Briefing Paper

SCOTTISH INPUT-OUTPUT TABLES FOR 1979

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1. Introduction

The first set of Input-Output tables for Scotland, for the year 1973, were published in 1978, as a result of a collaborative effort between the Fraser of Allander Institute, the IBM Scientific Centre and the Scottish Council Research Institute. A second set of tables, for the year 1979, have been compiled by the Industry Department for Scotland (IDS) and the results have recently been published in a series of four special volumes.

The compilation of input-output tables is a complex exercise which involves a substantial commitment of resources and time, which explains the long interval (nearly five years) between the base year of the tables and the publication of the results. The tables however reveal a great deal about the structure of the economy and have a wide range of applications. The next section of this paper explains what input-output tables are, while the following section summarises the main features of the Scottish tables for 1979. The last part of the paper outlines some applications of input-output models, and gives some examples of applications in the Scottish context.

2. What are Input-Output Tables?

An input-output table is a system of accounts, shown in the form of a large grid or matrix. Each row of the matrix records sales or receipts, while each column records purchases or outgoings.

An example is shown by Table 1, which is a summary of one of the Scottish tables for 1979. The first row of this table records the estimated sales of the Agriculture, forestry and fishing sector in Scotland, broken down by destination. Reading across the row, we note that the sector sold £256 million of production to itself (including for example sales by one farmer to others), £7 million to the Minerals, metal manufacturing and chemicals industry, £747 million to Other Manufacturing industries, £1 million to the Construction industry, £23 million to Distribution, hotels and catering, £1 million to Transport and Communications, and £1 million to Other Services. The foregoing represent what are called **intermediate** sales, since they are sales to other industries for further processing. The largest sale by Agriculture, forestry and fishing (£747m), to Other Manufacturing, includes sales of agricultural produce to the food processing industry, sales of timber to sawmills, furniture-makers, etc, and sales of fish to canners and processors.

The remaining items in the first row show sales of £124 million to Total domestic final demand, and of £156 million to Total exports. The former includes sales of unprocessed agricultural produce (fruit, vegetables, eggs, etc) and fish to households, changes in stocks of agricultural, forestry and fishing products (livestock, timber, etc) and some other transactions. Exports include exports to the Rest of the World and to the Rest of the UK. The sum of all the items in the first row constitute total sales of the agriculture, forestry and fishing sector in 1979 which, since changes in stocks are included as a "sale", equals total domestic output (£1315 million).

The items in the first column show what the agriculture, forestry and fishing

sector needed to purchase in 1979 in order to produce this output. This comprises seed, fertiliser, pesticides, energy, transport services, veterinary services, etc., and the value of these purchases or inputs are included in the appropriate cell in the first column. In addition to purchases from other Scottish industries (the first nine entries in the column), the sector also imports inputs of fertiliser etc from the rest of the UK (valued at £123 million) and from the rest of the World (£82m). The sum of all these items constitutes total intermediate purchases by the agriculture, forestry and fishing sector.

The remaining items in the first column account for the difference between the costs of materials and services purchased and the value of output. Income from employment (labour costs) were £230 million, and "other value added" (profits, income from self-employment) £254 million. The input-output acounts attempt to measure all monetary flows at producers', or factory-gate, prices. This means that adjustments must be made for both taxes on expenditures (which increase prices and costs) and subsidies (which reduce prices and costs). The taxes paid and subsidies received by each sector are also shown in the appropriate column of Table 1.

The first column of the table thus reflects the cost and profit structure of the agriculture, forestry and fishing sector in 1979 and the sum of the items yields the total input figure shown in the final entry of the column. It can be seen that the total input value for agriculture, etc is £1315m, which is identical to the value of domestic output of the sector. This is true for all industries of the table, and occurs because, by accounting convention, all receipts by an industry **must** be allocated to some expenditure category or to gross profits.

As we have seen, the first row shows us what happens to that output. Other industry rows and columns can be similarly interpreted. The table thus reveals in some detail the value of transactions between different sectors of the economy, the cost structure of industries and the pattern of sales.

The size of the table is determined by the degree of industrial detail used in its construction and this depends on a number of factors including the availability of data. The published tables for Scotland distinguish 83 sectors, which is quite detailed, though tables for the United States contain over 400 sectors. However, the degree of detail which can be shown is also affected by confidentiality considerations. Some sectors in Scotland comprise one or two firms, and these have to be merged with other sectors in order to conceal information which may be commercially sensitive.

3. The Scottish Tables

Table 1 is a summary version of the full Scottish tables, which as already noted, distinguishes 83 sectors of production as well as more detail on sales to final demand. The production accounts give results for 7 separate primary sectors, 55 manufacturing industries and 21 service sectors. The single 'total domestic final demand' column of Table 1 is subdivided into five separate categories and 'total exports' are broken down into exports to the rest of the UK (excluding the UK continental shelf), exports to the UK continental shelf and exports to the rest of the world.

Although the primary aim of the tables is to show the flows of goods and services between industries, the published results include a number of important subsidiary tables. One table for instance includes a commodity breakdown of each industry's imports from the rest of the UK, and another contains a similar analysis of imports from the rest of the world. A third records a commodity analysis of each industry's production.

The tables are too large to reproduce here, but some indication of the degree of detail is provided by reconsideration of the sales of £747m from Agriculture, forestry and fishing to Other Manufacturing noted in Table 1.

In the detailed tables Agriculture, Forestry planting, Forestry harvesting and

TABLE 1

SCOTTISH INPUT-OUTPUT TABLE FOR 1979: INDUSTRY BY INDUSTRY MATRIX
(Showing domestic flows)

£ million

Sales by: / Industry Heading	Purchases by: Agr. for. fish.	Energy and water supp.	Mins, metal man. chems.	Metal goods engineering	Other manufacture	Construction	Dist. hotel. catering	Tport. communication	Oth. services	Tot. dom. final demand	Total exports	Total domestic output
Agriculture, forestry, fishing	256	0	7	0	747	1	23	1	1	124	156	1315
Energy & water supply	46	272	251	62	110	14	155	124	17	749	426	2226
Minerals, metal man., chemicals	66	19	164	115	45	216	4	11	5	94	1491	2230
Metal goods & engineering	19	24	22	107	43	26	12	26	4	402	3151	3837
Other manufacturing	151	11	19	32	666	83	170	28	74	983	3645	5862
Construction	14	55	14	12	18	429	48	17	36	2215	-	2859
Distribution, hotels & catering	75	61	89	89	178	90	127	61	35	2563	297	3664
Transport & communication	14	61	81	60	197	58	165	116	81	534	583	2098
Other services	35	55	111	283	356	42	311	72	178	3720	254	5416
Imports from rest of UK	123	564	531	1005	1054	285	286	197	131	2977	3822	10977
Imports from rest of world	82	321	346	606	663	130	84	114	14	1715	10	4084
Sales by final demand	5	2	9	2	9	3	5	2	-15	-142	119	-
Taxes on expenditure	22	73	49	72	129	41	176	90	99	1959	66	2777
Subsidies	-76	-34	-15	-62	-44	-0	-3	-12	-8	-429	-11	-694
Income from employment	230	456	496	1269	1154	890	1362	851	3576	-	-	10283
Other value added	254	286	55	184	536	551	740	401	1188	-	-	4196
Total input	1315	2226	2230	3837	5862	2859	3664	2098	5416	17616	14007	61131

Where figures have been independently rounded, the sum of constituent items may not sum to that shown.

Fishing are separate sectors, and the Agricultural sector's share of total sales to Other Manufacturing is shown to be £637.2m. Table 2, derived from the fully detailed published tables, records sales to each of the industries which make up "Other Manufacturing" in Table 1. This gives us a much more detailed and hence useful profile of the market for agricultural products in Scotland. Similar "market profiles" may be derived for any of the other 82 industries in the tables, while on the production side, by examining the columns of the table a detailed profile of industry cost structures may be obtained.

Table 2 Analysis of Sales by Agriculture to "Other Manufacturing", 1979

Sales by Agriculture to:	(£ million)
- Meat products	89.7
- Slaughtering	133.7
- Bread and biscuits	3.1
- Sugar confectionery	3.8
- Other food and tobacco	262.2
- Whisky and other spirits	61.5
- Brewing	45.3
- Soft drinks	0.1
- Wool and worsted	18.1
- Cotton and silk	2.1
- Carpets	0.7
- Other textiles	11.4
- Paper and board	0.3
- Rubber products	4.9
- Plastic	0.3
	637.2

Source: Industry Department for Scotland, Scottish Input-Output Tables for 1979, Volume 2, Table 6.

Although the main value of input-output tables lies in this detailed depiction of inter-industry flows, they also throw light on a number of macro-economic features of the economy. From the tables it is possible to examine Scotland's exports to, and imports from, other countries, and hence derive the foreign trade balance of goods and services. It is also possible to evaluate Scotland's trade performance with the rest of the UK. Since Scotland is a UK region, information on her balance of trade with the rest of the country is not normally available (indeed the only previous estimates were obtained from the 1973 input-output study). The figures from the 1979 study are therefore of considerable interest.

The 1979 tables showed Scotland to have a balance of trade deficit of just over £1 billion in that year, but just over half this deficit arose through the accounting convention of counting crude oil landings in Scotland from the North Sea Continental Shelf as an import from the rest of the UK. Much of this is subsequently re-exported. If these flows of crude oil and gas are excluded, the trade deficit becomes £520 million, split roughly 50-50 between the rest of the UK and the rest of the world. This implies a shift in the trade balance from 1973, when it was estimated that Scotland had a small trade surplus with the rest of the world, and a larger deficit with the rest of the UK. The overall trade deficit in 1973 was estimated to be £253 million, which taking into account price changes in the intervening six years, is very close in real terms to the 1979 deficit.

4. Applications of Input-Output Tables

As the foregoing illustrations suggest, an input-output table can reveal a good deal about the basic structure of any economy including markets, cost structures and trade with other regions and countries. Nevertheless such tables are expensive and time-consuming to construct, and if their only value lay in their use as a historical record of transactions in some past year, it is doubtful many would be compiled.

However, by making a number of simple assumptions the input-output table may be converted into a powerful **model** of the economy with a wide range of applications. The nature of these assumptions may be grasped by a simple example drawn from Table 2 above. There it was noted that in 1979 the Brewing industry purchased £45.3 millions of agricultural produce (which we can assume to be mainly barley). The output of the Brewing industry in Scotland in 1979 was valued at £237 million (derived from the same detailed

table as the data in Table 2). In value terms therefore purchases of barley and other products from the agricultural sector accounted for 19.1% of the total cost of production in Brewing.

Suppose now the output of Brewing is forecast to increase by 20% (perhaps through anticipation of higher consumer demand). What will be the impact of this increase on the Agriculture sector? If we assume there is a constant relationship between inputs of barley and output of beer, which is reflected in the cost structure of the 1979 tables, the impact could be calculated as follows:

Forecast output of Brewing = 237 x1.20
= £284.4

Forecast purchase from Agriculture =
19.1% of 284.4 = £54.3

(output and input measured at constant 1979 prices)

Thus sales of agricultural produce to brewing are forecast to rise by £9 million or 20%, equal to the percentage increase in brewing output since we assume a proportional relationship between output and inputs.

The impact however extends beyond this. To supply those extra sales, the Agriculture sector will have to increase its own output by £9 million (assuming sales to other sectors remain constant). This in turn will require increased inputs of seed, energy, fertiliser and so on, the impact of which can also be traced through by making similar assumptions about input-output relations in other sectors.

In fact, when all the interactions among Scottish industries are taken into account, it transpires that an increase in consumption of Brewing products of £47.4m would lead to a total increase in Scottish output of £81.9 million. Put another way, each £1 increase in Brewing production increases total output in Scotland by £1.73. This latter figure of 1.73 is known as the **output multiplier** for Brewing. These multipliers have been calculated for all the industries in the 1979 input-output tables. Some additional examples are shown in Table 3.

Table 3 Output Multipliers for Scottish Industries 1979

Industry	Output Multiplier Value
Coal and Coke	1.41
Oil Refining	1.06
Computers	1.19
Spirits and Whisky	1.78
Retailing	1.31

Source: Industry Department for Scotland, Scottish Input-Output tables for 1979, Volume 3, Table 7

It can be seen that the output multiplier values vary significantly among different sectors - in general, an industry which buys a high proportion of its inputs from Scottish producers will have a larger multiplier than one which relies heavily on imports. Multipliers are useful for a number of purposes, one of which, as shown in the Brewing example above, is to predict the effects of growth or decline in a particular industry on the Scottish economy as a whole.

Although the above is a simplified account of what would be done in making a real forecast - allowance has to be made for technological change, economies of scale, substitution between inputs, and so on - it captures the essence of the input-output model. The inter-industry flows in the table are used to establish technical-economic relationships between the inputs and outputs of different sectors, and the resulting model can be used for a wide range of applications including

- industrial forecasting
- impact analyses
- calculation of output, income and employment multipliers
- economic planning
- marketing analysis
- analysis of effects of eg energy prices on industrial costs and prices
- studies of effective protection
- import dependence and import substition

One such example using the Scottish Tables is the Fraser Institute's Business Forecasting service. Based on estimates of trends in world trade, trends in the UK economy and government expenditure, forecasts are first made of the growth in Scottish exports, consumers' expenditure, public expenditure and investment over the next 3-5 years (and, more speculatively, for longer periods). The input-output model is then used to estimate the growth in output in each sector of the economy required to meet these levels of final demand, taking account of trends in the level of import penetration. Finally, the forecast outputs for each sector are disaggregated to show the expected pattern of future sales.

The relationships between inputs and outputs change through time as a result of technological innovation, substitution of inputs due to relative price changes (eg coal and gas for oil), economies of scale and changes in product mix, amongst other influences. While over short periods allowance can be made for such changes, it is important that input-output tables should be compiled at regular intervals so that the models based on them can be updated. Moreover, a comparison of input-output tables over time sheds light on the changing technical structure of the economy and often indicates the direction of future change. The Scottish tables are therefore a valuable addition to an understanding of the Scottish economy and to the capacity for analysing it.