Slovene Studies 11/1-2 (1989) 109-117

INPUT-OUTPUT RELATIONSHIPS IN THE SLOVENE ECONOMY IN 1986

Ivo Lavrač

Introduction

Combining statistical data on the cost structures of different industries with data on the uses of particular product groups in an interlocking grid which embraces the whole economy, a grid called an input-output table has been proven to be one of the most effective means of portraying an economy. It presents a detailed and consistent view of its specific production structure as one of the keys to its performance, and it offers rich analytical potential for exploring the features and responsiveness of an economy, using means ranging from simple ratios all the way to complex mathematical models. Input-output tables have been produced for almost all countries of the world, and for many regions as well. The compilation of tables for regions is a more complex undertaking, due to the scarcity of data, and a rich literature has evolved with respect to their compilation using approximate, non-survey methods.

The main aim of this article is to present to the reader who is interested in features of the Slovene economy some results and some implicit relationships that can be derived from the most recent input-output table for Slovenia. For its meaning to be properly understood two preliminary sections are however needed. The first section, describing the layout and contents of a table of this kind, will be of use not only to the general reader who is not acquainted with input-output principles but also to readers familiar with the general principles but not with the specific table format used for regional economies in Socialist countries. The second section, describing the specific procedure used in the statistical approximations for the table for Slovenia for the calendar year 1986, will give the reader some feeling for the difficulties involved and for the quality of the data. The presentation of the table itself will necessarily be of a very summary kind. It will be supplemented with a short commentary on the conditions which would allow a better descriptive use of the table. Finally, in the last section, some words on the present and potential use of the input-output table for Slovenia will probably be of interest.

Contents of Input-Output Tables

Since an input-output table can be viewed as a production account for a whole economy, disaggregated by industry, it may be useful to begin our description with an explanation of a macro production account. Like any account, it has receipts and expenditures, the totals of which must balance. Suppliers in an economy in the aggregate receive payments either from the sector of domestic final demand or, for exported goods, from abroad. On the expenditures side we can also distinguish two classes of items: one is payments to primary factors of production, or value added; the other is payments for imported supplies.

If, however, with a single production account we wish to show the production activity of an economy in greater detail, we can replace this one account with several accounts, one for each commodity group distinguished in total value of production. In this case, new flows come into view, viz., the purchases of one group of commodities needed for the production of another group of commodities. In the accounts of the commodities supplied these flows are receipts, and in the accounts of the commodities whose production requires these inputs, they are expenditures.

The convenient conventional solution is to show an interconnected set of accounts of this kind in such a way that each is represented by one row and by one column of the so-called input-output table, with each row representing monetary receipts, and each column representing expenditures. Physical flows have the opposite direction to that of monetary flows, and hence the row items represent the destinations of the comodity supplies, and the column items represent the commodity inputs and the other inputs into production, all of them expressed in value terms.

Table 1:

Schematic input-output table

commodities	1	2	3	domestic final demand	exports	demand
1	A	B	C	D	E	F
2	G	H	I	J	K	L
3	M	N	O	P	Q	R
value added	S	T	U			
imports	V	W	X			
supply	F	L	R			

To provide a clearer understanding of input-output tables, TABLE I shows the main features in a schematic way, with alphabet letters standing for entries in value terms. (Note that an input-output table can take somewhat different forms; this must be thought of as just one of a number of possible introductions to the world of input-output.) The table may be described as having three distinct quadrants: the central, the right-hand, and the lower quadrants. The central quadrant is a square, and the number of its rows and columns represent the number of commodity goods or commodity service groups that we wish to distinguish in the economy; in this particular schematic presentation there are only three. A typical entry in this quadrant, say **G**, stands for a value of commodities in the row, i.e., of type **2**, used as intermediate inputs in the production of commodities in the column, i.e., of type **1**, during the given year. It is obvious that the entries along the diagonal (**A, H, O**) stand for intermediate inputs that are classified as belonging to to the same commodity group as the one which uses them. A row total in this quadrant, e.g., **A + B + C**, represents the value of this part of commodity **1**, which is used as the intermediate input in the production of all the commodities. A column total, e.g., **A + G + M**, shows the value of all the different intermediate inputs that are used in the production of commodity **1.**

Let us now turn to the lower quadrant. It has as many columns as the number of different commodities that are distinguished. As it corresponds to the central quadrant, it consists of the same number of commodities (in this example: three). The lower quadrant has to display the remaining items which, in addition to the value of the intermediate inputs, comprise the value of total supply of each of these commodities. The first in this example is the total value added, or the value of the primary inputs. It could be further subdivided into depreciation, wages, taxes, and profit rows; or it could be subdivided in even more detail. If, in the first column, value added in the production of the first commodity, labeled **S**, were added to the value of the intermediate inputs (**A + G + M**), we would obtain a subtotal (not explicitly shown here) which would represent the value of the domestic output of the first commodity. If we add entry **V**, the value of the imports in the first commodity,

the value of total supply of the first commodity in this particular economy is obtained. It is labeled **F** and is explicitly shown as the total of the first column.

We now move on to the right-hand quadrant. It has the same number of rows as the number of commodities distinguished in the system. The column on the extreme right contains row totals representing the value of the total demand for each commodity. Since the table reflects the ex-post equilibrium achieved in the economy, these totals are the same as the column or supply totals. Apart from the intermediate demand, there is also domestic final demand for a commodity and demand from abroad, represented by the export column. The domestic final demand could be broken down further into consumption (personal and state) and investment (fixed capital formation by different industries and increase of inventories), but in this condensed example we display it all in one column. If we now look at the first row, we can see how the value of supply (**F**) of the first commodity, from both domestic and foreign sources, has been used for the intermediate consumption (**A** + **B** + **C**), for the domestic final consumption and investment in different industries (**D**), and for export (**E**).

The total value of the lower quadrant is the same as that of the right-hand quadrant, and reflects the equilibrium of the aggregate production account. The total value added or gross domestic product (**S** + **T** + **U**) plus the imports (**V** + **W** + **X**) equals consumption plus investment (**D** + **J** + **P**) plus exports (**E** + **K** + **Q**). This equality does not, of course, hold for individual commodities, only globally.

Let us now move from this schematic table format, which is commonly used for market economies, to the format used for socialist economies. The difference between the two ensues from a different definition of production, which is narrower in socialist economic theory, where the concept includes only industries that produce goods, and services whose value is embodied in goods. In particular, government services are not considered as contributing to the value added, but only as redistributing value added in the economy. We shall illustrate the input-output table format for Slovenia in relation to the format described thus far by using the letters representing the same value flows differently arranged on the table. We shall consider our third commodity to represent what in socialist terminology are non-productive services, and omit them from the central quadrant.

Table 2:

Schematic socialist input-output table

commodities	1	2	domestic final demand	exports	demand
1	A	B	D+C	E	F
2	G	H	J+I	K	L
value added	S+M	T+N			
imports	V	W			
supply	F	L			

This typical layout for input-output tables, as presented in socialist countries, is self-explanatory. Let us just point out that the macroeconomic aggregate in the system is no longer gross domestic product but is now gross material product, defined as **S** + **M** + **T** + **N**. Gross material product = gross material product minus **U** + (**M** + **N**).

Now we can turn to the other feature of the Slovene economy, namely that it is not only socialist but regional; this feature must also be considered when specifying the appropriate table format. Formally, the table retains the same format as specified above, the only difference being that imports and exports now include not only the region's trade with foreign countries but also its trade with other regions. In the case of Slovenia this means trade with the other republics of Yugoslavia and with the federal government; this may be a minor formal distinction, but suppying these data presents a major statistical challenge.

Statistical Procedure

To understand the meaning and quality of input-output data, it is necessary to take at least a short look at the specific statistical procedure used to derive the data for Slovenia for 1986. The substantial effort involved in compiling this input-output table reflects some of the basic decisions made at the outset of the study, viz., in 1985. The main decision was to make a break with the previous method of compiling input-output tables for Slovenia, as presented in Lesar (1982), because it was impossible to obtain enough documentation on the methods employed to permit (a) teamwork, (b) the integration of the input-output table into a broader system of regional accounts, and (c) a way of involving those who would use the table, in particular those in the planning office. The new orientation, which was accepted by the Slovene Office of Statistics, called for a transparent methodology which detailed all the steps in the compilation beginning with the basic statistical sources, and also for a computer. It was realized that such an approach was resource-intensive and had to be considered as an investment that was necessary for further development of and use of the table. The project started in unfavorable circumstances, with work on Yugoslav input-output tables discontinued; with inflation and system changes in Yugoslavia gathering steam; with the necessity of finding and training new project personnel; and without computer access. The final success and fruits of the project—the first practical analytical and modeling uses of the table—attest to the amount of work involved.

Other basic decisions with respect to the compilation of the table were also taken. Since, at the beginning of the project, the results of the last and very valuable statistical survey giving values of industrial outputs and inter-republican trade for the year 1983 (the so-called *PB-11* survey) were not available, we had to use as our basis the table for the year 1980, the year of the previous survey of this kind (Bizjak, Lavrač & Potočnik 1987). Subsequently a team in the Slovene Office of Social Planning updated this table to the year 1986, using additional, more recent statistical data (Strmšnik 1987). Decisions on table format followed the tradition of Yugoslav input-output tables produced hitherto by the Federal Office of Statistics in Belgrade. This involves a table formatted in size for 48 commodity groups, 3 value-added components and 4 domestic final-demand components. The final table was expressed in terms of producers' prices, and included also, for each flow in the central and in the right-hand quadrants, its subdivision into three components: domestic, other regions, and import.

It is impossible to present here all the steps taken in the compilation of the table. Let us just point out some features of this procedure. Before arriving at the final 1980 table some 30 intermediate tables were compiled. Usually these were 48-sector tables, based on various separate statistical surveys and then combined into that huge mosaic that is an input-output table. The use of LOTUS 1-2-3 computer software proved most helpful at this stage. In spite of the uneven quality of the survey data, less than 1% of the table cells required manual adjustment; this was based on group expert deliberations. The remaining smaller discrepancies between row and column totals were then automatically removed by

slight modifications to the figures for imports from the other Yugoslav republics (these being the least reliable data). The updating to 1986 was essentially based on (a) the use of income statements to estimate the lower quadrant of the table; (b) the use of preliminary estimates of final demand aggregates; (c) the adjustment for relative price changes in the period 1980 - 1986; and (d) the use of the RAS biproportional adjustment procedure for updating the price-adjusted central quadrant.

Before presenting the table itself, a few additional words of caution to the reader who is willing to explore the figures and their interrelationships in spite of the tortuous way in which they were obtained. The table uses the same definition of main production aggregate, i.e. of gross material product, as the official Yugoslav statistics; and this is, surprisingly, its main limitation. The author (cf. Lavrač 1987), among others, has drawn attention to the distortions caused by not taking into account inflationary effects in the calculation of the official gross material product. In the table, these are most clearly seen in the inflated figures for inventory change. It has at this stage unfortunately not been possible to purge these distortions from the table, since the full calculation of their sectoral structure has not yet been made.

The Input-Output Table for Slovenia for the Year 1986

Because of space limitations it is obviously out of the question to present here the full 48-sector (i.e., 48-commodity) table. It is even less possible to show separately the domestic and the imported components of intersectoral flows, to show different derived ratios (in particular the technical coefficients) and the sectoral multipliers, or to highlight the most important interrelationships (which could perhaps be done in graphic form). What can be done is to present the table of aggregate flows, irrespective of origin, in a very condensed—say, a 5-sector—format. It must be left to interested readers to derive for themselves those relationships considered significant which may be derived on the basis of a table with only 5 sectors. For more detail they will have to refer to documentation given in the bibliography below, or make enquiries at the institutions involved in the project.

The particular chosen aggregation on the level of five commodity groups finds its rationale in efforts to enable comparisons with recent national accounting and modeling work for Yugoslavia carried out at the Federal Office of Statistics in Belgrade (see Vujović et alii 1987). Unfortunately at this level it can not be directly translated into international classifications; this is one of the persistent problems that arise when trying to compare Yugoslav, or Slovene, structural data internationally. Because of the high aggregation level of the present table, the figures on the main diagonal of the table are omitted, since the preponderance of flows within sectors would otherwise overshadow more important interrelationships.

Before presenting the figures let us nonetheless try to make the absolute amounts somewhat more meaningful for the international reader. The figures are in millions of 1986 Yugoslav dinars. The mean 1986 official exchange rate was approximately 380 dinars to the U.S. dollar. This figure, and those that follow, are only approximate due to the different ways in which they can be calculated. The official Slovene gross material product (which is about 10% less than the equivalent gross domestic product at market prices), as the sum of value added rows of the table, amounted to over 3,800,000,000,000 Yugoslav dinars, or over US$ 10,000,000,000. As the population of Slovenia is about 1.9 million, this means a per capita gross domestic product of over $5,500. Without going deeper into the problems involved, this admittedly rough calculation hopefully enables some potential comparisons to be made.

Table 3:

INPUT-OUTPUT TABLE OF SLOVENIA, 1986 (central and lower quadrants)

commodity group		agri-culture	energy	manufac-turing	construc-tion	produc-tive services	intermed-iate de-mand(1–5)
		1	2	3	4	5	6
agriculture	1	0	738	183917	1685	19535	205875
energy	2	50619	0	182437	8657	132448	374161
manufacturing	3	91019	29460	0	224742	402372	747593
construction	4	9593	2064	36267	0	83027	130951
productive services	5	77057	45852	636583	88481	0	847973
materials(1 to 5)	6	228288	78114	103924	323565	637382	2306553
depreciation	7	22280	40318	202492	16406	116513	398009
wages	8	110946	43288	547200	123842	447419	1272695
profit+tax	9	77337	51123	111665	112623	829518	2187216
output (6-9)	10	438851	212843	290551	576436	203082	6164473
import from abroad	11	59337	89656	105804	0	165151	1372168
import from Yugosl.	12	165809	278585	185496	82229	434625	2816174
supply (10-12)	13	663997	581084	581841	658665	263068	1035285

Table 4:

INPUT-OUTPUT TABLE OF SLOVENIA, 1986 (right quadrant)

	personal consum-ption	govt. consum-ption	stock increase net	gross fixed capital format.	exports to abroad	exports to Yugosl.	final demand (7-12)	total demand (6+13)
	7	8	9	10	11	12	13	14
1	274572	2471	71090	5725	30278	73986	458122	663997
2	154167	25269	-329	0	5340	22476	206923	581084
3	621648	89641	59091	307121	896342	256525	507088	5818461
4	6137	8543	27682	395258	11570	78524	537714	658665
5	476441	113630	11601	109890	478566	488067	178265	2630608
6	153295	239554	805395	817994	142206	322828	804622	1035285

Although we must leave to the interested reader the work of calculating illuminating relationships from the table, and working out analyses and conclusions about policy, it may be useful to provide some guidelines and comments as to the possible descriptive uses of the table. As can be seen from a survey of the literature (see, e.g., Hewings 1985, Jensen 1986), the state of the art of descriptive uses of regional input-output tables evolved from comparisons of partial sectoral relationships to "holistic" attempts to arrive at synthetic measures derived from the tables, characterizing a regional economy as a whole in temporal and spatial comparisons, and trying to explain the results in terms of regional economic theory. In particular, measures of the connectedness (or of the complexity) of regional economies and sectoral ordering patterns, based on sectoral linkage characteristics, can be connected to the lack of development of a region. Although there is no apparent lack of proposed possible measures, using the most varied levels and branches of mathematics, it remains the sad truth that that in practice very little of all of this can be used.

The basic precondition for characterizing an economy via some input-output table measures is namely to have tables of the same format for other years and for other regions, so that comparisons may be established. Since a comparative format involves not only the same sector classification and the same level of aggregation, but also the same accounting techniques and the same conventions for constructing the tables, it is very rare that these preconditions are fully met. We encounter the same problems with our table for Slovenia. As an attempt to describe the tables closest to ours for comparative purposes and to point out format differences would exceed the limits of this report, we cannot pursue this line of application further; rather, we shall examine some actual and prospective modeling uses of the table.

Modeling Uses of the Table

There is a huge literature describing the possible uses of input-output tables as the statistical bases of models that simulate the workings of whole economies. In order to turn an input-output table into a model we have to assume, in addition, certain functional links between intermediate inputs and outputs of the sectors using them. Usually the simplest relationship is used, stating that inputs are fixed using a technically-determined proportion of the sector's output. By introducing functional links of this nature, instead of actual intermediate flows, we obtain a solvable system of simultaneous linear equations which explicate the direct and the indirect links between producing sectors. It follows that the functional relationships between the components of right-hand and lower quadrants on these tables (i.e., between the final demands by commodity and the sectoral value added) can be established.

A basic input-output equations framework can be used for modeling purposes in several different ways. Two standard methods are (a) the quantity (or, more precisely, the real flows) model and (b) the price model. The former establishes the functional relationships between the real flows contained in an input-output table assuming that prices remain constant. The latter establishes the functional relationships in a price system, assuming constant quantities. In practice both types of model have been extensively used throughout the world, despite their limitations, which have particularly restricted their utility as a predictive tool. Of especial analytic value have been the efforts to link the basic input-output framework with additional variables. As an example, if the structure of final demand can be partly explained by a demographic structure and if, on the other hand, the commodity outputs can be linked to (say) pollution, then we can establish the hidden link between changing demographic patterns, e.g., aging, and pollution trends—or, employment, or the use of space, or imports, or work accidents, or any other variable that can be linked to the output levels of particular commodities. The possible analytic applications of input-output models of this type seem to be virtually limitless.

In order to increase the predictive value of input-output models, researchers are looking for ways to explain the movements of real and price variables simultaneously, taking into account their possible interactions, since that is what happens in reality. This is done by making input-output a part of larger models, which, in addition to inter-industry linkages, comprise also income distribution and other aspects that are necessary to model supply and demand in each market. These are so-called computed general equilibrium models, which are now at the cutting edge of structural macroeconomic modeling throughout the world. There have, however, been very few efforts to date to apply these on the regional level.

This short survey of the state of input-output modeling has been necessary to locate the present and the prospective uses of the latest Slovene input-output table among possible

uses. Since this latest Slovene table, presented here in a very condensed form, became available less than one year ago, there are as yet only a few such applications. It is remarkable, however, that their results have not remained confined to academic circles, as much input-output modeling work still does, but has been used by policy-makers in the Slovene government. One such application has been a price model, used to evaluate the impact of changes in the administratively regulated prices at the federal level on the income level of Slovene industries (cf. Strmšnik 1987). Another application of price models has been used internally by the Slovene planning office, and made possible the calculation and use of differentiated deflators, instead of a single one, for transforming nominal flows into real flows (see Bole 1987). There has also been one application of quantity input-output models of Slovenia, namely that concerning the air and water pollution content of different final demand components in Slovenia (see Strmšnik 1987).

It is our intention to include, with certain adaptations, this input-output table in a wider social accounting matrix that we are developing for Slovenia. It will enable us to make the first steps toward a computed general equilibrium model for Slovenia, based on the "transacted values" approach developed at the World Bank (see Drud and Kendrick 1986) and already applied to Yugoslavia by Vujović (1987). This is the best way that we know of employing the knowledge gained from studying input-output relationships for formulating specific proposals to economic policy-makers and thus also, hopefully, for contributing to better decision-making.

Ekonomska fakulteta Borisa Kidriča, Ljubljana

BIBLIOGRAPHY

Bizjak, M., I. Lavrač & J. Potočnik. 1987. *Medsebojni odnosi gospodarskih dejavnosti SR Slovenije v 1980. 1. zvezek*. Ljubljana: Statistični urad Slovenije.

Bole, V. 1987. *Ocenjevanje deflatorjev komponent končnega povpraševanja*. Ljubljana: Ekonomski inštitut Pravne fakultete.

Drud, A. & D. Kendrick. 1986. *Hercules: A System for Large Economy-Wide Models*. Washington: The World Bank.

Hewings, G.J.D., R.C. Jensen & G.R. West. 1985. *Holistic Matrix Descriptors of Regional Input-Output Systems*. Honolulu: Fourth Australia-Japan Regional Science Exchange Workshop.

Jensen, R.C., G.R. West & G.J.D. Hewings. 1986. *On the Study of Regional Economic Structure Using Input-output Tables*. St. Lucia, Qld.: University of Queensland/Urbana IL: University of Illinois.

Lavrač, I. 1987. "Izračun narodnogospodarskih agregatov in inflacija," in *Statistika in inflacija. Simpozij Statističnega društva Slovenije*. Ljubljana: Zavod SR Slovenije za statistiko.

Lesar, T. 1982. *Medsebojni odnosi gospodarskih dejavnosti SR Slovenije v 1978. Input-output tabela*. Ljubljana: Zavod SR Slovenije za statistiko.

Strmšnik, I. 1987. "Ocena medsebojnih odnosov gospodarskih dejavnosti SR Slovenije v letu 1986. Sintezni prikaz dela na aplikaciji medsektorske analize v planiranju," in I. Lavrač, comp., *Računalniško podprti model vrednostnega spremljanja in planiranja družbene reprodukcije v SR Slovenije. Letni program 1987*. Ljubljana: Zavod SR Slovenije za družbeno planiranje.

Vujović, D., M. Labus, G. Biočić & L. Stjepanović. 1987. "A SAM-based approach to checking consistency of policy measures in Yugoslavia," paper, First International Symposium on Social Accounting Matrices, Naples, 1987; published in Belgrade, 1987.

POVZETEK

MEDSEKTORSKI ODNOSI V SLOVENSKEM GOSPODARSTVU V 1986

Članek predstavlja rezultate proučevanja slovenskega gospodarstva skozi izdelavo medsektorske ali input-output tabele za leto 1986. Na začetku je predstavljen pomen takih tabel za ekonomsko analizo in družbeno planiranje. V naslednjem poglavju je predstavljena vsebina le-teh tabel. Predstavljena je statistična metodologija uporabljena pri izdelavi zadnjih takih tabel za Slovenijo. Sama tabela je zaradi pomanjkanja prostora predstavljena v skrčeni 5-sektorski obliki, medtem ko sta izračun in analiza iz nje izvedenih odnosov prepuščena zainteresiranemu bralcu. Članek se končuje z analizo možnih in dejanskih dosedanjih uporab te tabele za analizo slovenskega gospodarstva.