Riedel, James

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Factor proportions, linkages and the open developing economy

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Working Paper No. 20
FACTOR PROPORTIONS, LINKAGES AND THE OPEN DEVELOPING ECONOMY
by
James Riedel

Institut für Weltwirtschaft an der Universität Kiel
Kiel Institute of World Economics
Department IV
2300 Kiel, Düsternbrooker Weg 120

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The purpose of this paper is to examine the theoretical rationale underlying the growth of "footloose", import-dependent industry observed in many of the most successful developing countries (Hong Kong, Taiwan, S. Korea, for example). A second objective is to develop empirical formulations appropriate for analyzing the resource allocation consequences of a "footloose" industrial structure in a developing country. It is argued that previous applications of input-output techniques to factor-intensity measurement have in general ignored the implications of trade in intermediate inputs. The "Leontief test" of the Heckscher-Ohlin trade theory is perhaps the first and certainly the most widely adopted application of input-output techniques to the measurement of the factor intensity of production. The first section of this paper will attempt to demonstrate that the procedure developed by Leontief is not strictly appropriate in an open economy which utilizes imported as well as domestically supplied inputs. An alternative formulation is developed in this paper, which when compared to the "Leontief" formulation yields a measure of the domestic resource cost or saving resulting from the use of imported rather than domestically produced inputs.

In section II, the formulations developed in section I are applied to the Taiwan economy in an effort to demonstrate the resource allocation consequences of an import-dependent, "footloose" industrial structure typical of the island economies in East Asia which dominate the exclusive group of superlative economic development performers. In concluding

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(section III), the overall importance of linkages in the development process is discussed in light of the results derived in section II. It is argued that the role of linkages as "generators" of economic activity may be less important than the resource allocation consequences in terms of factor proportions or economies of scale.

I. FACTOR INTENSITY MEASUREMENT AND IMPORTED INPUTS

Perhaps the most important contribution of the "Leontief test" aside from its interesting revelations about neo-classical trade theory, was its recognition that the factor intensity of production of any given commodity is determined not only by the factor requirements at the last stage of production, but also by the factor requirements at each intermediate stage. Applying input-output techniques, Leontief measured the total (direct and indirect) labor required to produce one unit of commodity j by

\[ L_j = \sum_i k_i r_{ij} \]  

(1)

where \( k_i \) is the direct labor-output ratio at the \( i^{th} \) stage of production, and \( r_{ij} \) are elements of the inverted Leontief matrix \([I-A]^{-1}\).  

\[ [I-A]^{-1} = \{r_{ij} \} \]

1 Standard input output notation is used.

\[ [A] = \{a_{ij} \} \]

\[ a_{ij} = \frac{x_{ij}}{X_j} \]

where \( x_{ij} \) is the total input of i in production of j, and \( x_j \) is the total value of production of j.

Note, the element \( r_{ij} \) is the total (direct and indirect) output requirement of i per unit final demand of j. \( k_i r_{ij} \) is thus the total labor required to produce that amount of commodity i used to produce one unit of commodity j for final demand, and \( \sum_i k_i r_{ij} \) is the labor required at each and every stage in the production of commodity j.
Similarly,

\[ K_j = \sum_{i} k_i r_{ij} \quad (2) \]

is the total capital required to produce one unit of commodity \( j \) for final demand, where \( k_i \) is the capital-output ratio at the \( i^{th} \) stage of production.

If, \( e_j \) is the proportionate share of the \( j^{th} \) commodity in total exports, and \( n_j \) is the proportionate share of \( j^{th} \) commodity in total imports, then the Heckscher-Ohlin theory is confirmed by the Leontief test, if

\[
\sum_{j} \left( \sum_{i} k_i r_{ij} \right) e_j \quad \text{greater (less) than} \quad \sum_{j} \left( \sum_{i} k_i r_{ij} \right) n_j
\]

in countries relatively well endowed with capital (labor).

The author is unaware of any application of the Leontief test which deviates from the above procedure. It will be argued, however, that the above procedure is appropriate only in the case in which a country imports strictly for final consumption.\(^1\) Consider a country which imports intermediate goods; in such a case, elements of the \( [I-A]^{-1} \) matrix \( \{r_{ij}\} \) do not measure the amount of domestic output per unit of final demand. They measure instead the total "output" (or input) required, which may be supplied externally or domestically.\(^2\)

---

\(^1\) The main interest of this paper is in deriving an appropriate measure of factor intensity in an economy utilizing imported inputs, not in providing an alternative test of Heckscher-Ohlin per se. Testing Heckscher-Ohlin is, however, one of the possible applications of the factor intensity measure formulated here.

\(^2\) What is measured is the factor intensity of the goods which go into the production of commodity \( j \). This is in itself interesting, but it does not reveal the factor intensity of the domestic structure of production, if imported inputs are utilized.
Consequently, the sum

\[ L = \sum_i k_i r_{ij} \]

and

\[ K = \sum_i k_i r_{ij} \]

do not measure the direct and indirect labor and capital required in the domestic economy to produce a given commodity \( j \). The domestic output required directly and indirectly per unit final demand is given by

\[ [I-D]^{-1} = \{s_{ij}\} \]

where

\[ [D] = \{d_{ij}\} \]

\[ d_{ij} = \frac{x_{ij}}{X_j} - \frac{M_{ij}}{X_j} = a_{ij} - m_{ij} \]

and where \( M_{ij}/X_j = m_{ij} \) is the per unit import requirement of \( i \) in the production of \( j \). Thus,

\[ L^*_{ij} = \sum_i X_i s_{ij} \]

and

\[ K^*_{ij} = \sum_i k_i s_{ij} \]
measure the labor/required in the production of commodity j at the last stage of production and in the production of domestically supplied intermediate inputs. Inter-industry transactions in imported inputs are omitted because the demand for imported inputs does not directly affect employment or capital investment in the domestic economy. Nevertheless, imported inputs are not freely available to the economy, much less the domestic producer; they can be acquired (in equilibrium) only through the exchange of domestically produced goods and services, which in turn involve a cost in terms of domestic resources -- capital and labor, to keep everything in neo-classical terms. The total factor cost per unit of production is, therefore, the sum of (1) the labor and capital employed in producing domestic inputs and at the final stage of production, and (2) the labor and capital cost implicit in earning the foreign exchange (exporting) with which to purchase imported inputs required directly and indirectly in the production process.

The labor and capital cost of earning one unit of foreign exchange (in equilibrium) is the labor and capital required to produce one unit of exports, which in turn can be defined as the average labor and capital requirements per unit output in each sector of the economy weighted by the distribution of exports from each sector. The labor and capital required at the last stage of production and in the domestic production of inputs which go into exports is thus

\[ L_f^* = \sum_j \left( \sum_i s_{ij} L^* i \right) e_j = \sum_j L^*_j e_j \]

and

\[ K_f^* = \sum_j \left( \sum_i s_{ij} K^* i \right) e_j = \sum_j K^*_j e_j \]

respectively. Of course the production of exports itself requires

1 The analysis throughout abstracts from international capital flows. The assumption is that the balance on goods and services is in equilibrium; imports can be traded only for exports -- an assumption neither uncommon nor extremely restrictive.
imported inputs. If $M^*_j$, defined as

$$M^*_j = \sum_i M_{ij} s_{ij},$$

is the total (direct and indirect) import requirement per unit output of commodity $j$, then

$$M^*_f = \sum_j \left( \sum_i M_{ij} s_{ij} \right) e_j = \sum_j M^*_j \cdot e_j$$

is the direct and indirect import requirement per unit export. Thus to produce one unit of exports we need $L^*_f$ units of labor and $K^*_f$ units of capital at the last stage of production and for domestically produced inputs; and we need $L^*_f M^*_f$ and $K^*_f M^*_f$ of labor and capital, respectively, to produce additional exports to finance the imports which were employed in the original production of one unit of exports. In addition, we recognize that the additional exports (required to finance the imports used in the first round) also require imported inputs. In the first round $M^*_f$ units of imports (foreign exchange = exports) are required; thus in the second round $M^*_f M^*_f$ units of imported inputs are required, which in turn will entail the employment of $L^*_f (M^*_f)^2$ labor and $K^*_f (M^*_f)^2$ capital in the production of exports with which to finance these additional imports. The second round of additional exports, likewise, requires imported inputs $(M^*_f)^2 \cdot M^*_f$ and consequently more exports and hence the employment of still more labor and capital, and so on. The sum of all labor and capital required in the production of one unit of exports (i.e., foreign exchange) is thus

$$L^*_f + L^*_f M^*_f + L^*_f M^*_f^2 + L^*_f M^*_f^3 + \ldots + L^*_f M^*_f^n$$

and

$$K^*_f + K^*_f M^*_f + K^*_f M^*_f^2 + K^*_f M^*_f^3 + \ldots + K^*_f M^*_f^n$$

respectively. Since $0 < M^*_f \leq 1$, the above expression reduces to
For any given commodity \( j \), therefore, the factor intensity of production as measured by total factor requirement per unit outputs is given by

\[
L_j^* = \sum_i s_{ij}^* + M_j \left[ \frac{L_f^*}{1 - M_f^*} \right] = L_j^* + M_j \left[ \frac{L_f^*}{1 - M_f^*} \right]
\]

and

\[
K_j^* = \sum_i s_{ij}^* + M_j \left[ \frac{K_f^*}{1 - M_f^*} \right] = K_j^* + M_j \left[ \frac{K_f^*}{1 - M_f^*} \right]
\]

which expresses the two components of total factor cost in an open economy: (1) employment and capital cost at the last stage of production and producing domestic inputs; and (2) employment and capital cost implicit in earning the foreign exchange (fraction of one unit of foreign exchange) with which to purchase imported inputs required directly and indirectly in the production of commodity \( j \).

\[\text{Note that}
\]

\[
\sum_j L_{j}^* e_{j} = \frac{L_f^*}{1 - M_f^*}
\]

and

\[
\sum_j K_{j}^* e_{j} = \frac{K_f^*}{1 - M_f^*}
\]
Recognizing the interrelatedness of the economy, not only explicit but also implicit relationships, points to the fact that the factor intensity of a given production activity is dependent upon the technology in the final stage of production, the technology in each and every sector of the economy from which it is supplied, and in an open economy, upon the technology which underlies the structure of foreign trade. In other words, when an economy, like Taiwan for example, imports steel, machinery, synthetic fibre and other relatively capital intensive intermediate goods with foreign exchange earned by exporting transistor radios, plastic toys, garments and the like, it is implicitly substituting the latter labor-intensive goods for the former capital-intensive goods in the production process. One can easily see that to evaluate the factor intensity of the structure of production on the assumption that all inputs are supplied domestically, can easily produce misleading conclusions in such an economy. It may very well be, for example, that automobile manufacturing is a relatively labor-intensive activity, if the steel for the body, the engine, the headlights and other relatively capital intensive inputs are imported, particularly if they are imported with foreign exchange earned by exporting relatively labor intensive goods.

The orthodox measure of total factor intensity, as developed by Leontief, indicates the factor intensity at the last stage of production and of the goods which go into the production process, only when all of the goods which go into the production process are supplied domestically does the Leontief measure indicate the total factor intensity of the prevailing structure of production. Comparing the Leontief measure of total factor intensity with the one developed above reveals the net factor cost or saving derived from the utilization of imported rather than domestically supplied intermediate goods. For example, \( L_j \leq L'_j \) and \( K_j \geq K'_j \) indicate that the importation of inputs (i.e. the implicit substitution of exports for otherwise domestically supplied inputs) reduces the overall capital requirement in the economy, but entails a greater demand for labor than would be the case if all intermediate inputs were supplied domestically. In a labor-abundant, capital-scarce LDC
presumably such a trade-off indicates that the importation of intermediate inputs is in accordance with neo-classical principles of comparative advantage, though of course the resource allocation consequences of any such trade-off can be precisely weighed and evaluated only if one has knowledge of the shadow prices of labor and capital, from which the net resource cost (saving) can be derived.

It should be recognized that the total factor intensity of production in an open economy is highly sensitive to the structure of exports. In such cases where the export pattern is drastically out of line with comparative advantage considerations, the comparison of factor intensities under the existing structure of production with those under a hypothetical structure which assumes all intermediate inputs are supplied domestically will yield little in terms of "explaining" the existing structure, or as a guide for planning and policy. It may be, for example, that relatively capital-intensive intermediate inputs are imported in a given LDC with foreign exchange earned by exporting equally, or even relatively more capital-intensive commodities. In such a case, even though we may find $K < K'$ and $L > L'$, the optimal solution would not be the substitution of domestic inputs for imports (though it might be an improvement), but rather a restructuring of exports toward more labor-intensive commodities. If the relevant problem is one of deriving an ex ante measure of comparative advantage then certainly a more general concept of "domestic resource cost" than the one discussed above is required.  

1 Such as developed by M. Bruno, Interdependence, Resource Use and Structural Change in Israel, (Jerusalem: Bank of Israel, 1963); and elaborated in his recent article "Domestic Resource Costs and Effective Protection: Clarification and Synthesis", Journal of Political Economy, Vol. 80 (Jan/Feb. 1972) p. 16-33.
II. FACTOR INTENSITY IN THE TAIWAN ECONOMY

Among the countries struggling to industrialize none has been more successful than several east Asian island economies (Hong Kong, Singapore, Taiwan, S. Korea); among this exclusive group perhaps Taiwan has witnessed the most remarkable gains. The manufacturing sector in Taiwan has grown at a compound growth rate of 18 percent per annum over the last decade, 1961-1971, providing the engine of growth in real per capita income of 7.0 percent per annum over the same period. The industrialization process of the East Asian island economies exhibits two outstanding characteristics: (1) strong orientation toward exports; (2) heavy reliance on imported inputs. In Taiwan, for example, 30 percent of manufactured output was exported in 1969, while 14 percent of the value of manufactured output was contributed by imported inputs. Applying the formulations developed above we attempt to demonstrate the rationale of these key features of industrialization in Taiwan in terms of neo-classical, factor-proportions theory.

Table I presents measures of total labor and capital requirements per million NT$ in each of 52 sectors of the Taiwan economy given the existing structure of production and alternatively assuming all intermediate inputs were domestically supplied. In columns $M_{ij}$ and $M'_{ij}$ the difference between factor requirements under the two alternative production structures has been calculated to reveal the capital and labor cost or saving attributable to the importation of intermediate inputs.

---


2 According to Input Output Table for Taiwan, 1969, CIECD, Executive Yuan, Taipei, Republic of China. The percent of value contributed by imported inputs is calculated by

$$ q_j = \frac{\sum_i M_{ij} s_{ij}}{\sum_j \sum_i M_{ij} s_{ij}} $$

where $q_j$ is the proportion of the $j^{th}$ sector in total value of manufacturing output.
<table>
<thead>
<tr>
<th>Sector</th>
<th>Direct Labor Requirement Per Million NT</th>
<th>Share of Total Requirement</th>
<th>Inward Processing Value</th>
<th>Share of Total Value</th>
<th>Final Product Value</th>
<th>Share of Total Value</th>
<th>Exports Value</th>
<th>Share of Total Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>50,700</td>
<td>0.015</td>
<td>1.400</td>
<td>0.015</td>
<td>190</td>
<td>0.042</td>
<td>200</td>
<td>0.042</td>
</tr>
<tr>
<td>Forestry</td>
<td>43,000</td>
<td>0.042</td>
<td>1.400</td>
<td>0.042</td>
<td>190</td>
<td>0.042</td>
<td>200</td>
<td>0.042</td>
</tr>
<tr>
<td>Tobacco</td>
<td>3,190</td>
<td>0.002</td>
<td>1.400</td>
<td>0.002</td>
<td>190</td>
<td>0.002</td>
<td>200</td>
<td>0.002</td>
</tr>
<tr>
<td>Alcoholic Beverages</td>
<td>4,000</td>
<td>0.003</td>
<td>1.400</td>
<td>0.003</td>
<td>190</td>
<td>0.003</td>
<td>200</td>
<td>0.003</td>
</tr>
<tr>
<td>Other</td>
<td>3,190</td>
<td>0.002</td>
<td>1.400</td>
<td>0.002</td>
<td>190</td>
<td>0.002</td>
<td>200</td>
<td>0.002</td>
</tr>
<tr>
<td>Total</td>
<td>102</td>
<td>0.002</td>
<td>1.400</td>
<td>0.002</td>
<td>190</td>
<td>0.002</td>
<td>200</td>
<td>0.002</td>
</tr>
</tbody>
</table>

*Note: Inward Processing Value, Exports Value, and Final Product Value are calculated based on the given data.
It is of course inappropriate to sum the factor requirements over all sectors since the factor requirements of any one sector are measured in terms of total requirements throughout the entire economy. However, taking the average factor cost (saving), weighted by the distribution of output over all sectors, reveals that the utilization of imported inputs in the Taiwan economy entailed a saving of .189 man-years of employment and an additional capital cost of NT$ 224 per million NT$ output. The apparent paradox (of the Leontief type) which result poses is resolved upon closer inspection of Table I. Note, it is precisely in those sectors which rely heavily on imported natural raw material inputs that exhibit the paradoxical \( L > L' \), \( K < K' \): wheat for flour; cotton for textiles; timber for plywood; hides for leather products, etc. In sectors more dependent upon imports of processed intermediate inputs the expected result (\( L < L' \), \( K > K' \)) is found. It is of course well known that neo-classical factor-proportions theory is unable to explain trade in natural resources, and this fact has been used to resolve the paradox which Leontief discovered in the United States trade as well.  

Total factor requirements per million NT$ output in each of 46 manufacturing sectors -- excluding the indirect requirements in the primary sector (1-4), construction (51) and services (52) -- under the two alternative production structures are presented in Table II. Column 1 of Table II indicates the direct and indirect import requirement of manufactured intermediate inputs. Calculation of the implicit factor

\[
M_i = \sum_{i=5}^{50} m_{ij}
\]

---


2
| Sector | Per Unit Required | Manufacturing | Requirement 
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugar</td>
<td>5</td>
<td>0.0123</td>
<td>0.0123</td>
</tr>
<tr>
<td>Cement</td>
<td>5</td>
<td>0.1200</td>
<td>12.0000</td>
</tr>
<tr>
<td>Tobacco</td>
<td>7</td>
<td>0.0050</td>
<td>0.0050</td>
</tr>
<tr>
<td>Alcoholic Beverages</td>
<td>8</td>
<td>0.0020</td>
<td>0.0020</td>
</tr>
<tr>
<td>H.S.G. (Engineering)</td>
<td>9</td>
<td>0.0005</td>
<td>0.0005</td>
</tr>
<tr>
<td>Steel Plate</td>
<td>11</td>
<td>0.0000</td>
<td>0.0000</td>
</tr>
<tr>
<td>Textile</td>
<td>13</td>
<td>0.0050</td>
<td>0.0050</td>
</tr>
<tr>
<td>Artificial Fibre</td>
<td>15</td>
<td>0.0020</td>
<td>0.0020</td>
</tr>
<tr>
<td>Artificial Plastic</td>
<td>16</td>
<td>0.0040</td>
<td>0.0040</td>
</tr>
<tr>
<td>Cotton</td>
<td>18</td>
<td>0.0040</td>
<td>0.0040</td>
</tr>
<tr>
<td>Wool &amp; Cotton</td>
<td>19</td>
<td>0.0040</td>
<td>0.0040</td>
</tr>
<tr>
<td>Lumber</td>
<td>20</td>
<td>0.0020</td>
<td>0.0020</td>
</tr>
<tr>
<td>Plywood</td>
<td>21</td>
<td>0.0020</td>
<td>0.0020</td>
</tr>
<tr>
<td>Hardware, Metal Products</td>
<td>22</td>
<td>0.0020</td>
<td>0.0020</td>
</tr>
<tr>
<td>Paper &amp; Paperboard</td>
<td>23</td>
<td>0.0020</td>
<td>0.0020</td>
</tr>
<tr>
<td>Printing &amp; Publishing</td>
<td>24</td>
<td>0.0020</td>
<td>0.0020</td>
</tr>
<tr>
<td>Leather &amp; Products</td>
<td>25</td>
<td>0.0020</td>
<td>0.0020</td>
</tr>
<tr>
<td>Rubber &amp; Products</td>
<td>26</td>
<td>0.0020</td>
<td>0.0020</td>
</tr>
<tr>
<td>Chemicals</td>
<td>27</td>
<td>0.0020</td>
<td>0.0020</td>
</tr>
<tr>
<td>Petroleum</td>
<td>28</td>
<td>0.0020</td>
<td>0.0020</td>
</tr>
<tr>
<td>Chemical &amp; Allied Products</td>
<td>29</td>
<td>0.0020</td>
<td>0.0020</td>
</tr>
<tr>
<td>Iron, Steel &amp; Manufactures</td>
<td>30</td>
<td>0.0020</td>
<td>0.0020</td>
</tr>
<tr>
<td>Motor Vehicles</td>
<td>31</td>
<td>0.0020</td>
<td>0.0020</td>
</tr>
<tr>
<td>Chemicals &amp; Allied Products</td>
<td>32</td>
<td>0.0020</td>
<td>0.0020</td>
</tr>
<tr>
<td>Electrical &amp; Allied Products</td>
<td>33</td>
<td>0.0020</td>
<td>0.0020</td>
</tr>
<tr>
<td>Machinery &amp; Allied Products</td>
<td>34</td>
<td>0.0020</td>
<td>0.0020</td>
</tr>
<tr>
<td>Communication Equipment</td>
<td>35</td>
<td>0.0020</td>
<td>0.0020</td>
</tr>
<tr>
<td>Electrical &amp; Allied Products</td>
<td>36</td>
<td>0.0020</td>
<td>0.0020</td>
</tr>
<tr>
<td>Manufacturing &amp; Allied Products</td>
<td>37</td>
<td>0.0020</td>
<td>0.0020</td>
</tr>
<tr>
<td>Total</td>
<td>38</td>
<td>0.0020</td>
<td>0.0020</td>
</tr>
</tbody>
</table>

**Notes:**
- The table represents various sectors and their requirements for manufacturing in the context of labor and capital. The data includes specific values for each sector, indicating the requirements per unit of output or production. The values are part of a larger dataset, possibly related to economic planning or industrial analysis, with columns for labor and capital requirements, and rows for different sectors. The table is part of a larger document, as indicated by the references to "See Table 1" and "See Table 6."
costs of imported inputs (i.e. the export equivalent) is based on average factor requirements of manufactured exports.\textsuperscript{1} Comparisons of \((L, K)\) and \((L', K')\) in Table II reveal the resource (labor and capital) cost or saving resulting from the importation of manufactured intermediate inputs, assuming these inputs were imported with foreign exchange earned by exporting strictly manufactured commodities.

Abstracting from trade in non-manufactured goods clearly resolves the paradox we found in our previous results. On the average (weighted by the distribution of output in the manufacturing sector) the trade off manufactured exports for imports of manufactured intermediate inputs saved the economy NT$ 59,893 in capital and entailed an additional labor cost of .083 man-years per million NT$ output \textemdash as compared the alternative of supplying all manufactured inputs domestically. Although we would need to know the shadow prices of capital and labor to precisely calculate the net resource cost of this trade off, it is quite apparent that resource savings in terms of capital well out weigh resource costs in terms of labor.\textsuperscript{2} In other words, import-dependent, "footloose" industry in a developing country such as Taiwan is quite justifiable in terms of resource allocation as judged by strictly factor-proportions considerations.

\textsuperscript{1}

\[
L_{e} = \frac{50 \sum_{j=5}^{50} [50 \sum_{i=5}^{50} L_{i} s_{ij}] e_{j}}{1 - \sum_{j=5}^{50} [52 \sum_{i=1}^{52} M_{i} s_{ij}] e_{j}}
\]

where \(e_{j}\) is the proportion share of the \(j^{th}\) sector in total export of manufactures.

\textsuperscript{2}

The yearly average wage in the manufacturing sector in Taiwan in 1969 was NT$ 16,000.
III. CONCLUSION: LINKAGES AND ECONOMIC DEVELOPMENT

The conclusion that the optimal allocation of resources in a developing country might well rule against industries with strong backward linkages goes against much of the conventional wisdom of development planning. In particular it is the antithesis of the prominent Hirschman model of development. The Hirschman model singles out the scarcity of decision-making as the primary constraint to development and argues that the most important and effective means of stimulating growth is to create circumstances that make the advantage of a certain course of action so obvious that even weak decision-makers will act. The appropriate development strategy, so the argument goes, should emphasize investments which induce further investment decisions. The interrelatedness of the economy provides the mechanism (in fact, the deus ex machina) through which decisions are induced. Hirschman described two directions in which the mechanism works — one through backward linkages, the other through forward linkages, though the former is recognized to be by far the stronger of the two. In terms of input-output terminology, the appropriate strategy of development is one which gives preference to industries for which \( \sum_i s_{ij} \) is relatively high. The sum \( \sum_i s_{ij} \) can be thought of as the total domestic income-output multiplier from the expansion of one unit of commodity \( j \) and is in effect a measure of the inducement to expand production throughout the economy resulting from the decision to expand the production of a given commodity \( j \).

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1 For example in discussing the pro's and con's of multinational corporate investment in developing countries it has been suggested that one of the most serious "con's" of this type of investment is that it typically entails few backward linkages to other sectors of the economy. D.K. Helleiner, "Manufactured Exports from Less Developed Countries and Multinational Firms", The Economic Journal, Vol. 83, No. 329 (March 1973) p. 21-47.

Having singled out decision-making ability as the binding constraint to development, Hirschman's model ignores other considerations which may in reality be equally important. As we have demonstrated, factor proportions considerations may rule against industries with strong backward linkages to other relatively capital intensive industries. Moreover, economies of scale considerations might also mitigate the appropriateness of the linkage hypothesis in a particular developing country. If, for example, a country is small either in terms of population or domestic resources, economies of scale considerations may recommend concentration on a relatively few, self-contained, "footloose" industries. If we examine the economies in which footloose industry has flourished, we find generally small, export oriented countries in which the structure of production conforms rather well to existing factor endowments. The fact that these countries dominate the exclusive group of superlative economic performers in post-war period provides some casual evidence that linkages are not particularly important.  

There is little doubt that the supply of entrepreneurship is a severe constraint to development. What is at question, however, is whether linkages provide an effective mechanism for generating entrepreneurship, and decision-making. According to the Hirschman hypothesis, the creation of bottlenecks induces entrepreneurs to come forward. At the same time, we know from the experience of many underdeveloped countries, particularly those of Latin America, that the creation of bottlenecks has other consequences which most profoundly inhibit the supply of entrepreneurship. Moreover, if one considers the intricate and innovative

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1 A direct test of the linkage hypothesis à la Hirschman has recently been published. However the results (which rejected the extreme interpretation of the theory, but confirmed a modified interpretation) are highly suspect on methodological grounds. See, Pan A. Yotopoulos and Jeffrey B. Nugent, "A Balanced-Growth Version of the Linkage Hypothesis: A Test", The Quarterly Journal of Economics, Vol. LXXXVII, No. 2, (May 1973) pp. 157-71.
ways in which people of developing countries deal with adversity (black markets are a prime example) it is apparent that decision-making ability is not altogether lacking. What is lacking is the incentive to apply this ability to productive enterprise. Whether the lack of incentive is the result of not knowing what to do because perhaps the bottlenecks (opportunities) are not obvious enough, or the result of government policy and the consequences of government policy which inhibit the market mechanism from transmitting the appropriate incentives is an open question which demands more attention than it has yet received. Certainly the mere existence of linkages is insufficient to ensure that inducements will indeed be generated. To speak of a certain amount of decision-making (output or employment) being "generated" throughout the economy via backward linkages implicitly assumes that demand creates its own supply. Such an assumption for developing countries at this point in history is at least as naive as the reverse assumption was for industrial countries in earlier times (pre Keynes). To conclude, one can find little a priori reason to favor linkage considerations à la Hirschman over factor proportions or economies of scale considerations in designing the appropriate industrialization strategy for a developing country.
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