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A Test Applied to Ecuador

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1. Introduction

How stable are input-output relations? Input-output analysis has been and still is a frequently applied tool for planning and policy design in developing countries (LDCs). Input-output relations underly many industrial planning techniques and form core elements of policy analysis based on social accounting matrices (SAMs) and multisectoral general equilibrium models. Stability (constancy) of input-output relations is a standard key assumption underlying this type of analysis geared towards projections of sectoral growth paths in the future and evaluation of policy simulations. It is thus assumed that technological change is slow and will not change during the planning period or period of analysis. However, since the construction of input-output tables tends to be costly and time-consuming, particularly in LDCs (e.g. Bulmer-Thomas, 1982), the periods of analysis may extend over a considerable number of years. In the same vein, recent input-output tables are often hard to come by, questioning the relevance of the policy analysis if it is based on seemingly outdated input-output relations.

This paper is concerned with input-output relations in the context of LDC economies and their stability over time, particularly in the medium run of a typical planning or policy analysis period (five years). The approach is comparative statics, i.e. comparing input-output relations at two points in time. Data analysis is applied to two input-output tables constructed for

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Ecuador for 1975 and 1980 using the same set up and sector and commodity breakdown, but independent primary data sources. This allows to analyze: (i) the nature and magnitude of changes in input-output relationships in the Ecuadorian economy during a period of rapid growth in the 1980s; (ii) determine the implications for changes in sectoral growth projections and inter-industry linkages; (iii) facilitate an understanding of the factors underlying these changes; and (iv) assess whether updates of input-output tables may be realistically based on projections of existing tables allowing for the preparation of new tables at frequent intervals.

Most related work on the stability of input-output relations has been concerned with techniques to update or forecast input-output tables for developed countries (e.g. Tilanus 1966; Barker 1975; Lynch 1979). Little evidence is available for LDCs, while the available evidence has tended to be based on highly aggregate, not strictly comparable input-output tables (Gaiha 1980). This paper analyzes comparable and fairly disaggregated input-output tables, which take into account the typical features of production structures in LDCs (e.g. modern and traditional technologies) and market segmentation due to differences in product quality (e.g. machine-made vis-à-vis hand-made). A methodology is elaborated to test the degree of stability of input-output tables for two reference years. A decomposition method is introduced to identify different sources of changes in input-output relations: (i) technological change; (ii) import-substitution and (iii) changes in market shares. It is concluded that the assumption of stable input-output relations in the medium run can be 'workable' under the condition of a proper disaggregation of the input-output table. A fair degree of stability is observed in the structure of production linkages in Ecuador despite accelerated, though sectorally unbalanced growth. Where significant changes in input-output relations were observed, these are considered 'predictable' and related to policy-biases: policies supporting more capital-intensive production technologies and import-substitution policies. Leaving aside other limitations of input-output analysis - such as the ignorance of endogenous technological change, changes in relative price and production capacity limits - these conclusions create optimism about the use of input-output analysis for medium-term planning and the use op updating techniques from existing input-output tables. Thus updating some crucial relationships in key sectors, e.g. through sample surveys, may be acceptable as an alternative to preparing costly new input-output tables at frequent intervals. However, such a conclusion should not preclude, but rather complement, work on integral updates of input-output tables at medium-run intervals.

The remainder of this paper is organized as follows. First, a simple and general methodology of testing the stability of input-output relations is given in Section 2. Second, the adaptation of the methodology to the particular features of the input-output tables for Ecuador, acknowledging typical features of LDC production structures, is given in the subsequent Section 3. Third, Section 4 supplies the data analysis.

2. General methodology

In this paper stability in input-output relations will be refered to in terms of the impact of technology changes on sectoral output projections and on multisectoral investment plans based on key sector identification for fulfilling growth and employment targets. The choice of the methodology is limited by the fact that there are only two input-output tables for Ecuador, which have adequate disaggregation to reflect the specific features of the economy, which are comparable in terms of coverage and valuation and which have been estimated from independent data sources (i.e. the one is not a mere extrapolation of the other).[1] Rigorous statistical analysis of inter-industry dynamics is thus limited to the comparative statics of two points in time. Whether changes in input-output relations are random, exogenous or systematic can only be conjectured with the help of supplementary analysis and evidence from other sources and methods.

The method applied here departs from the standard input-output model:

$$x = Ax + f \tag{1}$$

where: x = vector of output by production activity;
A = matrix of input-output, technical coefficients;
f = vector of final demand (by activity or commodity).

Solving gives:

$$x = (I - A)^{-1}f \tag{2}$$

If input-output relations are stable, output can be projected by using the same Leontief inverse $[(I-A)^{-1}]$ for exogenous changes in final demand or input requirements and final demand changes may be calculated for given (industry) growth targets. The availability of two input-output tables allows to isolate the impact of changes in input-output relations on output projections. Defining t as a subscript for the base year, equation (2) becomes:

$$x_t = (I - A_t)^{-1}f_t \tag{3a}$$

and for the updated input-output table:

$$x_{t+k} = (I - A_{t+k})^{-1}f_{t+k} \tag{3b}$$

To evaluate the impact of changes in the input-output relations output is simulated by interchanging the technical coefficients for the base year (t) and those for year for which the updated input-output table is available (t+k):

$$x_t^* = (I - A_{t+k})^{-1}f_t \tag{4a}$$

and

$$x_{t+k}^* = (I - A_t)^{-1}f_{t+k} \tag{4b}$$

where x_t^* and x_{t+k}^* are the simulated output vectors capturing changes in technical coefficients and inter-industry linkages. Input-output relations are completely stable if:

$$x_t^* - x_t = 0 \tag{5a}$$

and

$$x_{t+k}^* - x_{t+k} = 0 \tag{5b}$$

To analyze the relative importance of changing input-output relations, the simulated industry output may be expressed as a relative change to actual output:

$$z_1 = (x_t^* - x_t)/x_t \tag{6a}$$

$$z_2 = (x_{t+k}^* - x_{t+k})/x_{t+k} \tag{6b}$$

If $z_1 > 0$ and $z_2 < 0$, then it can be said that (domestic) production linkages or inter-industry interdependence have increased due to technological change that has taken place between t and t+k, and the converse holds if $z_1 < 0$ and $z_2 > 0$. Stability of input-output relations will be larger, the closer z_1 and z_2 are to zero. It is, however, less easy to define precise criteria for the significance of the degree of instability. One may consider cases where $z_i > 1$ and $z_i < -1$ as situations where there is extreme instability or of major technological change, but also most of the range where $0 < |z_i| < 1$ may reflect substantial instability. One way of approaching this difficulty is to relate instability measures to policy uses of input-output analysis, i.e. how would the assumption of stable input-output relations influence policy decisions?

One of the most widespread uses of input-output tables is that for the analysis of inter-industry linkages or 'spread effects' in production and employment. Hirschman (1958) gave a major push to this type of analysis. Inducement mechanisms resulting from certain investment decisions can be analyzed by making proper use of the information stored in the values of the elements of the Leontief inverse. Forward linkages, or output-utilization effects, are defined by the row elements of the matrix. These linkages indicate that activities do not cater all its produce to final demand, but will induce to utilize its output as inputs in other activities. Backward linkages, the column elements, refer to input-provision effects, i.e. expansion of the activity level in one sector will induce increased demand for inputs needed in that sector. 'Key sectors' in the economy can be defined by a high degree of linkage effects, either expressed in output or employment terms. Such analysis has been particularly influential in policy-making in LDCs with respect to sectoral investment programmes, industrial incentive policies and employment policies (e.g. Hirschman 1958; Polenske and Skolka 1976; Bulmer-Thomas 1982).

The 'stability' of inter-industry relations can be measured in a policy context by comparing the linkage or dispersion indices of economic activities for year t and t+k. Socalled dispersion indices of backward and forward production linkages can be defined as:

$$BL_j = \frac{1/n \sum_i l_{ij}}{1/n^2 \sum_{ij}\sum l_{ij}} \qquad (7a)$$

$$FL_i = \frac{1/n \sum_j l_{ji}}{1/n^2 \sum_{ji}\sum l_{ji}} \qquad (7b)$$

where l_{ij} are the elements of the Leontief-inverse. The index of total linkages can be defined for each activity as TL = (BL + FL)/2. If TL > 1, then a sector is considered to create relatively high production linkage effects, conversely, if TL < 1, then the industry has lower production linkages. A fairly crude, but policy-relevant test of the stability of inter-industry relations over time could thus be to compare the ranking of key sectors, identified by their degree of production (and employment) linkages, for both Leontief inverses. Rank correlation analysis[2] may serve as an instrument to determine the sensitivity of the degree of stability and instability of input-output relations for key-sector analysis and thereupon based policy analysis.

3. LDC economic conditions and input-output tables for Ecuador

The literature on input-output analysis contains some work on mathematical-statistical methods to update or forecast input-output tables from a base year (Tilanus 1966, Barker 1975, Allen and Gosling 1979, Lynch 1979). Much of this work was abandoned as comparisons with newly constructed input-output tables gave rise to serious doubts about the reliability of the assumption of stable input-output relations applied in the updating and forecasting procedures (De Boer 1979; Bulmer-Thomas 1982). The available evidence that concludes to instability of coefficients in the medium run refers almost exclusively to input-output tables for developed economies characterized by fairly integrated and homogeneous production structures, where there is continuous and endogenous technological change and where price signals seem to be important in the choice of techniques. Such dynamic elements may be far less significant in LDC economies, characterized by large technological dualities, exogenous (imported) technological change and where market segmentation and limited resource supplies distort the functioning of price signals. The stability of input-output relations in LDCs may thus be much larger if input-output tables are available that have taken the mentioned structural features into account in the disaggregation of industries and commodities.

Two input-output tables constructed for Ecuador for 1975 and 1980 fit such a criterion. Both authors were involved in the construction of both matrices (Alarcon, De Labastida and Vos 1984). For both years separate, but comparable sectoral survey and census data were used for the construction. The input-output tables were constructed to serve as a planning tool for basic needs satisfaction (Teekens, Barreiros, Kouwenaar and Vos 1988; Vos 1987). Within that context specific criteria were developed to classify commodities and industry production. As to commodities, a particular interest was to differentiate 'basic' from 'non-basic' goods and services. On the basis of consumption analysis major products satisfying basic human needs were separated (Barreiros 1988), while certain product qualities were distinguished to identify, within the same product category, different market segments of non-homogeneous commodities (e.g. machine-made and hand-made textiles and footwear). In order to be able to monitor adequately who benefits from growth, what degree of technological duality exists and what degree of external dependence characterizes domestic production, the production of commodities was disaggregated by different levels of technology and intermediate deliveries were separated by domestic and imported components. Traditional and modern, labour- and capital-intensive, large and small-scale industries were distinctions made to classify industries by technology level (activities). In agriculture three technology levels are distinguished: (i) large-scale (I: > 100 ha of landholding) and relatively mechanized production; (ii) small to medium scale (II: 5-100 ha), mostly traditional production and (iii) small scale, subsistance and family farming (III: 0-5 ha). For manufacturing, modern, large-scale (L) and small-scale (S) technology levels are separated together with a third technology level of family-based, handicraft manufacturing. Services sectors, where relevant, are separated by type of organization into 'formal' and 'informal' services.[3] The application of the indicated criteria resulted in a classification of

106 production activities (sectors and technology levels) and 70 commodities, while the input-output table was complemented by a domestic production matrix (or 'make matrix') and an import matrix at the same level of disaggregation. The make matrix is required to map domestic production of commodities to production activities, and is further required to ensure a unique solution for the non-square input-output table.[4]

Given these features of the Ecuadorian input-output tables, the basic methodology elaborated in section 2 will have to be adapted.

The basic equations of the modified input-output model can be presented as follows:

$$q = Ax - Mx + f - f^m \tag{8}$$

$$m = Mx + f^m \tag{9}$$

$$x = Qq \tag{10}$$

where: q = vector of domestic output per commodity (nx1);

x = vector of domestic output per production activity (mx1);

Q = matrix of domestic market shares of production activities by commodities (mxn). The typical element of Q is q_{ji} which is the market share of activity j in the market for commodity i. The condition is satisfied that $\sum_j Q_{ji} = 1.00$

A = matrix of total input-output or technical coefficients (nxm);

M = matrix of the import components of input-output coefficients (nxm);

f = vector of total final demand by commodities (nx1);

f^m = vector of imported final goods and services (nx1).

m = vector of total imported goods and services (nx1).

Defining the domestically produced component of final demand as f^d ($f^d = f - f^m$) and substituting (10) in (9) and (8) and collecting terms yields the following partitioned matrix:

$$\begin{bmatrix} q - (A - M).Q.q & 0 \\ -M.Q.q & m \end{bmatrix} = \begin{bmatrix} f^d \\ f^m \end{bmatrix} \tag{11}$$

solving the system in (11) we have

$$\begin{bmatrix} q \\ m \end{bmatrix} = \begin{bmatrix} [I - (A - M)Q]^{-1} & 0 \\ M.Q[I - (A - M)Q]^{-1} & I \end{bmatrix} \cdot \begin{bmatrix} f^d \\ f^m \end{bmatrix} \qquad (12)$$

The Leontief inverse has dimensions of the number of commodities (i.e. n= 70). One could also bring the multiplier matrix to the original dimensions of the input-output table and define the domestic activity output (x) and intermediate imports by activitiy (m^a) by pre-multiplying the upper and lower matrices in (12) by the market share coefficient matrix Q (or make matrix) and obtain the following solution:[5]

$$\begin{bmatrix} x \\ m^a \end{bmatrix} = \begin{bmatrix} Q[I - (A - M)Q]^{-1} & 0 \\ Q\ M\ Q[I - (A - M)Q]^{-1} & Q \end{bmatrix} \begin{bmatrix} f^d \\ f^m \end{bmatrix} \qquad (13)$$

Notice that for such model solution the assumption of constant market shares is required (see also Hoffman and Kent 1979, Polenske and Skolka 1976 and Alarcon 1988). This assumption is consistent, however, with the requirements in the construction of the input-output tables to define homogeneous commodities and homogeneous activities in terms of technology structure. Only if these requirements are met, economically interpretable results can be obtained through the calculation of the Leontief-inverse (also Bulmer-Thomas 1982).

For a proper comparison of the 1975 and 1980 input-output tables for Ecuador they should be valued at constant prices. As indicated earlier the tables were constructed independently from each other, but the same construction methodology and commodity and activity breakdowns were used. This has led to two input-output tables valued at current prices of each year of reference. The 1980 input-output table at constant prices of 1975 was obtained by using the double-deflation method[6].

The basic methodology for the test of the degree of coefficients stability can now be modified to include the features of the Ecuadorian input-output tables. As there are three possible sources of instability, namely A, M and Q equations (4) to (6) can be 'decomposed' to simulate the effects of changes in each matrix of either q in (12) or x in (13). Solving for q_{t+k} and assuming constant domestic final demand gives:

$$q_{t+k} = [I - (A_{t+k} - M_{t+k}) \cdot Q_{t+k}]^{-1} \cdot f^{d}_{t+k} \tag{14a}$$

$$q^{*}_{t+k} = [I - (A_{t} - M_{t}) \cdot Q_{t}]^{-1} \cdot f^{d}_{t+k} \tag{14b}$$

and the impact of each set of coefficients can be measured as follows:

<u>for A</u>

$$q^{*}_{1} = [I - (A_{t} - M_{t+k}) \cdot Q_{t+k}]^{-1} \cdot f^{d}_{t+k} \tag{14c}$$

<u>for M</u>

$$q^{*}_{2} = [I - (A_{t+k} - M_{t}) \cdot Q_{t+k}]^{-1} \cdot f^{d}_{t+k} \tag{14d}$$

<u>for Q</u>

$$q^{*}_{3} = [I - (A_{t+k} - M_{t+k}) \cdot Q_{t}]^{-1} \cdot f^{d}_{t+k} \tag{14e}$$

<u>for the combined A and M</u>

$$q^{*}_{4} = [I - (A_{t} - M_{t}) \cdot Q_{t+k}]^{-1} \cdot f^{d}_{t+k} \tag{14f}$$

<u>for the combined A and Q</u>

$$q^{*}_{5} = [I - (A_{t} - M_{t+k}) \cdot Q_{t}]^{-1} \cdot f^{d}_{t+k} \tag{14g}$$

<u>and for the combined M and Q</u>

$$q^{*}_{6} = [I - (A_{t+k} - M_{t}) \cdot Q_{t}]^{-1} \cdot f^{d}_{t+k} \tag{14h}$$

where the vectors and matrices for t+k are at constant prices of t. Equation (6b) can now be rewritten in terms of relative total effect variations as:

$$z = (q^{*}_{t+k} - q_{t+k}) / q_{t+k} \tag{15a}$$

and for the relative partial effect variations, for A, M and Q:

$$z_{1} = (q^{*}_{1} - q_{t+k}) / q_{t+k} \tag{15b}$$

$$z_{2} = (q^{*}_{2} - q_{t+k}) / q_{t+k} \tag{15c}$$

$$z_{3} = (q^{*}_{3} - q_{t+k}) / q_{t+k} \tag{15d}$$

plus the three effects of combining two sources of changes at the time. For this paper only the separate effects will be considered, as the sum of all three roughly exhaust the total effect, see column RES in tables 1 and 2. In (15a) - (15d) a $z > 0$ means that in the year t+k domestic production linkages tend to have decreased vis-à-vis the situation in the base year t. Similarly, the stability test can be applied for the impact of changes in A, M and Q on output by production activities (x), i.e.:

$$y = (x^*_{t+k} - x_{t+k}) / x_{t+k} \tag{16a}$$

where $x^*_{t+k} = Q_{t+k} q^*_{t+k}$

For the relative partial effect variations, for A, M and Q we derive:

$$y_1 = (x^*_1 - x_{t+k}) / x_{t+k} \tag{16b}$$

$$y_2 = (x^*_2 - x_{t+k}) / x_{t+k} \tag{16c}$$

$$y_3 = (x^*_3 - x_{t+k}) / x_{t+k} \tag{16d}$$

Note that in (16d) $x^*_3 = Q_t q^*_3$.

If z and y are substantially different from zero, then there is no stability of coefficients. Estimation of z_1, z_2, z_3 and y_1, y_2 and y_3 is required to determine whether the source of instability is technological change (A), import substitution (m) or changes in market shares (Q).

If all three partial effects are additive (which is not a necessary condition), then it should hold that:

$$RES_z = z - z_1 - z_2 - z_3 = 0 \tag{17a}$$

$$RES_y = y - y_1 - y_2 - y_3 = 0 \tag{17b}$$

Otherwise, part of the instability is to be explained by residual, multiplicable effect of z_1, z_2 and z_3 or y_1, y_2 and y_3. Below in Tables 1 and 2, these residuals are given in colum 5 and from a quick inspection it appears that in nearly all cases these approximate zero. In a few cases (10% of the number of commodities in Table 1) the residual is substantially different from zero and coincides with relatively high values of z_1, z_2 or z_3.

4. Results of stability test for Ecuador

The period under analysis (1975-1980) is characterized by accelerated growth of the Ecuadorian economy. Ecuador became a net oil exporter in 1972 and could benefit from the 1973/74 oil prise rise and in subsequent years the country participated in the financial boom of external bank credits to middle-income developing countries. This foreign-exchange boom fueled growth of particularly non-traded goods and import-substituting industrial sectors (Vos 1989). During the 1970s overall economic growth averaged around 9 percent per annum. Growth of manufacturing industry was even slightly above 10 percent per annum. Investment rates stepped up, particularly in modern technology with a large imported component. The growth strategy strengthened unbalanced and disarticulated sectoral development. Sectoral imbalances form an important element in adjustment problems which the economy had toface in the 1980's when external conditions turned less favourable. These problems are not the subject matter of our present discussion, however.[7] This background of accelerated growth, rapid industrialization and modernization would suggest, however, that most input-output relations may have changed substantially during the period of reference. The results of the comparative analysis confirm this expectation, but at the same time changes in input-output relations tend to be concentrated in a limited number of sectors, leaving a good degree of medium-run stability in the rest of the system.

The stability test was carried out along the lines outlined in the previous sections. As a first step the test for total effect variations implied by equations (15a) and (16a) was carried out. Secondly the test of technology changes was carried by calculating equations (15b) and (16b). Since the input-output system was solved for domestic production and domestic input-output linkages, a future source of change in input-output relations could be import substitution, this was tested using equations (15c) and (16c); this is checked as a third step. Changes in sectoral market shares between 1975 and 1980 could be another source of change in input-output relations. These aspects are analyzed as a fourth step via equations (15d) and (16d). Finally, the consequences of the changes in input-output relations for policy analysis based on production and employment linkages are analyzed.

4.1 Stability of input-output relations

Since we are interested in changes in input-output relations, final demand has been kept constant for all simulations discussed below.

Table 1 gives the results for the test of equations (15a) to (15d) (solution for commodities), while Table 2 presents the results for equations (16a) to (16d) (solution for output by production activities).

We defined $-0.10 < z < +0.10$ and $-0.10 < y < +0.10$ as the reference range of relative stability of input-output relations. Outside the area there would be instability. If z and y are positive, total domestic production linkages in the current year (t+k=1980) are lower than those on the basis of the input-output relations of year t (1975). A negative z and y would point at an increase of total domestic production linkages in 1980.

Table 1 indicates that in the case of 41 percent of the 70 commodities there have been substantial changes, of which most cases lie in the range of $|0.10| < z < |0.25|$. The principal cases where total domestic production linkages increased ($z < -0.10$) include: barley (06), wheat (07), crude oil (21), other mining (22), processed fish (23), processed coffee and other processed food (32), machine-made textiles (35A), leather (37), wood and furniture (39A), oil refinery (41), chemicals (42), machinery (44), communications (50) and rural financial services (51B). Cases in which production linkages have decreased ($z > +0.10$) are: coffee (02), cocoa (03), sugarcane (04), rice (09), three minor agricultural crops (naranjilla, onion and tomato), other agricultural products (17), livestock (18A) and (18B), fishing and hunting (20), oils and fats (31A), hand-made textiles (35B), urban financial services (51A) and household services (55B).

Table 1
Simulation of Changes in input-output coefficients
Ecuador 1975 and 1980: commodities

Commodities		z	z_1	z_2	z_3	RES_z
01	Banana	-0.016	-0.017	0.000	0.000	0.001
02	Coffee	1.194	1.152	0.007	-0.015	0.049
03	Cocoa	0.399	0.365	0.002	0.000	0.032
04	Sugarcane	0.354	0.316	-0.001	0.036	0.003
05	Potato	0.047	0.045	0.001	-0.002	0.003
06	Barley	-0.352	-3.678	1.776	0.009	1.540
07	Wheat	-0.225	0.556	-0.947	0.148	0.018
08	Soft Maize	-0.037	-0.038	0.002	0.006	-0.007
09	Rice	0.233	0.236	0.006	-0.028	0.019
10	Cassave (Yuca)	0.063	0.017	0.000	0.009	0.037
11	Orange	0.074	0.071	0.004	-0.005	0.004
12	Naranjilla	0.455	0.467	0.001	-0.001	-0.012
13	Onion	0.215	0.215	0.001	-0.004	0.002
14	Cabbage	0.013	0.013	0.000	0.000	0.000
15	Tomato	0.121	0.120	0.000	-0.001	0.002
16	Beans	0.020	0.020	0.000	0.000	0.000
17	Oth. agric.prod.	0.239	0.031	0.050	-0.008	0.166
18A	Lstk-bovine/meat	0.130	0.143	-0.029	-0.003	0.020
18B	Livestock-milk	0.101	0.105	0.017	-0.036	0.015
18C	Poultry, eggs	-0.002	0.003	0.000	-0.003	-0.003
18D	Other livestock	0.060	0.020	0.027	0.000	0.013
19	Forestry	0.015	-0.028	0.041	-0.158	0.160
20	Fish.& hunting	0.227	0.227	0.001	-0.001	0.000
21	Crude oil	-0.211	-0.132	0.009	0.003	-0.091
22	Other mining	-0.242	-0.471	0.193	-0.013	0.048
23	Processed fish	-0.315	-0.316	0.003	0.000	-0.002
24	Processed meat	0.097	0.117	-0.050	-0.004	0.034
25	Milling products	-0.003	-0.020	0.005	-0.007	0.018
26A	Bread	-0.018	-0.019	0.002	-0.005	0.003
26B	Vermic. & alike	-0.006	-0.006	0.001	-0.003	0.002
27	Refined sugar	0.001	0.011	-0.001	-0.004	-0.005
28	Crud.sug(panela)	0.006	0.006	0.000	0.001	-0.001
29A	Processed milk	-0.053	-0.210	0.115	-0.003	0.045
29B	Oth.dairy prod.	0.073	0.068	0.001	0.001	0.003
30	Process cocoa	-0.044	-0.045	0.000	0.000	0.000
31A	Oils&fats, crude	0.392	-0.142	0.373	-0.002	0.163
31B	Oils&fats,edible	0.082	0.103	-0.010	-0.003	-0.009
32	Process.coff.oth	-0.196	-0.217	0.016	-0.007	0.013
33A	Non-alcho.bevera	-0.011	-0.006	-0.002	-0.003	0.000
33B	Alcoh.beverages	-0.023	-0.017	-0.001	-0.005	0.001
34	Tobacco	0.000	0.000	0.000	0.000	0.000
35A	Text.machine-made	0.119	-0.444	0.265	-0.009	0.070
35B	Text.hand-made	0.509	0.526	0.023	-0.028	-0.012
36	Clothing	0.028	0.013	0.001	0.000	0.013
37	Leather products	-0.357	-0.379	0.019	0.152	-0.149
38A	Footwear mac.mad	-0.005	-0.008	0.001	0.001	0.000
38B	Footwear handmad	-0.007	-0.009	0.000	0.006	-0.004
39A	Wood/furnt.h.qua	-0.112	-0.222	0.034	0.205	-0.129
39B	Wood/furnt.rusti	0.005	-0.048	0.054	0.013	-0.015
40	Paper & printing	0.092	-0.097	0.211	-0.074	0.051
41	Oil refinery	-0.228	-0.604	0.382	0.006	-0.011
42	Chemical prod.	-0.143	-0.609	0.586	-0.025	-0.095
43	Basic min&metpro	-0.002	-0.304	0.328	-0.009	-0.017
44	Mach&transp equ	-0.142	-1.166	1.165	-0.005	-0.136
45	Other manufactur	-0.023	0.064	-0.068	0.005	-0.023
46	Electr.,gas&water	0.013	-0.047	0.051	0.002	0.007
47	Construction	0.014	0.013	0.004	-0.001	-0.003
48	Commerce	0.076	0.017	0.037	-0.002	0.024
49	Transport	0.013	-0.012	0.022	-0.018	0.020
50	Communication	-0.137	-0.161	0.051	-0.043	0.016
51A	Urban fin. serv.	0.118	-0.145	0.211	-0.028	0.080
51B	Rural fin. serv.	-0.182	0.173	0.008	-0.020	0.021
52	Rental housing .	-0.019	-0.011	0.004	-0.020	0.009
53	Serv. to enterpr	-0.065	-0.113	0.040	-0.021	0.029
54A	Hot/bars&rest for	0.056	-0.061	0.020	-0.045	0.031
54B	Hot/bars&rest inf	0.030	-0.026	0.003	-0.009	0.002
55A	Househ.serv.form.	0.027	0.021	0.007	-0.002	0.002
55B	Househ.serv.infor	0.138	0.129	0.000	0.000	0.009
56	Governm.services	0.000	0.000	0.000	0.000	0.000
57	Other goods&serv.	0.000	0.000	0.000	0.000	0.000

Source: Input-output tables for Ecuador, 1975 and 1980. See Alarcon, De Labastida and Vos (1984)

Table 2
Simulation of Changes in input-output coefficients
Ecuador 1975 and 1980: Production Activities

Activities			y	y_1	y_2	y_3	RES_y
01	Banana I		-0.105	-0.017	0.000	-0.090	0.002
01	II		0.010	-0.017	0.000	0.026	0.000
01	III		0.158	-0.017	0.000	0.178	-0.002
02	Coffee I		1.067	1.152	0.007	-0.072	-0.021
02	II		1.461	1.152	0.007	0.106	0.196
02	III		0.546	1.152	0.007	-0.306	-0.308
03	Cocoa I		0.262	0.365	0.002	-0.098	-0.007
03	II		0.700	0.365	0.002	0.216	0.118
03	III		-0.225	0.365	0.002	-0.446	-0.146
04	Sugarcane I		0.360	0.316	-0.001	0.040	0.004
04	II		0.438	0.316	-0.001	0.100	0.022
04	III		-0.121	0.316	-0.001	-0.328	-0.109
05	Potato I		0.080	0.045	0.001	0.030	0.005
05	II		-0.039	0.045	0.001	-0.084	-0.001
05	III		0.173	0.045	0.001	0.119	0.009
06	Barley I		-0.363	-3.678	1.776	-0.008	1.546
06	II		-0.295	-3.678	1.776	0.098	1.508
06	III		-0.418	-3.678	1.776	-0.094	1.577
07	Wheat I		-0.195	0.556	-0.947	0.193	0.004
07	II		-0.211	0.556	-0.947	0.169	0.011
07	III		-0.286	0.556	-0.947	0.058	0.048
08	Soft maize I		-0.130	-0.038	0.002	-0.091	-0.003
08	II		0.014	-0.038	0.002	0.059	-0.009
08	III		-0.054	-0.038	0.002	-0.012	-0.006
09	Rice I		0.146	0.236	0.006	-0.097	0.000
09	II		0.201	0.236	0.006	-0.053	0.012
09	III		0.308	0.236	0.006	0.031	0.035
10	Cassave(Yuca) III		0.063	0.017	0.000	0.009	0.037
11	Orange II		0.074	0.071	0.004	-0.005	0.004
12	Naranjilla III		0.455	0.467	0.001	-0.001	-0.012
13	Onion III		0.215	0.215	0.001	-0.004	0.002
14	Cabbage III		0.013	0.013	0.000	0.000	0.000
15	Tomato II		0.121	0.120	0.000	-0.001	0.002
16	Beans II		0.020	0.020	0.000	0.000	0.000
17	Oth.agr. prod. II		0.239	0.031	0.050	-0.008	0.166
18	Livestock I		0.039	0.108	-0.009	-0.073	0.012
18	II		0.099	0.083	-0.004	0.004	0.016
18	III		0.155	0.084	-0.006	0.068	0.008
19	Forestry III		0.015	-0.028	0.041	-0.158	0.160
20	Fish.&hunting III		0.227	0.227	0.001	-0.001	0.000
21	Crude Oil	L	-0.211	-0.132	0.009	0.003	-0.091
22	Other mining	S	-0.242	-0.471	0.193	-0.013	0.048
23	Processed fish	L	-0.315	-0.316	0.003	0.000	-0.002
24	Processed meat	S	0.097	0.117	-0.050	-0.004	0.034
25	Milling prod.	L	0.140	-0.020	0.005	0.136	0.019
25		S	-0.090	-0.020	0.005	-0.094	0.018
26	Bread	S	-0.433	-0.009	0.001	-0.430	0.005
26	Bread	A	0.200	-0.018	0.002	0.214	0.001
27	Refined sugar	L	0.001	0.011	-0.001	-0.004	-0.005
28	Crude sug(panela)	A	0.006	0.006	0.000	0.001	-0.001
29	Processed milk	L	0.128	-0.196	0.109	0.186	0.029
29		S	-0.081	-0.073	0.059	-0.070	0.003
29		A	-0.167	-0.050	0.049	-0.223	0.057
30	Processed cocoa	L	-0.044	-0.045	0.000	0.000	0.000
31	Oils&fats,crude	L	0.212	0.001	0.150	-0.002	0.063
32	Proc.coff.&oth.	S	-0.196	-0.217	0.016	-0.007	0.013
33	Beverages	L	-0.045	-0.011	-0.002	-0.033	0.001
33		A	0.125	-0.017	-0.001	0.145	-0.002
34	Tobacco	L	0.000	0.000	0.000	0.000	0.000
35	Textiles	L	0.057	-0.444	0.265	0.189	0.048
35		S	0.160	0.234	0.096	-0.192	0.023
35		A	0.611	0.526	0.023	0.038	0.025
36	Clothing	S	-0.097	0.013	0.001	-0.122	0.010
36		A	0.027	0.013	0.001	-0.001	0.013
37	Leather prod.	S	-0.252	-0.379	0.019	-0.149	0.256
37		A	-0.612	-0.379	0.019	-0.304	0.052
38	Footwear	S	0.006	-0.008	0.001	0.154	-0.142
38		A	0.294	-0.009	0.000	0.431	-0.128
39	Wood&furniture	L	-0.482	-0.222	0.034	-0.297	0.003
39		S	0.245	-0.074	0.051	0.411	-0.143
39		A	0.850	-0.048	0.054	0.865	-0.022
40	Paper	L	0.157	-0.097	0.211	-0.018	0.061
40	Printing	L	0.004	-0.097	0.211	-0.148	0.038
41	Oil refinery	L	-0.228	-0.604	0.382	0.006	-0.011
42	Paint& farmac.	L	-0.424	-0.609	0.586	-0.344	-0.056
42	Industr.chem	S	0.592	-0.609	0.586	0.811	-0.196
42	Rubber & plast.	S	-0.101	-0.609	0.586	0.022	-0.101

(Table 2, Continued...)

43	Cement	L	0.056	-0.304	0.328	0.048	-0.017
43	Other non-met.	S	-0.338	-0.304	0.328	-0.343	-0.019
43	Basic metalic	L	0.211	-0.304	0.328	0.202	-0.015
43	Metalic prod.	S	0.298	-0.304	0.328	0.289	-0.015
43		A	-0.383	-0.304	0.328	-0.387	-0.020
44	Machinery	L	1.980	-1.166	1.165	2.458	-0.477
44	Electrical eq.	L	-0.290	-1.166	1.165	-0.176	-0.112
44	Transp. equip.	S	-0.347	-1.166	1.165	-0.242	-0.103
45	Other manuf.	A	-0.023	0.064	-0.068	0.005	-0.023
46	Elec. gas&water	L	0.013	-0.047	0.051	0.002	0.007
47	Construction	F	-0.108	0.013	0.004	-0.120	-0.004
47		IN	-0.012	0.013	0.004	-0.026	-0.003
47	Public Works	F	0.112	0.013	0.004	0.096	-0.001
48	Commerce	F	0.291	0.017	0.037	0.198	0.039
48		IN	-0.231	0.017	0.037	-0.287	0.001
49	Transport commu.	F	0.082	-0.012	0.022	0.049	0.023
49		IN	-0.096	-0.012	0.022	-0.124	0.017
50	Communication	F	-0.137	-0.161	0.051	-0.043	0.016
51	Fin. services	F	0.095	-0.145	0.211	-0.048	0.077
51		IN	0.231	0.173	0.008	0.022	0.028
52	Rental housing	F	-0.019	-0.011	0.004	-0.020	0.009
53	Serv.to enterpr.	F	-0.065	-0.113	0.040	-0.021	0.029
54	Hotels,bars,rest.	F	-0.056	-0.061	0.020	-0.045	0.031
54		IN	-0.030	-0.026	0.003	-0.009	0.002
55	Household serv.	F	0.027	0.021	0.007	-0.002	0.002
55		IN	0.138	0.129	0.000	0.000	0.009
56	Government serv.	F	0.000	0.000	0.000	0.000	0.000
57	Other goods	O	0.000	0.000	0.000	0.000	0.000
57	Imputed banking	O	0.000	0.000	0.000	0.000	0.000

Source: Input-output tables for Ecuador, 1975 and 1980. See Alarcon, De Labastida and Vos (1984).

Symbols
- I Farm units larger than 100 has
- II Farm units between 5-100 has
- III Farm units smaller than 5 has
- L. Large scale units
- S Small scale units
- A Handycraft and family producing units
- F Formal sector units
- IN Informal sector units
- O Adjustment activities

For production activities (Table 2) the degree of instability apppears to be even greater: about 62% of the number of activities exceed the 10%-degree of deviation ($|y|>0.10$). In addition to the commodities/activities mentioned above changes occurred in bananas (01-I and -III), potatoes (05-II), soft maize (08-I), milling products (25-L), bread (26-S and -A), processed milk (29-L, -S and -A), processed cocoa (30-L), beverages (33-A), construction (47-F) and commerce (48-F and -IN).

These are quite a number of cases relating to principal sectors of the economy and one is inclined towards a conclusion that would reject the hypothesis of medium-term stability of input-output relations, particularly in a dynamic economic growth process. The degree of detail of the input-output tables allows, however, to trace the sources of technical change. It appears that most changes have to do with the industrialization process geared towards import substitution and with the foreign exchange abundance that stimulated use of import-intensive technologies (see below).

As indicated above the information just presented is not sufficient to judge whether the source is technological (A), trade dependent (M) or demand changes inferred (Q), these will be presented below.

4.2 Changes in technology coefficients (matrix A)

In agriculture the fall in domestic production linkages, in ' naranjilla', onion and tomato and other agriculture is related to a shift towards a modernization of production methods using improved seeds and chemical fertilizers (see columns z_1 and y_1 in Tables 1 and 2). In the case of coffee, cocoa, sugarcane and rice, most of the reduction in domestic linkages is explained by a shift towards modern production techniques with a high component of imported inputs (Vos 1988). Barley (06) and wheat (07) are special cases. Domestic consumer prices of both products were heavily subsidized during the 1970s. This disincentivated domestic production and the shortfalls in domestic supply which followed have been increasingly covered by grain imports. In the case of wheat there has been a retreat to less costly traditional production techniques, with little use of fertilizers and other modern inputs, both domestically produced and imported. This explains the reduction in domestic linkages of the sector. The high relative change expressed by $z_{1,07}$ is further due to the enormous drop in total wheat production ($q_{t+k,07}$). In the case of barley results are influenced by the fact that in 1980 domestic demand was largely satisfied from existing commodity stocks accumulated in previous years, leading to a negative value for domestic final demand in 1980 (due to the high negative value of changes in stocks). Applying the A matrix of 1975 to this negative value led to a "negative" simulated output for q^*_{06t+k}.

In manufacturing industry, production linkages have tended to increase in a large number of cases, i.e. $z_1 < -0.10$ and $y_1 < -0.10$. This relates in general terms to a process of modernization of production under influence of import-substitution policies. These policies were expressed by high levels of effective protection, tariff and tax exemption on imports of inputs and capital goods and lowering of investment costs through subsidized domestic real interest rates (Vos 1987). This process is further reflected in the fact that the larger technological changes are found in modern industries (L and S) and that in nearly all cases where substantial changes in z_1 and y_1 were found, there were significant increases in import intensity, i.e. $z_2 >$ 0.10 and $y_2 > 0.10$. Good examples are machine-made textiles (35A; 35L) and nearly all intermediate and capital goods sectors (40-44). In the case of oils and fats (31A; 31L) and processed milk (29A; 29L) the expansion of manufacuring industry went well ahead of productivity increases and expansion of the natural-resource bases (livestock; palm oil, soya), leading to increased demand for raw material imports. Lower domestic production linkages thus reflect an increase in the import share of basic raw materials for the sector. An additional volume effect of import demand for these raw materials (oils and fats; milk powder) resulted from low world market prices. The increased demand for imported intermediates off-set in most cases much or all (e.g. 31A) of the increase in production linkages due to the increase in technical coefficients.

4.3 Changes in import intensity (matrix M)

Changes in import intensity of production have been measured by applying equations (15c) and (16c).

In Tables 1 and 2 columns z_2 and y_2 the corresponding result can be found. In the solution for commodities (q^*_2) the number of significant changes amount to only 17%, of total, whereas for production activities (x_2^*) this holds for 15%.

Particularly in manufacturing industry there has been a tendency towards an increase in the import intensity of production. It was already pointed out in the previous section, that in most manufacturing industries increasing import intensity (z_2 > 0.10; y_2 > 0.10) tended to offset partially or fully increases in production linkages due to higher input-output coefficients.

4.4 Changes in domestic market shares (matrix Q)

If in Tables 1 and 2 z_3 > 0 and y_3 > 0, then a change in domestic market shares has led to a fall in domestic linkages going from year t to t+k, and vice versa if z_3 < 0 and for y_3 < 0. The results are presented in the fourth columns of Tables 1 and 2 respectively. At the commodity level (z_3) only in 5.7% of the number of commodities there are major changes due to market shares changes, while at the activity (y_3) this is the case for 25% of the number of activities. In table 1 variations appear to be very small in most cases. This indicates at a fair degree of constancy of the market shares comprised in the make matrix. More variation is apparent for y_3. For this reason we will concentrate on the analysis of Table 2.

In agriculture export crops show noticeable effects of changing domestic market shares. For coffee (02) and cocoa (03) a shift in market share towards small-scale farms (III) implied an increase in domestic production linkages, as these tend to use less imported inputs. In the case of banana (01) and potatoes (05) an opposite tendency can be observed. For the peculiar case of wheat, changing market shares towards larger units of production (I) meant lesser use of intermediates across all units. Other cases in which changes in input-output relations can be directly related to substantial shifts in domestic market shares are: forestry (19), bread (26), processed milk (29), beverages (33), textiles (35), leather products (37), footwear (38), and in some of the intermediate-goods sectors (pharmaceuticals, chemicals, metallic products and machinery).

In the case of forestry the increase in inter-industry linkages reflects a shift in domestic market shares from final demand (subsistence, non-marketed wood consumption in rural areas) towards intermediate demand (for the rapidly growing commercial wood and furniture production). Larger intermediate demand for wood is reflected in the higher domestic linkages in high-quality wood and furniture production (39A) as the figure for z_3 in Table 1 indicates. However, at the same time one can observe a shift towards large-scale technology in this branch. The net increase in the use of domestic inputs has been larger than that in the use of imported inputs, which explains the negative value y_3 for 39L in Table 2. Finally, similarly in leather production (37) there was a shift between 1975 and 1980 from handicraft, family-based production towards more modern small-scale industries. Assuming 1980 technology, sustained market shares of 1975 in the leather sector meant higher domestic linkages. However for the footwear activities, technology changes in S and A activities have led to lower domestic linkages.

Apart from the mentioned cases, in general the changes in domestic markets shares have contributed little to instability in input-output relations in Ecuador between 1975 and 1980.

4.5 Inter-industry analysis and employment and growth policies

In the previous steps changes in input-output relations were quantified as well as some of their potential determinants. As a final excercise we investigate the consequences of the observed changes for the identification of key sectors and inter-industry linkages that may be part of growth and employment policy analysis. If a development strategy aims at maximizing growth and employment and at reconciling both goals, inter-industry analysis to identify key sectors and potential bottlenecks and trade-offs may be seen as a useful instrument (e.g. Leontief 1951; Hirschman 1958; Bulmer-Thomas 1982; PREALC 1978; Vos 1987). Sophisticated input-output models can be designed for this purpose, but a more simple 'identification excercise' may be applied by ranking economic sectors according to their contribution to output growth and employment growth. To assess the effects of changing input-output relations on the ranking of key sectors, rank correlations analysis can be applied to the production and employment linkages derived from the two input-output tables.

Tables 3a and 3b give results for rank correlations of total linkage effects. Table 3a shows the results of the linkages specified for the commodity classification, i.e. based on the model solution implied by equation (12). Table 3b shows those for forward linkages by production activities and level of production (equation 13). Backward linkages by production activities are not defined in the input-output model applied here (see footnote 5).

Two major conclusions come to the fore. Firstly, rank correlation for 1975 and 1980 production and employment linkages is positive, high and significant, implying that the input-output relations in Ecuador can be considered 'stable' for this type of policy analysis during the period of analysis. The rank correlation coefficient for production linkages (TL_{75}- TL_{80}) is 0.912, while that for employment linkages (TLE_{75}- TLE_{80}) is 0.907.

Secondly, rank correlations for production with employment linkages, both for each reference year and across years, are low or negative. This reflects a low degree of social articulation of the economy (De Janvry and Sadoulet 1983; PREALC 1987 and Vos 1987), i.e. there is a large trade-off between sectoral output growth and employment creation (and, most likely, also growth and income inequality tend to be conflicting goals in the present production structure).

Table 3b also points out that primary income multipliers for gross operating surplus (R_{75} and R_{80}) show a high rank correlation for the two reference years (0.851 by activities in Table 3b), indicating at a fairly stable distribution of primary incomes between 1975 and 1980. The fact that R shows a high rank correlation with forward production linkages at the activity and technology breakdown may be seen as yet another indication that the type of disaggregation of input-output tables is crucial since sectoral variations in primary income multipliers seem to correlate closely with sector and technology specific differences in production multipliers.

Table 3a

Rank correlation matrix for production and employment linkages, Commodity breakdown[1], Ecuador 1975 and 1980

	TL_{75}	TL_{80}	TLE_{75}	TLE_{80}
TL_{75}	1.000			
TL_{80}	0.912*	1.000		
TLE_{75}	-0.234	-0.229	1.000	
TLE_{80}	-0.255*	-0.249*	0.907*	1.000

Source: Input-output tables for Ecuador, 1975 and 1980. See Alarcon, De Labastida and Vos (1984).

Note:
* Correlation coefficients marked with an asterisks are significant at the 0.5 % level (n=70).
1. Ranking of dispersion indices based on Leontief inverse by commodity breakdown, i.e. $[I - (A - M)Q]^{-1}$.

TL = Index for total production linkages (See text eq. 7a and 7b).

TLE= Index for total employment linkages (i.e. the average of forward and backward linkages), based on multiplier matrix $\Lambda Q[I - (A - M)Q]^{-1}$, where Λ is a commodity-by-activity matrix of employment coefficients; the typical element of Λ is l_{ij}/x_j where l is employment measured in man-years and x is total output.

Table 3b

Rank correlation matrix for production and employment linkages, Production activity breakdown[1], Ecuador 1975 and 1980

	FL_{75}	FL_{80}	FLE_{75}	FLE_{80}	R_{75}	R_{80}
FL_{75}	1.000					
FL_{80}	0.932*	1.000				
FLE_{75}	0.230*	0.119	1.000			
FLE_{80}	0.188	0.114	0.920*	1.000		
R_{75}	0.764*	0.742*	0.251*	0.233*	1.000	
R_{80}	0.727*	0.770*	0.211*	0.190	0.851*	1.000

Source: See Table 3a.

Note:
* Correlation coefficients marked with an asterisks are significant at the 0.5 % level (n=106).
1. See Table 3a for explanation of symbols, with the difference that FL and FLE refer to forward linkage indices for the activity breakdown, using the inverse $Q[I - (A - M)Q]^{-1}$. Employment linkages are now defined through $\Lambda' Q[I - (A - M)Q]^{-1}$. Profit income linkages, R, are defined as $BQ[I-(A-M)Q]^{-1}$, where B is a row vector of profit (gross operating surplus) shares in total output (b_j/x_j).

5. Conclusions

The purpose of this paper was to test the stability of input-output relations in the medium run through a simulation test on two comparable input-output tables. Input-output tables are often not available at frequent intervals, so that in many cases, particularly in developing countries, up-to-date input-output analysis may not be possible and extrapolation of an existing input-output table is required over a fairly long time period. Such extrapolations require assumptions about the stability of input-output relations. Similarly, for policy uses, even the use of an up-to-date input-output table will require assumptions about the stability of input-output relations over the plan period. Doubts about the degree of stability has also discredited the application of input-output analysis for policy making.

The methodology applied in this paper allowed for a detailed analysis of the stability of input-output relations by decomposing the total variation in interindustry linkages for two reference years according to three different sources of instability: technological change, import (de)substitution and changes in market shares. In the application to Ecuador a great deal of sectoral detail about the degree of instability could be obtained as two adequately disaggregated and comparable input-output tables were available. Commodities and production activities were properly defined by homogeneous types and technologies. Existing tests (e.g. Gaiha 1980) have compared input-output tables at much higher levels of sectoral aggregation, in which case apparent stability of input-output coefficients might disguise intra-sectoral instability. In the Ecuadorian case a fair amount of activities, either defined through their commodity or sector breakdown have shown substantial medium-run changes in input-output relations. The degree of detail of the input-output tables made it possible to identify in most cases the sources of changes in input-output relations. According to the analysis many of the variations have tended to be largely policy induced, particularly related to the import substitution policies followed in Ecuador. Despite the fairly large number of cases in which significant instability was observed, these have not been strong enough to 'upset' the outcomes of frequently used policy-oriented applications of input-output tables, such as the identification of key or priority sectors through the ranking of sectors by production and employment linkages. From the rank correlation analysis for production and employment linkages for the 1975 and 1980 input-output tables for Ecuador it was concluded that the relative 'dynamics' of the sectoral structure of the Ecuadorian economy has been stable over the five-year period of analysis.

These conclusions underpin, in our view, two suggestions for the future of applications of input-output analysis in developing countries. Firstly, if a properly disaggregated input-output table is available that takes the structural characteristics of the production structure into account, it provides the basis for a simple (input-output) model for certain types of policy simulations. Within a reasonable time horizon stable input-output relations may be assumed, or changing technologies may be introduced if they are clearly policy induced (e.g. through a strategy of import substitution). Secondly, at the same time the observed changes in the technology structure of the Ecuadorian economy over the five-year period of analysis, give rise to emphasizing the need for the construction of new input-output tables at frequent time intervals. The experience of the authors is that once a proper design of the input-output table is established as well as knowledge of data sources and practical knowledge of the economy, such an excercise may be realized within a reasonably short period. The construction of the 1975 and 1980 input-output tables took together about two and a half years. If the effort is institutionalized and reconciled with industrial surveys and censuses, input-output tables can become regularly available and may serve as a permanent tool of multisectoral analysis for development policies.

NOTES:

1. The Central Bank of Ecuador produces input-output tables at a 34-sector/commodity level of disaggregation. These tables are however constructed to ensure consistency of supply-demand balances in national accounts data at the sectoral level. The actual input-output structure is extrapolated from a base year (1974), correcting for inflation, sectoral shifts and adjustments required by the national accounts consistency rules. These tables are published in Banco Central del Ecuador (BCE) Cuentas Nacionales, No. 1-9, Quito: BCE.
2. The rank correlation coefficient is a measure to compare two different rankings to which the same rule of ranking is applied. Here we will rank sectors according to their dispersion index or relative linkage effect.
   The dispersion indices are defined in equations (7a) and (7b). Now the ranking of sectors according to their dispersion indices for forward, backward or total linkages may be compared for 1975 and 1980. A standard measure is the Spearman correlation coefficient which is defined as:

   $$r = 1 - \frac{6\Sigma d^2}{n(n^2 - 1)}$$

   where d = the difference between the ranks of corresponding pairs;
   n = number of observations.
   The value of r may be in the range between +1 and -1. If r=+1 both series have equal ranking.
3. See Alarcon, De Labastida and Vos (1984) for a detailed discussion of the construction methodology.
4. Non-square, commodity-activity input-output tables are not commonly referred to in the standard input-output literature, but see e.g. Hoffman and Kent 1979 and Polenske and Skolka 1976.
5. Given the solution methodology of the Ecuadorian commodity-activity input-output tables, the multiplier matrix $Q[I - (A - M)Q]^{-1}$ only defines the forward linkages of production activities, backward linkages remain defined by commodities.
6. The deflation method applied here used specific price vectors for total intermediate demand by commodities and for each of the final demand components. Different price vectors were used for domestic and imported components of each of the demand categories. Of the value added components, wage categories by production activity were deflated by a simple weighted consumer price index. Assuming fixed net indirect tax rates (to sectoral output), sectoral operating surplus at constant prices was derived as a residual. Consistent and acceptable results were obtained in the first round of this deflation procedure. The applied deflation method is very similar to the 'double-deflation' method proposed by the UN (United Nations 1979).
7. For a further analysis of these issues see e.g. Schodt (1987), Vos (1987, 1988a,b).

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