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DEVELOPMENT PATTERNS AMONG COUNTRIES REEXAMINED

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IT has already been established in development literature that temporal growth in per capita income of a country is generally accompanied by changes in its economic structure. The evidence derived from cross-section studies of the developed and developing countries shows that not only are there systematic changes in the industrial structure as per capita income rises but also that the changes follow uniform patterns.[1] Historical evidence derived from time-series data of the highly developed countries also shows that as per capita income increases the composition of income changes in the same manner indicated by cross-section data.[2]

In the early studies income per capita and population size were considered to be the crucial variables in describing variations in production and trade structure during the process of growth. The procedure for estimating the effects of these variables on structural change was to subdivide the pool sample into groups of countries on the basis of either size or per capita income and observe the differences in economic structure between the groups [5]. More recently, other explanatory variables were added to improve the estimations procedure of sectoral growth functions.[3]

In these recent studies, the impact of each independent variable on the trends in economic structure was examined by utilizing all of the explanatory variables in a single multiple regression equation on the assumption that the effect of each variable is independent and additive [3, p. 393]. Because this assumption is often violated, the interaction effects of the main independent variables were captured by subdividing the pool sample into groups of countries that are expected to exhibit homogeneous growth patterns. The pool sample was subdivided on the basis of either population size (large and small countries) or population and resource endowments (large, small industry-oriented, and small primary-

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1 See for example [1].

2 Both intercountry and intertemporal comparisons reveal that there is a relatively strong but negative association between per capita income and the share of agriculture in income and a positive and a strong association between per capita income and the share of industry in income. These studies also demonstrate that there is a strong and positive association between per capita income and the share of total service activities in income but that this share does not vary markedly with income. For intertemporal comparison see [7].

3 See for example [3].

oriented countries) [6] [3, p. 393]. From these studies different development patterns emerged for each group and the statistical results proved to be more satisfactory than those provided by the pool sample.

This study is similar to other recent works on development patterns in that it tests the same set of hypotheses that underlie structural change and employs the same econometric procedure, but it differs from other studies in that it explores other possible subdivisions of the pool sample that were not tested previously. The main explanatory variables that are identified in recent studies are income, population, and natural resources. Since estimated production and trade structure is compared at different levels of income, there is no need to subdivide countries on the basis of per capita income. The pool sample, then, is subdivided on the basis of either resource orientation (first set of development patterns) or size (second set of development patterns). The results of the two sets (industry-primary, small-large) are compared and evaluated and they clearly show that natural resources provide a better explanation of the variation in industrial structure than size. However, when the pool sample is initially subdivided into industry and primary-oriented countries then subdivided further into small and large countries, the following third set of development patterns emerges: primary-oriented small, primary-oriented large, industry-oriented small, and industry-oriented large countries. The three sets show distinct development patterns for each subgroup but that the third set provides less satisfactory statistical results than the first two sets. Also, the first set is more consistent with the hypothesis that underlies changes in industrial shares than the other two sets. Finally, we compare the first set to a fourth set proposed by Chenery and associates (large, small industry-oriented, and small primary-oriented countries). Although Chenery's set represents a statistical improvement over the third set, it is not preferred statistically over the first set and it is still inconsistent with respect to the hypothesis about the role of large and small countries in industrial development. Thus, the first set of development patterns provides more satisfactory results about changes in industrial structure than other sets.

The paper also examines causes of industrialization for the first set of development patterns, as well as for countries at large. In Section I, the model, statistical procedures, and data are represented. In Section II, general findings and the results of the pool sample and the four sets of development patterns are examined. In Section III, trade structure and causes of industrialization of the first set as well as of the pool sample are summarized, and in Section IV, a conclusion is made.

I. THE MODEL, STATISTICAL PROCEDURE, AND DATA

A. *The Model*

To formulate our model, we start with the following production function for a single commodity in an open system:

$$C_i=(K_i, L_i, E_i, R_i, T_i), \qquad (1)$$

where C_i is domestic output of commodity i, while K_i, L_i, E_i, R_i and T_i are

capital, labor, entrepreneurship, natural resources, and a composite index of other factors required to produce C_i. In order to be able to make intercountry comparisons of production and trade structure it is assumed that there exist uniformities in production, domestic demand, and trade patterns across countries at each level of income [3, p. 392]. This means that supply-demand conditions alter systematically with income among countries at a given point in time which is analogous to the change in these conditions as income rises within each country over a period of time.

It is also assumed that factor proportions depend on income, which is given as an exogenous variable. Equilibrium conditions require that commodity price (P_{c_i}) depends on relative prices of inputs being used which depend on factor proportions which in turn depend on income. This gives

$$P_{c_i}=P_{c_i}(P_{k_i}, P_{l_i}, P_{e_i}, P_{r_i}, P_{t_i})=P_{c_i}(K_i, L_i, E_i, R_i, T_i)=P_{c_i}(Y) \qquad (2)$$

and

$$C_i=C_i(P_{c_i})=C_i(Y)\,, \qquad (3)$$

where P_{k_i}, P_{l_i}, etc. are relative factor prices. In our formulation, income determined the composition of output from the supply side.

On the demand side, the following identity equation exists in an open system:

$$C_i=D_i+X_i\,, \qquad (4)$$

where D_i is domestic demand for C_i, while X_i is exports for C_i. There is ample empirical evidence to indicate that components of domestic demand are primarily determined by per capita income [4]. The available evidence also supports the proposition that the composition of exports and imports varies systematically with income[1, p. 627]. Therefore, the previous equation becomes

$$C_i=D_i(Y)+X_i(Y)\,. \qquad (5)$$

Besides income, population is added as an explanatory variable on the hypothesis that an increase in population size affects directly and proportionately the size of the domestic market which in turn influences the cost of production per unit due to economies of scale [1, p. 645]. Expansion of market would encourage import substitution in domestic industries and would induce the rise of intermediate demand by other sectors. Therefore, our supply equation becomes

$$C_i=C_i(Y, N)\,, \qquad (6)$$

while the equation describing the demand conditions becomes

$$C_i=D_i(Y, N)+X_i(Y)\,. \qquad (7)$$

The above analysis postulates that population and income are the only determinants of economic structure. If the assumption of uniform resources with income is dropped, then differences in resource endowments between countries must be allowed for. This means that commodity prices are no longer a function of income and population alone but also of resource base (R).

Also, variation in natural resources among countries may affect their terms of trade significantly. The process of import substitution, manufactured export expansion, and hence industrial development may either be delayed or fostered

depending upon the opportunity cost of earning foreign exchange in each country. For those with comparative advantage in the export of natural resources, industrial growth would tend to slow down since the resource opportunity cost of earning foreign exchange is low, while industrial development could tend to move rapidly for countries that lack the natural resource base since the resource opportunity cost of foreign exchange earnings is higher [3, p. 396]. On the supply side, equation (6) becomes

$$C_i = C_i(Y, N, R), \tag{8}$$

while on the demand side, equation (7) becomes

$$C_i = D_i(Y, N, R) + X_i(Y, R). \tag{9}$$

B. *Statistical Procedure and Data*

Because of the multilinearity problem due to the high correlation between resource endowments and income for the primary-oriented countries, the resource endowment variable (as measured by primary imports per capita) was dropped from the regression equation and its effect was examined indirectly when comparing differences in trade and production compositions between our subgroups of countries. Since population and income are completely uncorrelated, their effects on economic and trade compositions are considered to be independent from each other and additive. Thus, changes in economic structure among countries will be examined by focusing on the effects of two exploratory variables, population and income. Also, a quadratic term on income will be added to the regression equation to allow for the variation in elasticity with income observed for most industrial sectors [6, p. 223].

The following nonlinear multiple regression equation was used to estimate sectoral growth functions as well as the path of other aggregate economic variables:

$$\ln Z = a + b(\ln Y) + c(\ln Y)^2 + d(\ln N), \tag{10}$$

where a is a constant term while b, c, and d are regression coefficients. The dependent variable is Z while Y, N, and Y^2 are the independent variables signifying per capita income, population, and quadratic term, respectively. In our equation, b coefficient measures growth elasticity, c coefficient measures changes in elasticity with income, and d coefficient measures size elasticity. The dependent variable Z is of the following forms:

V_1 = value added per capita in primary production (agriculture and mining),
V_2 = value added per capita in industry (manufacturing and construction),
V_3 = value added per capita in services (transportation, communication, and other services),
V_t = total exports per capita,
X_m = manufactured exports per capita,
X_p = primary exports per capita,
M_t = total imports per capita, and
M_k = capital imports per capita.

All of the above dependent variables plus per capita income (GDP per capita)

are estimated in U.S. dollars for the year 1976 while population is given in millions for the same year. The cross-section data are collected from various U.N. sources for the year 1976. The pool sample consists of sixty-four countries and is almost equally divided between developing and developed countries. This large size of the sample allows for a great degree of variaiton among countries in terms of size, phase of development, degree of openness of their economy, as well as industrial base.

The pool sample was then subdivided into two groups of countries, primary and industry-oriented, on the basis of a trade orientation index toward either primary or industry exports used in other recent studies [2, p. 69]. This index (I) can be expressed as follows:

$$I=\frac{e_p-e_m}{e_t}-\frac{e'_p-e'_m}{e'_t}=I_a-I_e\,,$$

where e_p, e_m, and e_t are actual primary exports, manufactured exports, and total exports per capita, respectively, while e'_p, e'_m, and e'_t are expected values. The differences between actual index (I_a) and expected index (I_e) if positive will classify the countries as primary export-oriented and if negative as industry export-oriented. Of the countries examined twenty-six are classified as primary and thirty-eight as industry-oriented (see Table I). Following Kuznets, we have also subdivided the pool sample by size into small and large countries with populations below and above 10 million, respectively. The pool sample contains twenty-eight small and thirty-six large countries (see Table I). Of the primary-oriented group nine are considered to be small and seventeen as large countries, while of the industry-oriented group nineteen are considered to be small and nineteen to be large countries.

II. EMPIRICAL ANALYSIS

A. *General Findings and the Pool Sample's Development Patterns*

The regression equations' results of production structure provided in Table II show a good fit for all the samples examined here and for almost all of the sectors as evidenced by the high R^2 values. This indicates a strong association between the dependent and independent variables with a small percentage of the variation in the regressions unexplained by the independent variables. Despite the high values of R^2, not all of the parameter estimates are significant and their degree of significance varies from sample to sample (see Table II). These findings are consistent with those of other studies [2, pp. 38–39] [1, p. 634] [3, pp. 395–400] [13, p. 233]. The regression results, though, show an overall significance of regression for all equations reported here as is shown by the high actual F ratios as compared to the theoretical ones at a 0.01 level of ∞. Also, the *SER* values are satisfactory in that they account in almost all of the equations for less than 10 per cent of the mean values of the dependent variables, indicating a good predictive power of regression equation parameters.

The regression equation results from the pool sample show that growth elas-

TABLE I

IDENTIFICATION OF COUNTRIES IN THE POOL SAMPLE AND THE BASIS FOR THEIR GROUPING

Country	Group(s) to Which the Country Belongs[a]	Index of Trade Orientation (I)[b]	Population (millions)[c]
Algeria	P, L	+0.92	17.3
Argentina	P, L	+0.06	25.7
Australia	P, L	+0.30	13.8
Austria	I, S	−0.72	7.5
Belgium	I, S	−0.51	9.8
Bolivia	I, S	−0.31	5.6
Brazil	P, L	+0.39	109.2
Burma	I, L	−0.49	30.8
Canada	P, L	+0.41	23.1
Chile	I, L	−0.66	10.5
Colombia	P, L	+0.44	24.3
Denmark	I, S	−0.59	5.1
Dominican Republic	I, S	−0.41	4.8
Ecuador	P, S	+0.69	7.3
El Salvador	I, S	−0.24	4.1
Finland	I, S	−0.76	4.7
France	I, L	−0.34	52.9
Gabon	P, S	+0.72	0.5
Ghana	P, S	+0.37	9.6
Great Britain	I, L	−1.40	55.9
Greece	I, S	−0.30	9.2
Guatemala	I, S	−0.33	6.3
India	I, L	−0.13	610.0
Indonesia	P, L	+1.08	139.6
Iran	P, L	+1.20	33.6
Iraq	P, L	+1.06	11.5
Italy	I, L	−0.35	56.2
Jamaica	I, S	−0.75	2.1
Japan	I, L	−0.22	110.2
Jordan	I, S	−0.27	2.7
Kenya	P, L	+0.15	13.9
Kuwait	P, S	+0.78	1.0
Libya	P, S	+1.05	2.5
Malaysia	I, L	−0.05	12.3
Mexico	P, L	+0.35	62.3
Morocco	P, L	+0.17	17.3
New Zealand	I, S	−0.58	3.1
Netherlands	I, L	−0.36	13.5
Nicaragua	P, S	+0.32	2.2
Nigeria	P, L	+1.17	62.9
Norway	I, S	−0.27	4.0
Pakistan	I, L	−0.36	72.4
Paraguay	I, S	−0.61	2.8
Peru	I, L	−0.43	16.1
Philippines	I, L	−0.54	43.8
Portugal	I, S	−0.82	9.5
Saudi Arabia	P, S	+1.18	9.2

Table I (Continued)

Country	Group(s) to Which the Country Belongs[a]	Index of Trade Orientation (I)[b]	Population (millions)[c]
Sierre Leone	P, S	+0.24	3.1
South Africa	P, L	+0.30	26.1
Republic of Korea	I, L	−0.66	35.9
Spain	I, L	−0.94	25.6
Sri Lanka	I, L	−0.42	13.7
Sweden	I, S	−0.59	8.2
Syria	P, S	+0.59	7.6
Thailand	I, L	−0.20	43.0
Tunisia	I, S	−0.05	5.7
Turkey	P, L	+0.65	41.1
Uganda	P, L	+0.67	11.9
Uruguay	I, S	−0.83	2.8
U.S.A.	I, L	−0.54	215.1
Venezuela	P, L	+0.63	12.4
West Germany	I, L	−0.29	61.5
Zaire	I, L	−0.60	24.9
Zambia	I, S	−1.29	5.1

[a] P identifies primary-oriented countries; I identifies industry-oriented countries; L identifies large countries; S identifies small countries.

[b] Countries with positive I values are classified as primary-oriented, and those with negative values are classified as industry-oriented.

[c] Countries with populations of 10 million and above are classified as large, and those with less than 10 million are classified as small.

ticity (b coefficient value) of the industrial sector is markedly above one (2.680) and significant, of the pirmary sector is less than one (0.433) and insignificant, and of the service sector is moderately above one (1.167) and significant (see Table II-A). This is in conformity with the results of previous studies and in support of the hypothesis that as income increases the compositions of domestic demand and trade shift in favor of industry and against primary sector due to the Engel effects, import substitution, and growth in manufactured exports [2, pp. 32–40]. Evidence also shows that the service sector increases with income because of the shift in consumers' taste and the rising expenditures on public services as income rises [6, p. 232]. The negative and significant value of c (−0.107) of the industrial sector for the pool sample supports the observations (verified in other studies) of the declining growth elasticity in manufacturing as income increases [3, pp. 393–400]. The small, positive, but not significant c values of the primary and service sectors show a constant elasticity path for both sectors which agrees with the results in other studies [6, p. 236].

Regression equation data of Table II-A show that size elasticity (d coefficient value) of industry is positive (0.122), small, and significant. This supports the premise and agrees with previous studies that variation in population size has a positive effect on industry due to economies of scale and import substitution [6, p. 230]. The d value of the primary sector is negative (−0.184) and significant. This agrees with the conjecture that as population increases the level

TABLE II

REGRESSION EQUATIONS OF PRODUCTION STRUCTURE

Sample & Sector	Intercept	Regression Coefficients			R^2	*SER*	*F*
		$\ln Y$	$(\ln Y)^2$	$\ln N$			
	a	*b*	*c*	*d*			
A. All countries							
Primary	2.317	0.433	0.011	−0.184	0.670	0.614	40.688
		(0.753)	(0.052)	(0.060)*			
Industry	−8.163	2.680	−0.107	0.122	0.959	0.315	472.885
		(0.386)*	(0.027)*	(0.031)*			
Services	−1.542	1.167	0.009	0.036	0.957	0.293	439.507
		(0.359)*	(0.025)	(0.029)			
B. Primary-oriented countries							
Primary	2.253	0.367	0.032	−0.235	0.811	0.620	31.536
		(1.164)	(0.082)	(0.104)*			
Industry	−9.071	3.001	−0.136	0.112	0.939	0.356	112.250
		(0.668)*	(0.047)*	(0.059)**			
Services	−1.390	1.082	−0.069	0.099	0.924	0.367	83.729
		(0.389)*	(0.490)	(0.610)			
C. Industry-oriented countries							
Primary	0.158	1.006	−0.037	−0.058	0.842	0.299	60.444
		(0.535)**	(0.037)	(0.410)			
Industry	−6.961	2.353	−0.081	0.081	0.989	0.174	1,048.828
		(0.311)*	(0.021)*	(0.023)*			
Services	−0.210	0.835	0.016	−0.033	0.995	0.109	2,115.922
		(0.195)*	(0.014)	(0.015)*			
D. Large countries							
Primary	−2.997	2.023	−0.109	−0.105	0.712	0.473	26.346
		(0.764)*	(0.055)**	(0.090)			
Industry	−6.399	2.163	−0.070	0.115	0.970	0.264	339.536
		(0.474)*	(0.034)*	(0.056)*			
Services	1.135	0.341	0.053	0.014	0.973	0.249	386.319
		(0.401)	(0.029)**	(0.047)			
E. Small countries							
Primary	5.795	−0.569	−0.866	−0.421	0.675	0.712	16.625
		(1.923)	(0.128)*	(0.194)*			
Industry	−13.187	4.028	−0.196	0.204	0.949	0.334	147.713
		(0.901)*	(0.060)*	(0.091)*			
Services	3.669	1.801	−0.056	0.108	0.940	0.315	124.610
		(0.851)*	(0.057)	(0.086)			
F. Industry-oriented small countries							
Primary	−2.723	1.760	−0.083	−0.113	0.766	0.357	16.338
		(1.507)	(0.100)	(0.194)			
Industry	−6.853	2.281	−0.073	0.737	0.989	0.163	436.328
		(0.685)*	(0.045)	(0.089)*			
Services	0.568	0.659	0.025	−0.053	0.995	0.095	976.967
		(0.399)	(0.027)	(0.052)			

Table II (Continued)

Sample & Sector	Intercept	Regression Coefficients			R^2	*SER*	*F*
		ln *Y*	$(\ln Y)^2$	ln *N*			
	a	*b*	*c*	*d*			
G. Industry-oriented large countries							
Primary	−1.728	1.525	−0.077	0.019	0.907	0.242	48.491
		(0.608)*	(0.044)	(0.065)			
Industry	−8.734	2.893	−0.127	0.104	0.991	0.183	582.079
		(0.459)*	(0.033)*	(0.049)			
Services	0.627	0.572	0.036	−0.042	0.995	0.120	1,045.904
		(0.302)**	(0.022)	(0.032)			
H. Primary-oriented small countries							
Primary	6.620	−1.281	0.166	0.097	0.988	0.227	137.274
		(0.851)	(0.058)*	(0.087)			
Industry	−16.252	5.136	−0.286	−0.044	0.984	0.217	101.400
		(0.813)*	(0.055)*	(0.083)			
Services	−4.003	2.080	−0.088	−0.105	0.976	0.230	67.332
		(0.862)*	(0.058)	(0.088)			
I. Primary-oriented large countries							
Primary	−4.489	2.562	−0.141	−0.239	0.688	0.590	9.554
		(1.426)**	(0.103)	(0.119)			
Industry	−5.175	1.788	−0.045	0.127	0.942	0.366	70.910
		(0.889)**	(0.064)	(0.124)			
Services	2.540	−0.256	0.099	0.152	0.947	0.331	78.063
		(0.800)	(0.098)	(0.111)			

Note: The numbers in parentheses are standard errors of the regression coefficients.
* Significant at 0.05 level of α.
** Significant at 0.10 level of α.

of primary production declines due to the decreasing role of primary exports since size induces diversification [2, pp. 40–42]. The effect of size on the service sector is small, positive, but insignificant indicating that population does not play an important role in its effect on the growth path of the service sector. Thus, the regression equation results of Table II-A show that parameter estimates vary significantly by sectors in terms of sign, value, and degree of significance. When the pool sample is subdivided into various subgroups, the regression equation data of the rest of Table II show a substantial variation for the estimated parameters (with respect to sign, value, and degree of significance) not only among sectors but also among subgroups. Obviously, the effects of income, population, and resources are not independent of each other in the pool sample and that subgrouping of the total sample in order to separate the interaction effects of economic determinants leads to substantial variation in parameter estimates by subgroups.

Since the regression equations are derived on the basis of per capita data, estimates of production structure were obtained by calculating relative shares

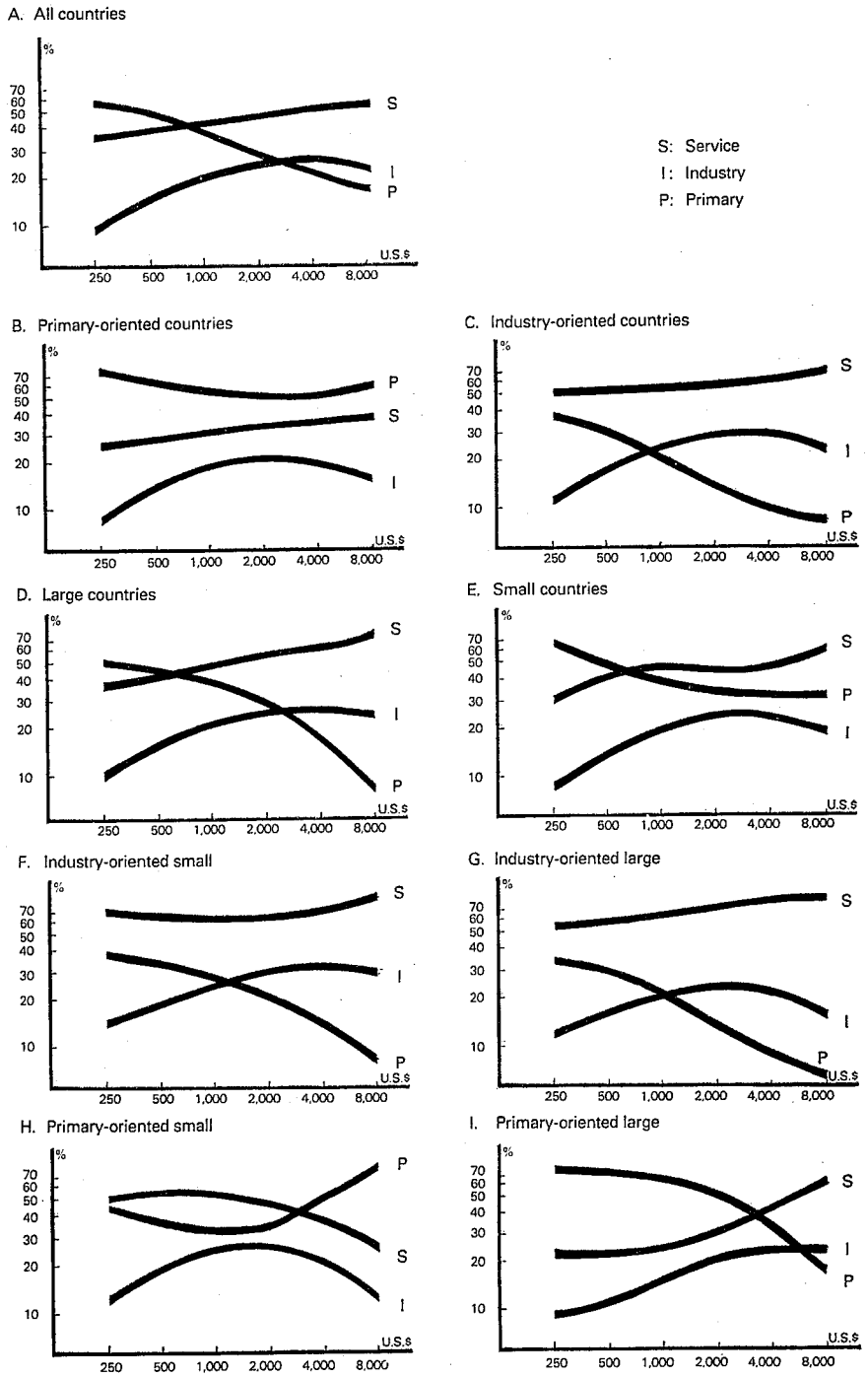
TABLE III

ESTIMATES OF PRODUCTION STRUCTURE

Sectoral Share \ Income (U.S.$)	250	500	1,000	2,000	4,000	8,000
All countries						
Primary	0.55	0.48	0.36	0.29	0.23	0.19
Industry	0.10	0.14	0.19	0.22	0.24	0.23
Service	0.35	0.38	0.45	0.49	0.53	0.58
Primary-oriented countries						
Primary	0.64	0.58	0.53	0.50	0.49	0.51
Industry	0.09	0.14	0.17	0.18	0.17	0.14
Service	0.26	0.29	0.30	0.32	0.34	0.36
Industry-oriented countries						
Primary	0.37	0.29	0.21	0.15	0.10	0.07
Industry	0.13	0.18	0.23	0.26	0.27	0.26
Service	0.50	0.53	0.56	0.59	0.62	0.67
Large countries						
Primary	0.50	0.44	0.36	0.26	0.16	0.09
Industry	0.11	0.15	0.20	0.23	0.24	0.23
Service	0.39	0.40	0.44	0.51	0.59	0.68
Small countries						
Primary	0.64	0.49	0.39	0.37	0.32	0.34
Industry	0.07	0.13	0.19	0.25	0.23	0.20
Service	0.30	0.38	0.42	0.38	0.45	0.46
Industry-oriented small countries						
Primary	0.32	0.28	0.23	0.17	0.12	0.07
Industry	0.13	0.17	0.22	0.25	0.27	0.28
Service	0.55	0.55	0.55	0.58	0.61	0.65
Industry-oriented large countries						
Primary	0.32	0.26	0.18	0.13	0.08	0.04
Industry	0.12	0.17	0.20	0.21	0.19	0.15
Service	0.56	0.57	0.62	0.66	0.73	0.80
Primary-oriented small countries						
Primary	0.40	0.31	0.28	0.32	0.44	0.63
Industry	0.12	0.20	0.26	0.26	0.21	0.12
Service	0.48	0.49	0.46	0.42	0.35	0.25
Primary-oriented large countries						
Primary	0.70	0.68	0.62	0.51	0.36	0.20
Industry	0.09	0.11	0.15	0.19	0.22	0.22
Service	0.21	0.21	0.23	0.30	0.43	0.58

of each sector (per cent of GDP) at different levels of income and for each group from the regression equations results. The income levels used vary from U.S.$250 to U.S.$8,000 which correspond to the actual income per capita range of the countries examined. As is expected, estimates of production composition from the pool sample (see Table III) confirms the Kuznets-Chenery hypothesis of changes in production structure with income. As income rises the shares of both service and industry in income increase while that of primary production decreases. The results show that the industrial share rises at a relatively high rate from 10 per cent at an income level of U.S.$250 to 19 per cent at U.S.$1,000.

Fig. 1. Development Patterns of Various Groups of Countries



Thereafter, the increase is slower with a peaked share of 24 per cent at an income of U.S.$4,000 then declining to 23 per cent at U.S.$8,000. Service share increases at an increasing then decreasing rate from 35 per cent to 58 per cent, while primary share declines more rapidly at an increasing then decreasing rate from 55 per cent to 19 per cent within the income range of U.S.$250 to U.S.$8,000. For the three sectors the biggest percentage change in shares occurs between U.S.$500 and U.S.$1,000 levels of income (see Table III and Figure 1-A).

B. *Industry vs. Primary-Oriented Countries Patterns*

Having examined the regression equation estimates from the pool sample, we are now ready to compare the regression equations of industry and primary-oriented groups. The regression equations of these two samples show statistical improvements over the pool sample for the industry group only. For this group, the R^2 values have all increased, especially for industry and service sectors, and the *SER* values have all dropped slightly for primary production but declined appreciably for industry and service shares while *SER* values have all risen slightly (see Table II-B and II-C). This is expected, since this group includes petroleum-exporting countries that on the average have the highest indices of primary orientation, and their development patterns may depart somewhat from the general patterns of the primary group. Also, the number of parameter estimates that is significant is the same for the primary group but has risen by one for the industry group as compared to the pool sample. The sign of size elasticity of the service sector has become negative (-0.033) and significant for the industry group in comparison to the pool sample. Two parameter estimates changed sign while two others changed their level of significance but have the same signs (see Table II-B and II-C).

To determine whether the growth patterns of primary-oriented groups differ significantly from the industry-oriented countries, a dummy variable test is conducted (see Table IV-A).[4] The results clearly show that the regression values of the two groups differ significantly from each other in terms of the slope as well as the intercept, excepting for the service sector which shows a significant difference for the slope only.

Besides the dummy variable test, estimates of industrial shares derived from these subgroups give further support for the subdivision of the pool sample on the basis of resource orientation. Sectoral shares estimates of the subgroups confirm our hypothesis that natural resource abundance shifts comparative ad-

[4] To test for the difference in economic structure between different subgroups, two dummy variables ($D, D \ln Y$) are added to our equation with D equals 1 for large and industry-oriented countries while it equals 0 for small and primary countries. Our original equation becomes

$$\ln Z = a + b(\ln Y) + c(\ln Y)^2 + d(\ln N) + eD + f(D \ln Y) .$$

Obviously, D tests for the difference in the intercept while $D \ln Y$ tests for the difference in the slope in terms of income. Other dummies that test for slope differential ($D \ln N$, $D \ln Y^2$) were ignored since the emphasis here is on growth elasticity. It should be noted that a covariance test was not used here since it would not directly separate the intercept and slope differentials in the regression equation.

TABLE IV

DUMMY VARIABLE TEST

Sample & Sector	Intercept	Regression Coefficients					R^2	*SER*	*F*
		$\ln Y$	$(\ln Y)^2$	$\ln N$	D	$D \ln Y$			
	a	*b*	*c*	*d*	*e*	*f*			
A. Primary vs. industry-oriented countries									
Primary	3.197	0.193	0.02	−0.141	−2.056	0.386	0.821	0.461	53.154
		(0.566)	(0.039)	(0.046)*	(0.670)*	(0.094)*			
Industry	−8.514	2.785	−0.111	0.104	0.739	−0.149	−0.973	0.260	421.000
		(0.320)*	(0.022)*	(0.026)*	(0.378)**	(0.053)*			
Services	−1.814	1.253	−0.013	0.023	0.527	−0.113	0.968	0.255	353.420
		(0.313)*	(0.022)	(0.025)	(0.370)	(0.052)*			
B. Large vs. small countries									
Primary	−1.254	1.282	−0.037	−0.230	2.026	−0.258	0.694	0.602	26.284
		(0.872)	(0.058)	(0.093)*	(1.004)**	(0.137)**			
Industry	−8.460	2.750	−0.111	0.158	0.002	−0.017	0.960	0.317	279.018
		(0.459)*	(0.031)*	(0.049)*	(0.529)	(0.072)			
Services	0.401	0.705	0.017	0.057	−1.104	0.140	0.960	0.285	280.533
		(0.412)**	(0.027)	(0.044)	(0.474)*	(0.068)*			
C. Primary vs. industry small countries									
Primary	0.590	0.467	0.046	−0.002	3.715	−0.654	0.928	0.350	56.595
		(0.968)	(0.065)	(0.109)	(0.921)*	(0.124)*			
Industry	−11.128	3.664	−0.186	0.020	−1.907	0.317	0.981	0.211	227.993
		(0.585)*	(0.039)*	(0.066)	(0.566)*	(0.075)*			
Services	−1.283	1.301	−0.035	−0.074	−1.466	0.268	0.987	0.150	345.456
		(0.415)*	(0.028)	(0.047)	(0.395)*	(0.053)*			

TABLE IV (Continued)

Sample & Sector	Intercept	Regression Coefficients					R^2	*SER*	*F*
	a	ln *Y* *b*	(ln *Y*)² *c*	ln *N* *d*	*D* *e*	*D* ln *Y* *f*			
D. Primary vs. industry large countries									
Primary	−2.601	1.792 (0.732)*	−0.083 (0.052)	−0.055 (0.086)	0.805 (0.826)	−0.169 (0.120)	0.764	0.442	19.438
Industry	−6.889	2.343 (0.463)*	−0.085 (0.033)*	−0.088 (0.054)	−0.138 (0.522)	−0.052 (0.076)	0.974	0.279	226.133
Services	0.810	0.420 (0.420)	0.048 (0.030)	0.010 (0.049)	0.214 (0.474)	−0.021 (0.069)	0.974	0.254	222.577
E. Large vs. small industry-oriented countries									
Primary	−1.690	1.451 (0.673)*	−0.063 (0.045)	−0.028 (0.068)	0.679 (0.694)	−0.102 (0.092)	0.852	0.304	36.717
Industry	−9.018	2.861 (0.381)*	−0.112 (0.025)*	0.102 (0.038)*	0.782 (0.393)**	−0.111 (0.052)*	0.990	0.172	648.116
Services	1.085	0.517 (0.234)*	0.352 (0.016)*	−0.046 (0.024)**	−0.500 (0.241)*	0.071 (0.032)*	0.995	0.106	1,380.284
F. Large vs. small primary-oriented countries									
Primary	−3.617	1.703 (1.170)	−0.040 (0.079)	−0.095 (0.139)	3.205 (1.432)*	−0.519 (0.199)*	0.866	0.548	25.898
Industry	−7.975	2.761 (0.774)*	−0.124 (0.052)*	0.055 (0.092)	−0.534 (0.947)	0.103 (0.131)	0.942	0.362	65.239
Services	2.086	0.283 (0.710)	0.037 (0.048)	0.042 (0.084)	−1.950 (0.869)*	0.302 (0.121)*	0.943	0.332	66.343

* Significant at 0.05 level of α.
** Significant at 0.10 level of α.

TABLE V

INDUSTRIAL DEVELOPMENT OF VARIOUS GROUPS OF COUNTRIES AT THE INITIAL, PEAKED, AND FINAL SHARE OF INDUSTRY

(%)

Grops of Countries	Initial Share	Initial Share Difference	Initial Difference Plus Difference at the Peaked Share	Initial Difference Plus Difference at the Final Share
All countries	10	0	14	13
Primary-oriented	9	−1	8	4
Industry-oriented	13	+3	17	16
Large countries	11	+1	14	13
Small countries	7	−3	15	10
Industry-oriented small	13	+3	18	19
Primary-oriented small	12	+2	16	2
Industry-oriented large	12	+2	11	5
Primary-oriented large	9	−1	12	12

Notes: Initial share is the industry share of each group at the U.S.$250 level of income. Initial share difference is the difference between the initial share in each group and the initial share of the pool sample. Differences at the peaked and final shares are obtained as the differences between the initial, peaked, and final shares for each group.

vantage away from industry, which is the opposite to resource paucity. This is reflected by the fact that the industrial share of the primary group increases at a slower rate than that of countries at large and that it declines more rapidly after it reaches its peaked share. Since the growth of sectoral shares starts before the U.S.$250 level of income, for comparison purposes any industry share differential of other groups from the 10 per cent share of countries at large (as shown in Table III) will be counted in determining the percentage increases of their industry share within the income range of U.S.$250 and U.S.$8,000. For example, industry shares of the primary group increase from 9 per cent at the U.S.$250 level of income to the peaked share of 18 per cent, but the increase will be 8 per cent rather than 9 per cent to allow for the initial difference between the 9 per cent of this group and the 10 per cent industry share of countries at large. Thus, industry share of the primary group increases by 8 per cent from the initial peaked share then decreases by 4 per cent as it reaches the final share (see Table V). In contrast, industry-oriented countries experience a rapid rise of their industrial share, with a moderate decline after reaching the peaked share. Their share increases by 17 per cent at the peak then declines by 1 per cent afterward. The two groups also differ with respect to the growth patterns of the primary and service shares. Within the income range of U.S.$250 to U.S.$8,000, the primary share of the primary group declines over a long range of income then increases thereafter, showing a very mildly U-shaped curve while of the industry group it shows a continuous but accelerating decline. The growth path of the service sector differs for the two groups not only in terms of its percentage increase which is higher for the industry group but also for the fact that the curve lies above that of other sectors for the primary group at all levels of income (see Figures 1-B and 1-C). Thus, the results obtained from

this subgroup are consistent with our hypothesis of the influence of resources on industrial structure.

C. *Large vs. Small Countries' Patterns*

When the pool sample is subdivided into large and small groups of countries, the statistics show mixed results for the small countries sample as reflected by the standard error of estiamte, R^2, and *SER* values which increased for some equations but decreased for others, but have moderately improved for the large countries sample (see Table II-D and II-E). The number of significant parameter estimates has increased by one for each group as compared to the pool sample. The notable difference for the small and large countries samples is their negative (and significant) sign of the c coefficient as compared to the positive sign of countries at large (-0.866 and -0.109 vs. 0.011). The significance of subdivision on the basis of size is, however, confirmed for the primary and service sectors but not for industry in terms of both the slope and the intercept as shown in Table IV-B. Furthermore, estimates of industrial shares do not support the proposed hypothesis of the influence of size on industrial development. Large countries are expected to industrialize earlier and more rapidly than small ones because of economies of scale which shift comparative advantage to industry [3, p. 395 and p. 399]. The industrial share of large countries increases by 14 per cent then declines to 13 per cent while of small groups the increase is 15 per cent at the peak and declines to 10 per cent at the final share (see Table V). The more rapid increase then decrease of the industry share of small countries as compared to the large group is reflected by the more pronounced inverted U-shaped curve for the small groups than for countries at large (see Figures 1-D and 1-E). Thus, the influence of size on industrial structure is not revealed on the basis of the aforementioned subdivision. This suggests that the influence of size on industrial composition is secondary to that of resources.

D. *The Third Set of Development Patterns*

Our subdivision so far reveals the interaction effects of either income and resources or income and size. The above analysis shows that the influence of resources overshadows that of size on industrial structure. It is possible that the effects from size are significant but are hidden behind resources. To reveal the effects of size on economic structure, primary and industry-oriented countries are subdivided further into small and large countries. Thus, we have the following four subgroups: primary small, primary large, industry small, and industry-oriented large countries. The significance of subdivisions of the industry group (large vs. small) is confirmed by the dummy variable test for the industry and service sectors, but not for the primary sector and of the primary group (large vs. small) is confirmed for the service and primary sectors but not for the industry sectors (see Table IV-E and IV-F). The statistical results have improved across subsamples and sectors (excepting for primary-oriented large countries) as compared to the pool sample in terms of R^2, and *SER* values (see Table II-F, II-G, II-H, and II-I). However, the number of significant parameter estimates has dropped for all subsamples. Also, estimated industry shares are inconsistent

with the hypothesis of the influence of resources and size on industry structure when small and large countries are compared or when industry and primary-oriented groups are compared for large countries. The results are consistent with the hypothesis only when industry and primary-oriented groups are compared for small countries (see Table III).

E. *The Fourth Set of Development Patterns*

We finally examine briefly the set of development patterns proposed by Chenery and associates [3] [2]. The pool sample is subdivided into: large, small industry-oriented, and small primary-oriented countries. When the pool sample is subdivided initially on the basis of size into large and small groups then subdivided further on the basis of resources, the statistical results are the same as those obtained for the third set (see Table II-F, II-G, II-H, II-I). The significance of the subdivision of the small group (primary vs. industry orientation) is confirmed for the three sectors but of the large group is not confirmed for any of the sectors for both the slope and the intercept (see Table IV-C and IV-D). This justifies combining large primary-oriented and large industry-oriented countries into one group, large countries. This shows that resource effects are insignificant for large countries and this may be due to their relatively small share of total trade in GDP. However, estimates of production structure are consistent in terms of the role of resources on industrial growth for the small countries only. The industry share of the industry-oriented small countries increases by 19 per cent within the income range of U.S.$250 to U.S.$8,000, with no tendency to decline, while that of the primary group of small countries increases initially by 16 per cent then the increase declines substantially to only 2 per cent (see Table V). Thus, resource effects are significant on industrial growth for small countries. But when the large group of countries sample is compared to the two small groups (industry and primary-oriented small countries) the three development patterns that emerge are still inconsistent with the hypothesis of the role of size in industrial development since the share of industry rises more rapidly from the initial to the peaked share for the two small groups of countries than for the large group. Also, the statistical results are mixed in terms of R^2 and *SER* values as compared to the pool sample. Furthermore, the statistical results are not as good as those of the first set especially in terms of the number of significant parameters which are larger for the first set. Thus, the overall results of this set are not as satisfactory as those of the first set (as shown in Table II-D, II-F, and II-H).

III. REGRESSION RESULTS, ESTIMATES OF TRADE STRUCTURES, AND CAUSES OF INDUSTRIALIZATION FOR THE FIRST SET AND THE POOL SAMPLE

A. *Regression Results and Estimates of Trade Structure*

The regression results of trade structure are similar to those of production composition in that they show relatively high R^2 values and are all significant

TABLE VI

REGRESSION EQUATIONS OF TRADE STRUCTURE

Sample & Sector	Intercept	Regression Coefficients			R^2	*SER*	*F*
		$\ln Y$	$(\ln Y)^2$	$\ln N$			
	a	*b*	*c*	*d*			
A. All countries							
Total exports	1.105	0.270	0.058	−0.181	0.870	0.608	125.123
		(0.765)	(0.053)	(0.064)*			
Primary exports	−0.004	0.960	−0.022	−0.511	0.465	1.328	16.214
		(1.671)	(0.116)	(0.141)*			
Manufactured exports	−1.226	0.275	0.707	0.063	0.716	1.089	47.004
		(1.371)	(0.096)*	(0.115)			
Total imports	−2.048	1.328	0.024	−0.184	0.859	0.583	113.310
		(0.734)**	(0.051)	(0.062)*			
Capital imports	−5.751	2.005	−0.076	−0.203	0.827	0.620	89.289
		(0.780)*	(0.054)	(0.066)*			
B. Primary-oriented countries							
Total exports	7.135	−1.426	0.175	−0.145	0.890	0.581	53.787
		(1.155)	(0.082)*	(0.105)			
Primary exports	5.606	0.801	0.122	−0.320	0.798	0.808	26.295
		(1.605)	(0.113)	(0.149)*			
Manufactured exports	11.152	−3.800	0.355	0.396	0.748	0.976	19.790
		(1.939)**	(0.137)*	(0.176)*			
Total imports	2.549	—	0.063	−0.112	0.782	0.698	37.640
			(0.009)*	(0.121)			
Capital imports	−1.443	0.646	0.019	−0.033	0.772	0.716	22.572
		(1.423)	(0.101)	(0.129)			
C. Industry-oriented countries							
Total exports	−4.087	1.650	−0.036	−0.128	0.890	0.580	86.185
		(1.061)	(0.074)	(0.087)			
Primary exports	−2.422	1.499	0.064	0.503	0.563	1.033	13.729
		(1.891)	(0.132)	(0.155)*			
Manufactured exports	−7.028	2.200	−0.064	0.057	0.914	0.565	113.498
		(1.035)*	(0.072)	(0.072)			
Total imports	−4.284	1.956	−0.063	−0.215	0.920	0.463	122.506
		(0.484)*	(0.059)	(0.070)*			
Capital imports	−5.946	2.079	0.079	0.297	0.885	0.533	82.467
		(0.975)*	(0.068)	(0.080)*			

* Significant at 0.05 level of α.
** Significant at 0.10 level of α.

in the overall test as is shown by the high *F* ratios relative to the theoretical ones at the level of α of 0.01 (see Table VI). The subdivision of the pool sample on the basis of resource orientation has led to an improvement in the statistical results as is reflected in the overall rise of the R^2 and decline in the *SER* values

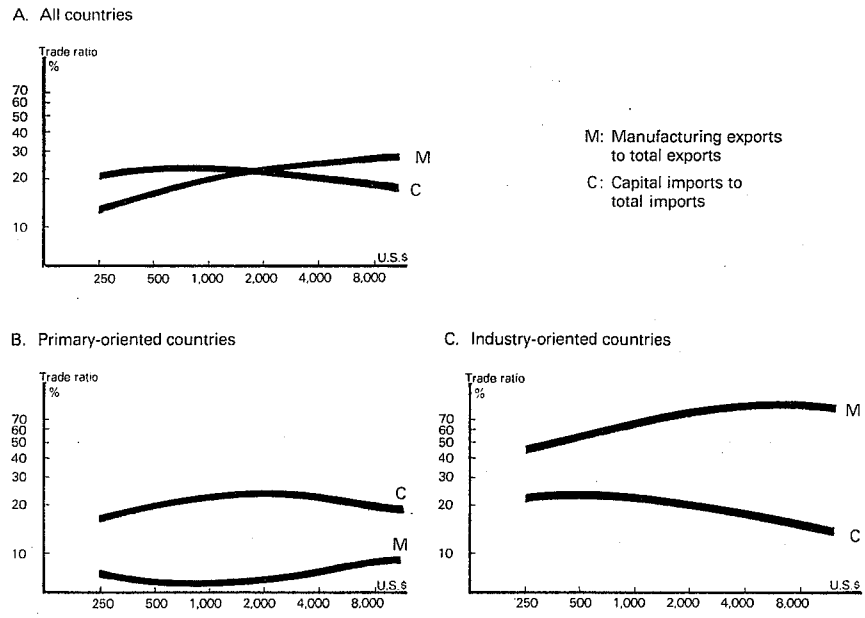
TABLE VII

ESTIMATES OF TRADE STRUCTURE

Trade Ratio \ Income (U.S.$)	250	500	1,000	2,000	4,000	8,000
All countries						
Manu. exports/Total exports	0.14	0.16	0.18	0.20	0.24	0.27
Cap. imports/Total imports	0.21	0.23	0.22	0.21	0.19	0.16
Primary-oriented countries						
Manu. exports/Total exports	0.02	0.02	0.02	0.03	0.04	0.06
Cap. imports/Total imports	0.17	0.18	0.20	0.20	0.19	0.18
Industry-oriented countries						
Manu. exports/Total exports	0.47	0.55	0.62	0.68	0.74	0.77
Cap. imports/Total imports	0.23	0.22	0.21	0.19	0.18	0.16

(see Table VI-B and VI-C). As in the production structure, not all of the parameters are significant and they also vary among the three samples examined here. As is expected, growth elasticity of all trade components is positive for the pool sample (see Table II-A). Evidence shows that manufactured exports increase more rapidly than total exports which is supported here in terms of the *b* (0.275 vs. 0.270) and *c* values (0.707 vs. 0.058) [2, p. 36]. The data in Table II-A also show that capital imports initially increase then decrease relative to total imports as income increases. This is reflected by the higher growth elasticity of capital imports relative to total imports (2.005 vs. 1.328) and also by the declining elasticity of capital imports (−0.076 vs. 0.024). Size elasticity is negative for all trade components (excepting for manufactured exports with a small, positive, but insignificant *d* value). This is expected however, since trade becomes less important as population size increases, as other studies show [3, p. 49]. Estimates of trade structure, which are derived from the regression equation data of Table VI, show a steady increase of manufactured exports to total exports ratio from 14 per cent to 27 per cent and an increase then decrease of capital imports to total imports ratio from 21 to 23 then 16 per cent within the income range of U.S.$250 to U.S.$8,000 for countries at large (see Table VII and Figure 2-A). Trade structure estimates show a marked difference between industry and primary groups with respect to the manufactured exports to total exports ratio at various levels of income. For the primary group the ratio is 2 per cent at the U.S.$250 level of income, then slowly rises to 6 per cent at the U.S.$8,000 level. In contrast, for the industry group it starts at 47 per cent at U.S.$250 and rises steadily to 77 per cent at U.S.$8,000. The difference between the two groups in terms of capital imports to total imports ratio is less pronounced although the shapes of the two ratio curves are dissimilar. For the primary group it has a mildly inverted U-shape with the ratio rising from 17 per cent at U.S.$250 to 20 per cent at U.S.$2,000 then declining to 18 per cent at U.S.$8,000. For the industry group it has a negatively sloped curve declining slowly from 23 to 16 per cent at our income range (see Table VII and Figures 2-B and 2-C).

Fig. 2. Trade Patterns of Various Groups of Countries



B. *Causes of Industrialization*

The relative importance of manufacturing exports, import substitution, and domestic demand in the process of industrialization for the first set and the pool sample is estimated here on the assumption that both manufactured exports to total exports and capital imports to total imports ratios stay the same at all levels of per capita income as they would at U.S.$125. Assume that domestic demand is equal to the industry value added per capita at U.S.$125 and that it grows proportionately with per capita income.[5] Given these assumptions, the contribution of domestic demand to industrial growth of countries at large is 39 per cent at U.S.$250 and declines mildly but steadily to 31 per cent at U.S.$8,000, while export expansion accounts for 22 per cent and increases to 47 per cent at U.S.$350 and U.S.$8,000, respectively. Import substitution contributes 39 per cent at U.S.$250 and rises to 41 per cent at U.S.$500 then declines to 22 per cent at U.S.$8,000 (see Table VIII).

Domestic demand plays a more important role in the process of industrialization for the primary than for the industry group. For the primary group domestic demand contributes 50 per cent at U.S.$250 then increases to 56 per cent at the U.S.$1,000–U.S.$2,000 range and declines to 47 per cent at U.S.$8,000. In contrast, the contribution of domestic demand to industry for the industry group starts at 16 and ends at 13 per cent within our income range of U.S.$250–U.S.$8,000. Both export expansion and import substitution play a lesser role in the primary than in the industry group. For the primary group, export expansion

[5] These assumptions are similar to those given by [6, p. 229].

TABLE VIII

ESTIMATED CONTRIBUTIONS TO INDUSTRIALIZATION PROCESS

Contribution of \ Income (U.S.$)	250	500	1,000	2,000	4,000	8,000
All countries						
Domestics demand	0.39	0.37	0.36	0.35	0.33	0.31
Export expansion	0.22	0.22	0.25	0.29	0.37	0.47
Import substitution	0.39	0.41	0.39	0.36	0.30	0.22
Primary-oriented countries						
Domestic demand	0.50	0.55	0.56	0.56	0.54	0.47
Export expansion	0.08	0.05	0.05	0.06	0.11	0.24
Import substitution	0.42	0.41	0.40	0.38	0.36	0.29
Industry-oriented countries						
Domestic demand	0.16	0.14	0.13	0.12	0.12	0.13
Export expansion	0.16	0.19	0.22	0.25	0.28	0.32
Import substitution	0.67	0.67	0.66	0.64	0.61	0.60

contributes 8 per cent at U.S.$250 and declines to 5 per cent at the U.S.$500–U.S.$1,000 income range, then increases to 24 per cent at U.S.$8,000, while for the industry group it increases steadily from 16 per cent at U.S.$250 to 32 per cent at U.S.$8,000. Import substitution accounts for 42 per cent at U.S.$250 and 29 per cent at U.S.$8,000 for the primary group, while it contributes 67 per cent at U.S.$250 and declines to 60 per cent at U.S.$8,000 for the industry group. All these estimates are consistent with our hypothesis about the role of resources in industrialization as well as their effects on trade structure.

IV. CONCLUSION

Subdivision of the pool sample has been utilized by development economists to examine changes in economic structure among countries on the ground that a more homogeneous growth function of the elements of production and trade can be achieved within each subgroup than for the pool sample. This would allow for more clear identification of the factors that influence structural changes as income increases. The predictive power of the regression equations to estimate production and trade patterns would improve further when the homogeneity criterion of growth functions within each subgroup is accompanied by a heterogeneity of growth functions between subgroups. If the above two conditions are met then the regression estimates derived from the subgroups would be more reliable than those obtained from the pool sample. When the pool sample is subdivided into small and large and into industry and primary-oriented groups the latter set is clearly preferred over the first one on both econometric and theoretical grounds. Thus, resources seem to play a more important role than size in their influence on economic structure.

One popular set of development patterns that has surfaced in development literature, advanced by Chenery and associates, is the subdivision of the pool sample into large, industry-oriented small, and primary-oriented small countries.

However, the set that is being presented in this paper, i.e., industry-oriented vs. primary-oriented countries, gives equally satisfactory statistical results as compared to the set proposed by Chenery and others and is more consistent with the hypothesis about the role of resources and size in changes in economic structure as per capita income increases. Again, this supports our notion that resource endowments are the main force in the structural transformation and that size plays a secondary role to that of resources in its effects on economic structure as development proceeds.

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