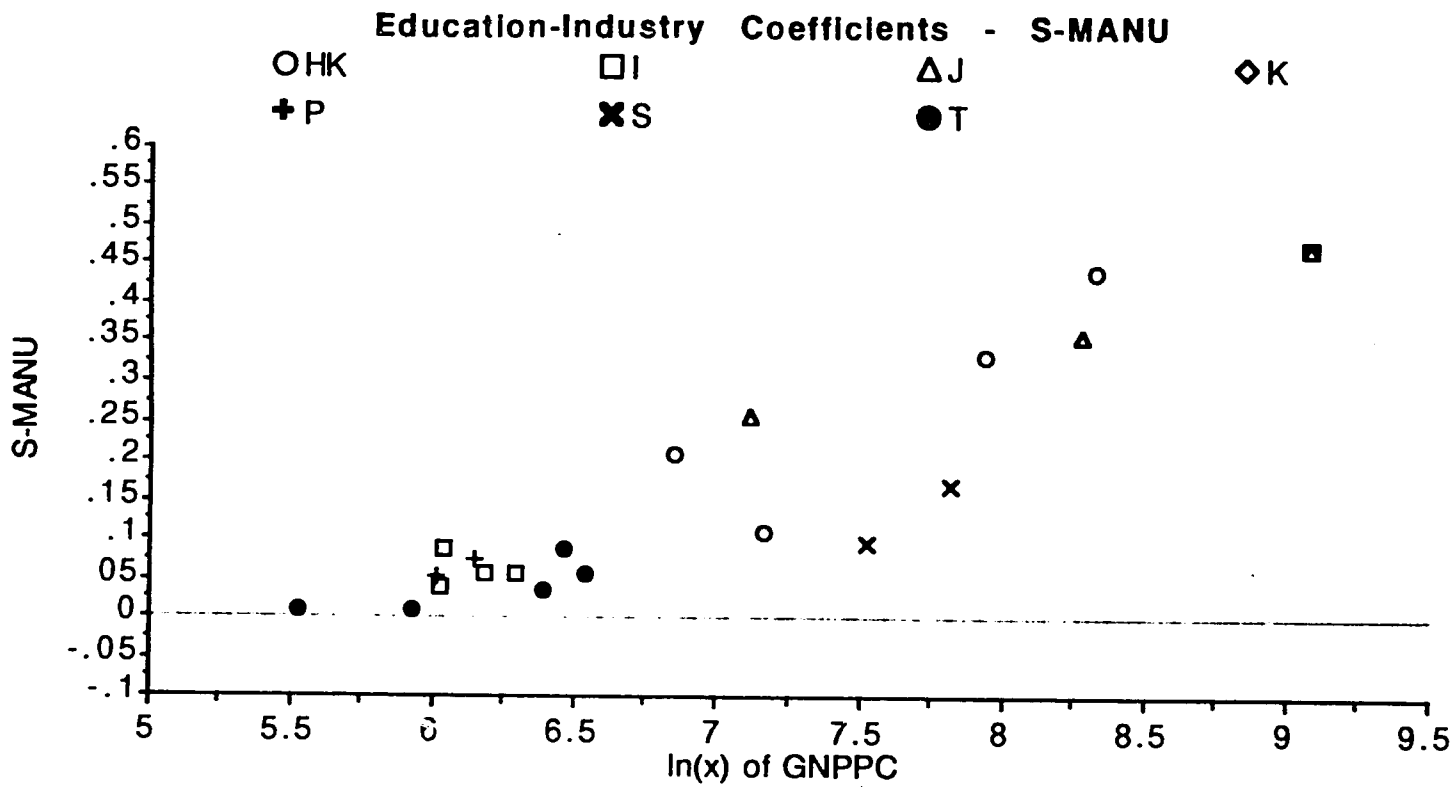
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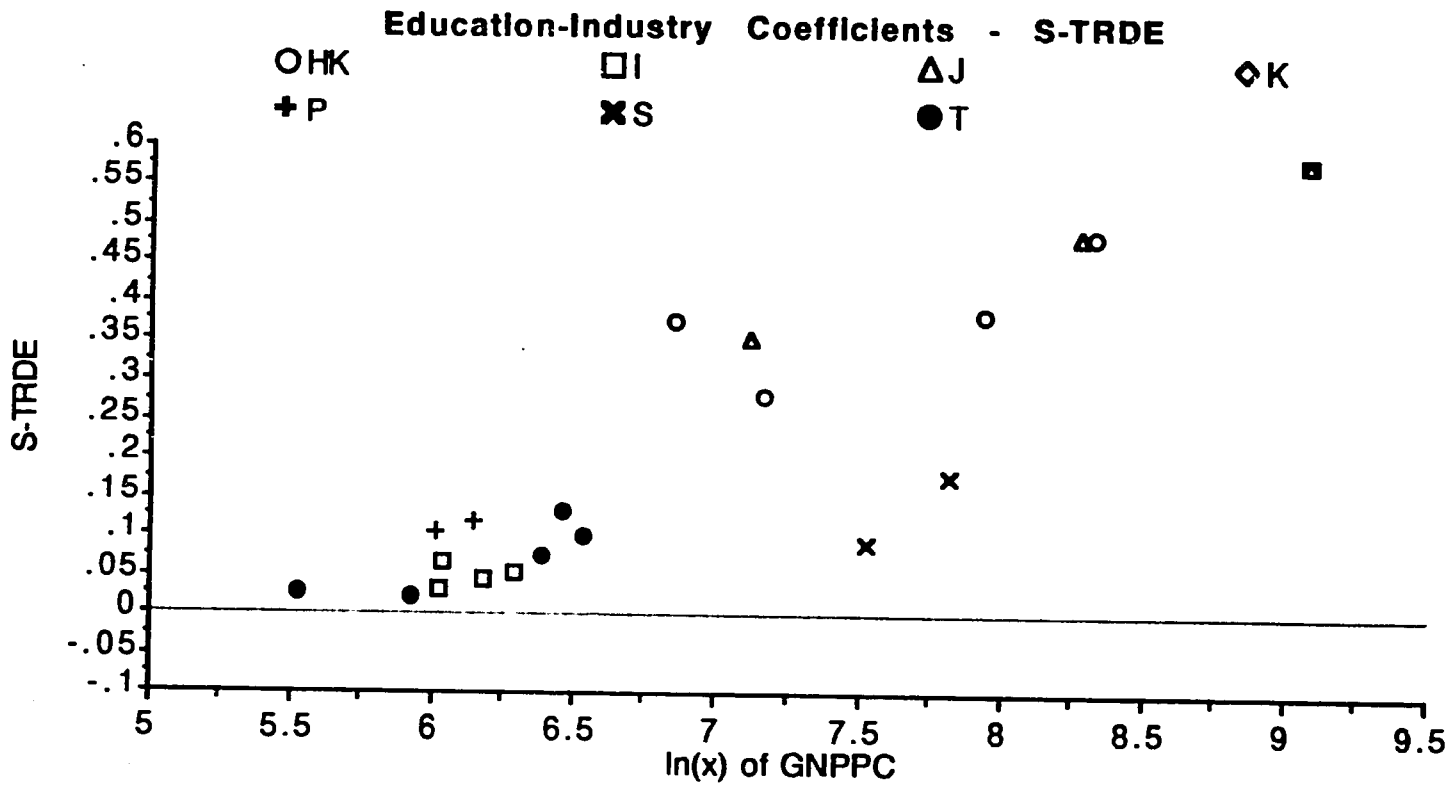
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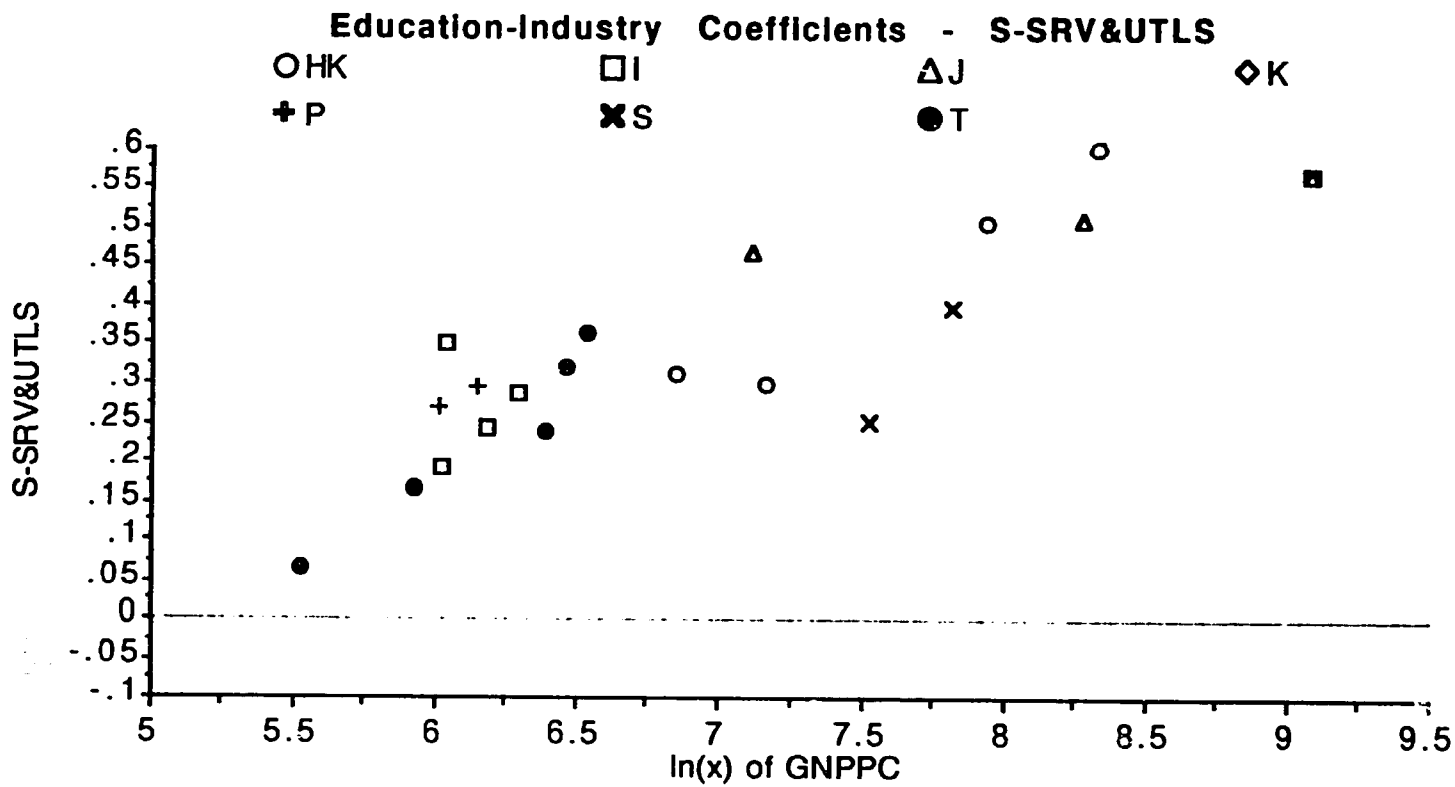
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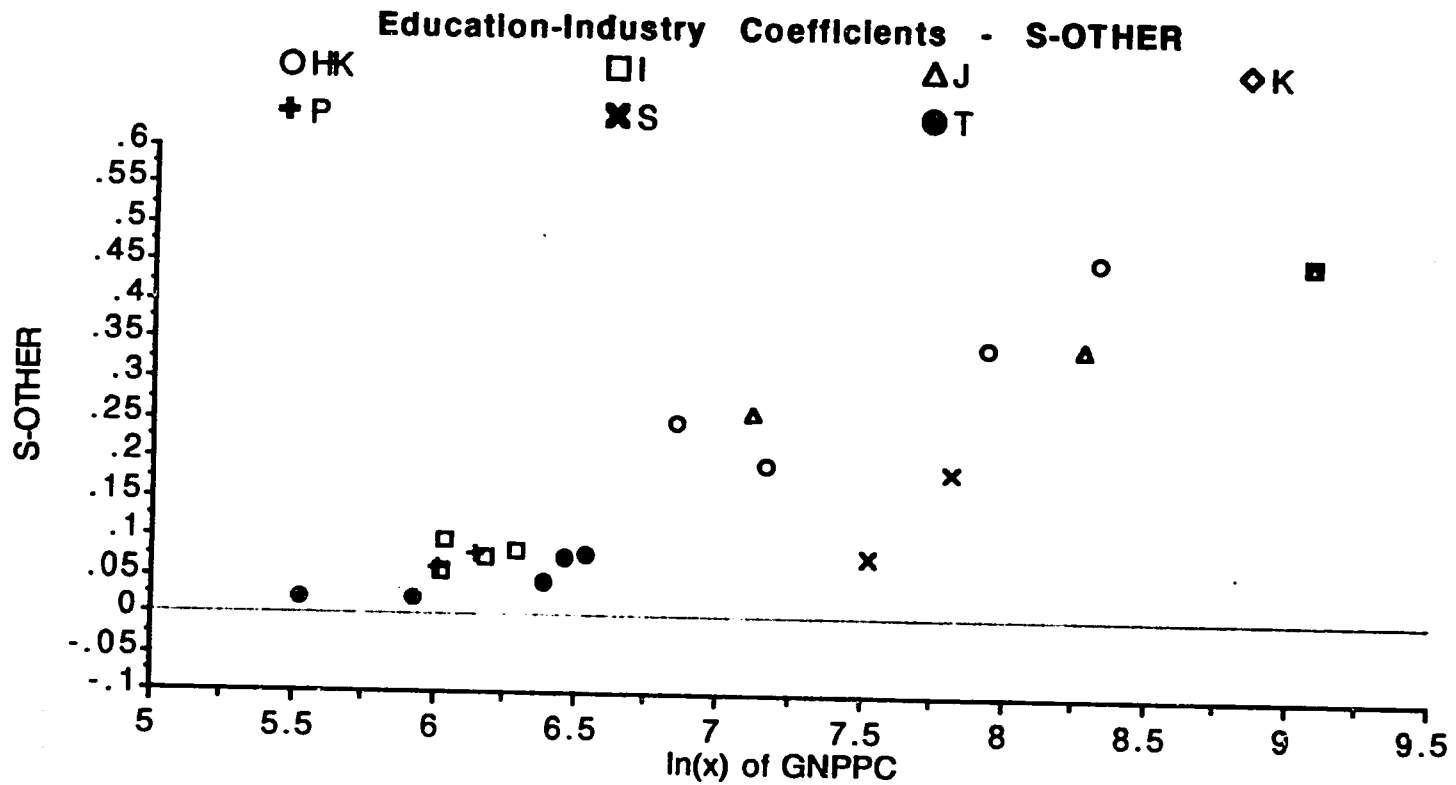
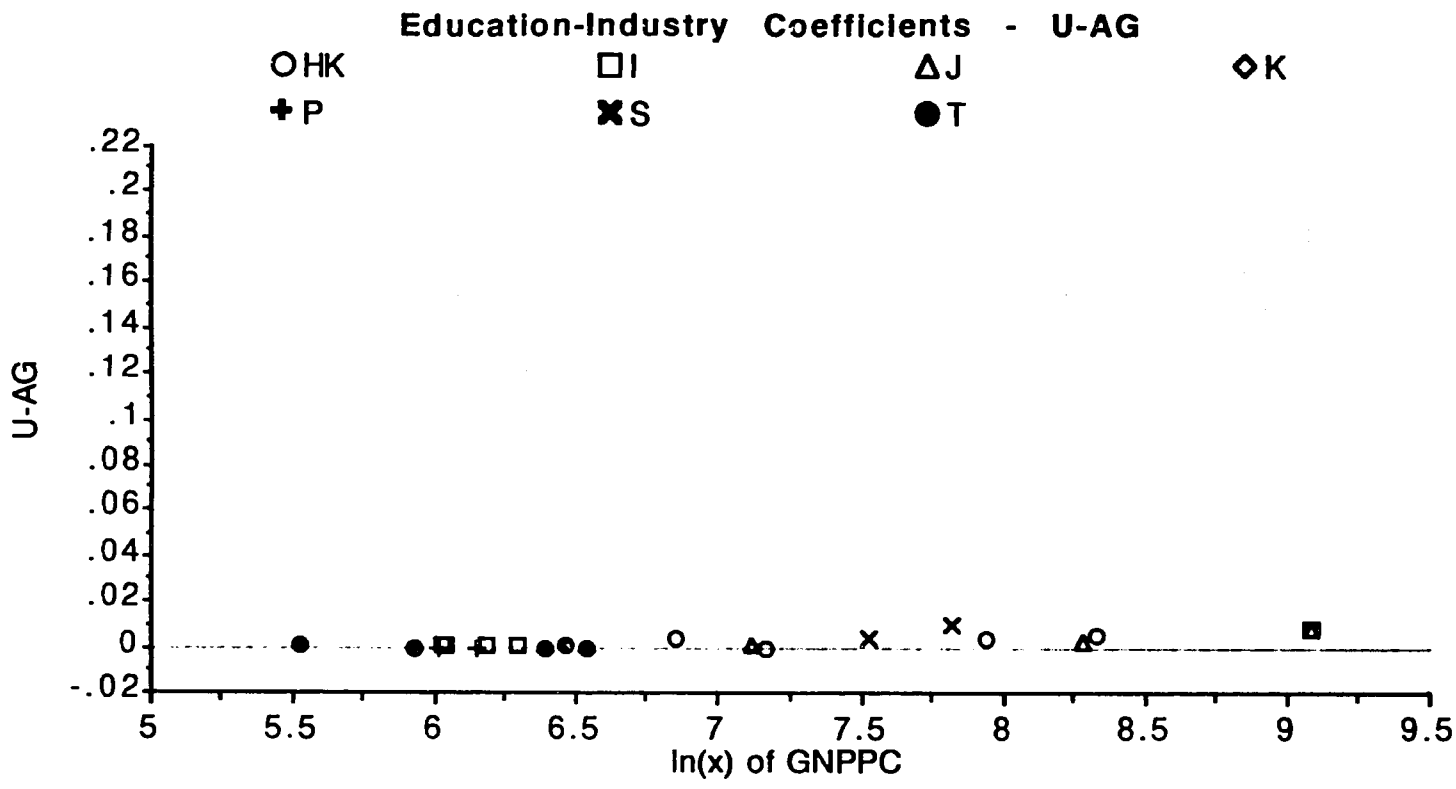
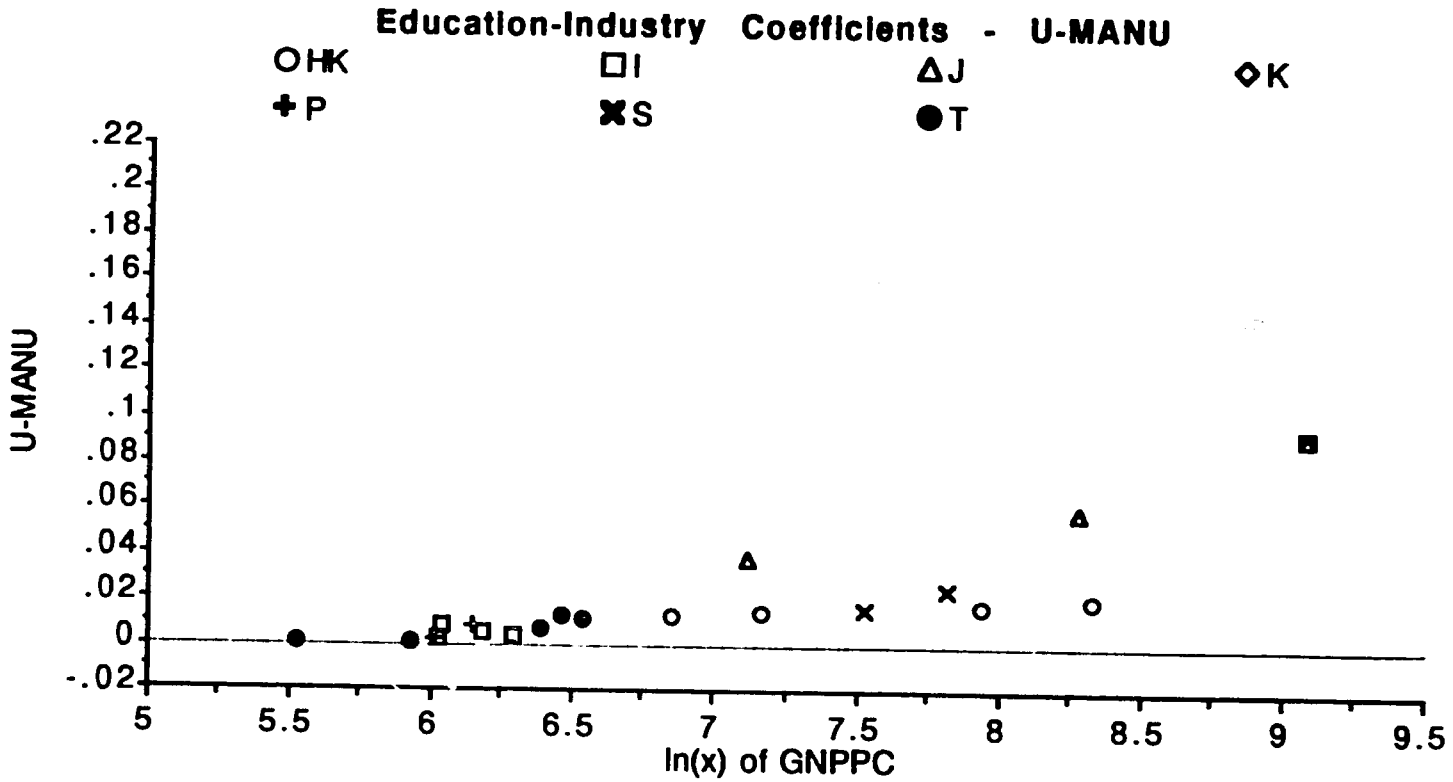
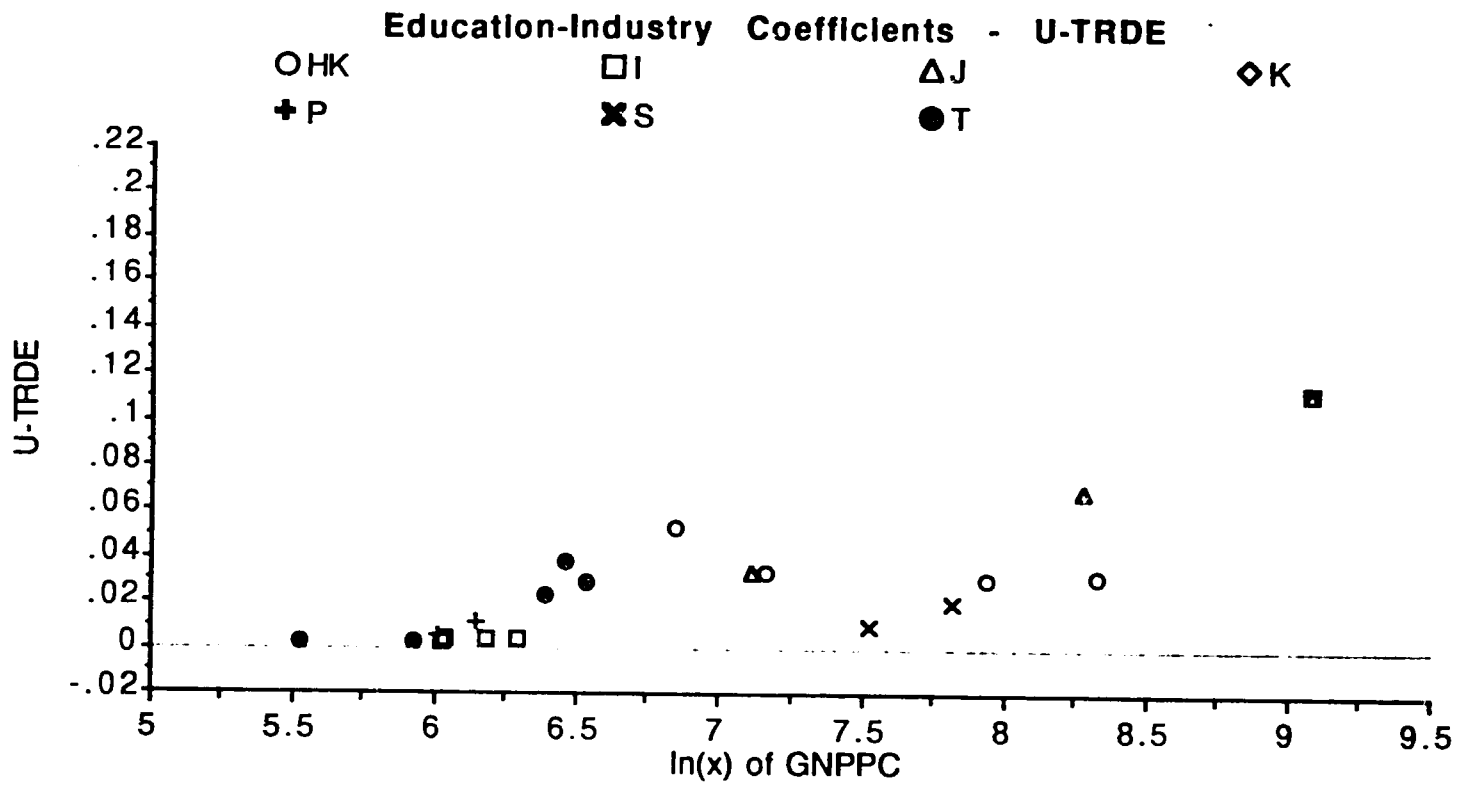
ln(x) of GNPPC


Education-Industry Coefficients - S-OTHER
H K
I
J
K
P
S
T
S-OTHER
.6
.55
.5
.45
.4
.35
.3
.25
.2
.15
.1
.05
0
-.05
-.1
5
5.5
6
6.5
7
7.5
8
8.5
9
9.5
ln(x) of GNPPC


Education-Industry Coefficients - U-AG
HK
I
J
K
P
S
T
U-AG
.22
.2
.18
.16
.14
.12
.1
.08
.06
.04
.02
0
-.02
5
5.5
6
6.5
7
7.5
8
8.5
9
9.5
ln(x) of GNPPC


Education-Industry Coefficients - U-MANU
HK
I
J
K
P
S
T
U-MANU
.22
.2
.18
.16
.14
.12
.1
.08
.06
.04
.02
0
-.02
5
5.5
6
6.5
7
7.5
8
8.5
9
9.5
ln(x) of GNPPC


Education-Industry Coefficients - U-TRDE
HK
I
J
K
P
S
T
U-TRDE
.22
.2
.18
.16
.14
.12
.1
.08
.06
.04
.02
0
-.02
5
5.5
6
6.5
7
7.5
8
8.5
9
9.5
ln(x) of GNPPC