PROBLEMS OF DESIGNING AND USING REGIONAL INPUT-OUTPUT MODELS FOR IRELAND, ILLUSTRATED BY 1974 NUMERICAL DATA

E.W. HENRY

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INTRODUCTION

The main purposes of the following essay can be grouped under four headings:

(i) to stimulate interest in the capabilities of regional models to provide useful information for planning, once numerous problems of compilation have been faced and solved and a satisfactory design chosen.

(ii) to show how regional input-output models can complement the County Incomes' published researches of Miceál Ross (1971 and 1972) and the associated employment findings of Baker and Ross (1975).

(iii) to draw attention to existing data lacunae, in the hope that statistical information might be sought and provided as part of a thorough investigation of regional models, if such a project were undertaken.

(iv) to illustrate the regional modelling ideas by way of a two-region model for 1974. The results give insight into the kinds of information provided by regional models, in conjunction with a national model; the regional and national results complement each other usefully. One of the regions chosen consists of the five major county boroughs. They have about 30 per cent of State employment but include negligible employment for agriculture, mining and solid fuel. They have employment data in detail, via the 1971 Census of Population. Thus, as one region they provide the maximum economic contrast one can find between two regions of Ireland, the other region being the rest of the State. The analysis of such contrasting regions is interesting, even for the rough illustrative estimates used.

Much has been written on regional input-output (I/O) models. Chenery and Clark (1959) devote Chapter 3 of their textbook to a two-region model. R.C. Geary (1966) considers regional I/O models in Lecture 8 of his *Lectures on Input-Output.* Brody and Carter (1970 (1) and (2), 1972) allocate a section of each of their three volumes on I/O analysis to regional problems. *The Journal of Regional Science* is published three times a year; this also has papers on input-output models and various other models of regions and States, mostly within the USA. Thus it is apparent that there is a plentiful supply of information on the theory and application of regional models, if we want it. The present essay, however, is mainly concerned with the basic problems of design and compilation, not with more elaborate aspects.

The discussion is developed below under three main heads. First we consider the purposes and uses of regional I/O tables and derived models. Secondly, we examine the main problems which arise in designing regional I/O models and using them for projections. Finally, we see numerical illustration of a two-region model by means of 1974 Irish data.

PART I: PURPOSES AND USES OF REGIONAL INPUT-OUTPUT TABLES AND OF DERIVED MODELS

There are in existence at least three sets of Irish regional accounts, those for county incomes, for agriculture and for the Industrial Development Authority (IDA) planning activities. We look briefly at these before considering regional input-output tables.

County Incomes

A paper by Miceál Ross (1971) discusses the methodology of estimating personal income for each county of the State. In Chapter 1 we get insight into the purposes and use of county accounts, by contrast with national accounts. We are told (1.4) that "regional income estimates seek to throw light on a different set of policy issues than those for which national income accounts were designed... The regional estimates should be reconciled with the national control totals to underline the analytical and statistical inter-dependence of regional and national estimates..... If regional accounts are to be developed from the national accounting framework, then priority should be given to those aspects of national accounts which can be most meaningful in answering the likely range of regional policy issues." We see that there are twenty-six regions to consider, each region being a county.

A Regional Study of the Relative Prosperity of Irish Farms

Miceál Ross (1969) describes the methodology of estimating agricultural income by size of farm and by region; and gives some results. He uses seven regions, each having a name describing the kind of farming typical of that region, e.g., "1. Subsistence", which geographically includes parts of Kerry, Galway, Mayo, etc. The obvious purpose of the study is to estimate for each region the agricultural income, with related data on kind of output, employment, input costs, etc. The results are available to government and to agricultural policymakers as an aid to regional policy decisions and planning.

Regional Industrial Planning by the IDA

The IDA (1972) discuss their regional industrial plans for the years 1973-7 within a system which divides the State into nine regions. The regions are geographical and their names (e.g. Midlands) do not imply any characteristic of each region, other than its location. Chapters 3, 4 and 10 are of particular relevance for explaining the purpose and uses of regional accounts and multipliers derived from these.

Chapter 3 is entitled "The problem of regional inbalance" and shows that (3.1) "wide disparities exist between regions when assessed against criteria such as population change, income per person, unemployment, proportion employed in industry". Section 3.4.2 considers "counties requiring special remedial action "namely the six counties: Leitrim, Mayo, Roscommon, Longford, Cavan, Sligo. These counties experienced population decline of 2 per cent or more in the period 1966-71".

Chapter 4 has the title "Goals and objectives of the regional industrial plans" and section 4.1 discusses the goals, which will suffice for our present purpose. As national goals there are listed full employment, elimination of involuntary emigration, real increases in GNP, and a wide range of employment opportunities. As regional economic and social goals there are seven items which include:

(a) the avoidance of unbalanced regional development

(b) increased industrial and service employment at the regional level

(c) the full exploitation of each region's resources, human and natural

(d) reduction of regional disparities of per capita income and of unemployment.

Chapter 10 is entitled "The need for further research". The shortage of reliable statistics below the national level is noted, as well as the need for more information about the functions of cities, towns and villages. "Reliable information is lacking on the multiplier effects..... of changes in manufacturing employment at regional and county

levels. Associated with this is the surprising fact that regular intensive study has not been made of regional and sub-regional employment in the service sector..... The substantially higher agricultural incomes resulting from membership of the European Economic Community are expected to generate growth in other sectors of the economy. Measurement of this growth at regional and local level would be useful. Study and research is needed to provide further knowledge".

Even the last paragraph justifies research into how the economic system operates within each IDA region, or within each of some other set of regions. We now consider regional I/O transactions and models derived from them, to see how these provide at least some results of the kind sought by the IDA in their discussion of the need for further research.

Regional Input-Output Transactions and Models

There is no denying that regional I/O tables and derived models are difficult to design and difficult to use for economic projections. Part II below is fully given to discussion of these difficulties. For the present we suppose that we have solved our design problems and thus have to hand a set of I/O transactions tables, one for each region, say an IDA region.

Readers not familiar with I/O transactions might look at the 1974 table published in the Henry (1977) paper. This kind of table is an extension of the county incomes' data. We have sales and purchases of goods and services, the sales along I/O rows, the purchases within I/O columns. One or more rows contain the data on incomes, shown as "household income" and "government income" in Henry (1977), but frequently listed as "wages and salaries", "profits", "depreciation", in other I/O tables. The latter rows of a national I/O transactions table for a certain year should be fully reconciled with that year's GNP by Sector of Origin; the right-hand columns (e.g., household expenditure) should be fully reconciled with the corresponding GNP Expenditure. Any departures from GNP control totals should be deliberately made and fully explained to users. The set of regional tables should have figures which either aggregate directly to corresponding national figures or meaningfully fit together. Regional income figures should add to national figures, as stated by Ross (1971) and quoted above in the "County Incomes" section. Inter-regional imports minus exports should fully cancel out, for all regions together.

Regional transaction tables have two valuable properties:

(1) They arrange and fit together economic data in an orderly fashion. Thus they form a useful and efficient framework for thinking about the economic structure of a region. This framework can extend over many years and can include social and demographic data, as well as I/O transactions.

(2) They show flows of goods and services over regional boundaries; this property is strictly I/O accounting. They show imports to the region from outside, in greater or lesser detail, and exports out of the region. Thus they show trade links between a region and all regions outside, including foreign countries, in greater or lesser detail. For a typical region this aspect is so important that the region's economic structure cannot adequately be described without reference to such trade flows.

In order to get further benefit from regional I/O tables we use their data to make a model of a mathematical or statistical kind. Such a model assumes known mathematical properties of the economic structure, including the property that either its parameters and coefficients are constants or they change in a specified way. The obvious first model derivable from I/O regional transactions is the linear static kind which yields the well-known Leontief inverse. If a household row and column have been included in the inverse we get Keynesian-type multipliers for household income etc. All this is explained at length in the Copeland and Henry (1975) paper. We can also get multipliers which estimate how much imports are needed from other regions, per unit final demand (e.g., exports) of output of a given region. We can get various kinds of employment multiplier, both for the region being analysed and for *related* imports from other regions, i.e., a chain of employment response (within the region and outside) to a stimulus such as exports from that region.

The most ambitious and complicated use of regional I/O models is for regional projections of employment, income, exports, industrial outputs and so on. The stimulus effects of one region on another may be estimated by this kind of model. If a new factory or industry imports most of its raw materials from abroad and exports its products to foreign countries, there will still be inter-regional effects within Ireland, due to the spending of the household income generated by the factory. If the new factory uses Irish materials (either from its own region or from another Irish region) the inter-regional effects will be more complicated. If unbalanced regional development is to be avoided and regional disparities to be reduced (points (a) and (d) listed above under chapter 4 of the IDA plan), then inter-regional effects need to be estimated, which implies regional I/O models or some near equivalent.

PART II: PROBLEMS ARISING IN DESIGNING REGIONAL I/O MODELS AND IN USING THEM FOR PROJECTIONS

In this part of the paper we examine briefly the main problems and difficulties inherent in designing and using regional I/O models. Let us suppose we have a national transactions table for a given year, such as the 1974 22-sector illustrative table shown in the Henry (1977) paper. Once we set about sub-dividing this into a set of regional tables, we are confronted by many problems of various kinds. We have further problems if we decide to use such regional tables to make models for regional economic projections and planning. We must somehow find practical workable answers to both sets of problems, in order to get usable regional models. In what follows we will list the main groups of

problems and suggest solutions; the reader will soon appreciate that regional model-building is not a task to be undertaken lightly, in view of so many difficulties. The fundamental and all-pervading difficulty is lack of precise information at the regional level and the consequent necessity of making estimates which depend on the assumptions used to obtain them.

How to Define a Region

The most obvious definition of a region is its geographical extent, e.g., a county or group of counties. This definition has been used for the county incomes, the agricultural study and the IDA report, all referred to in Part I above. We may suppose that, through Central Statistics Office (CSO) breakdown of national industrial and service data, we have the makings of first approximations to regional I/O transactions tables, with the additional data on county incomes and agricultural regions to help us.

We now come up against a problem which must be faced: how do we deal with employment and earnings which cross regional boundaries? Many people from Wicklow and Kildare travel daily to work in the Dublin region and presumably spend much of their income in Wicklow and Kildare, which are outside the Dublin region. Thus, in general there is some movement of this kind in both directions, over the boundary of a region; if the regions are small we may expect more movement than in the case of fairly large regions which are chosen so as to minimise such movement. To deal with this problem adequately we need to know the kind of employment and the take-home pay of workers crossing regional boundaries. Outflows of such income can then be shown in a separate primary input row for the regional table supplying the income (i.e., as an invisible import cost); a corresponding extra amount of income must appear as an invisible export, or income inflow, of the region or regions where the workers reside.

The second, and less obvious, definition of a region is the estimated full economic activity and household income related to people resident in a given geographic region. This definition attempts to avoid the problem of cross-boundary flows of income, as discussed above. We have, for years such as 1971, the Census of Population (CP) numbers of gainfully occupied persons resident in various geographic regions, by type of industry. We suppose that CSO data for industries and services, with related employment, are available for each of the specified regions. We now scale the CSO industrial data via employment ratios CP/CSO for each industry or service within each region, to give estimated regional levels corresponding to employees resident in each region. Some overall scaling may be necessary, to make the aggregates of regional industrial outputs and costs coincide with specified national totals. All that is intended here is an outline of the second definition of a region and the methods used to attach to that region the full economic activity of the working population living in the region. Pensions and transfer payments must also be allocated to the inhabitants of each region.

How Many Regions?

We have seen that nine regions were used by the IDA and seven regions were used by Ross in his study of agriculture. Thus seven to nine regions might be taken as a reasonable upper limit. But for I/O tables this number of regions could be too many, if one were showing inter-regional trade in full detail: each region would have a table like the 1974 illustrative national table referred to above, but with seven or nine rows generally needed in place of each row of that 1974 table. If one were satisfied to combine all imports to a region in one single import row, then each regional table would be just the same size as the 1974 table referred to and thus a case could be made for seven or nine regional I/O tables. We will consider below the data problem of deciding how to separate out intra-regional trade from purchases of imports; here we are merely considering the problem of size and complexity of I/O rows and columns.

In summary, for Irish applications one might like up to nine regional I/O tables, corresponding to the IDA regions, if each table is kept simple by aggregating all imports into one or two rows (the latter showing as separate rows the foreign and Irish imports into the region). But if the users of the tables require explicit details of imports (and thus by implication the details of exports from other regions), then three or four regions might be elaborate enough for initial modelling. One can make smaller and more numerous regions, with experience of modelling for two or three regions. We will see later in this section some reasons for wanting detailed import structures.

How Many Sectors?

The number of sectors (kinds of economic activity) chosen for a national model is to some extent arbitrary, but three kinds of number are fairly typical of developed economies: 100 sectors (most detailed), 40 sectors and 15 sectors. The Irish 1964 published tables had three levels of detail; 92, 33 and 17 sectors, which correspond quite well with the international levels.

When we come to consider regional tables within Ireland, we may expect that some activities are of negligible importance (or indeed non-existent) in certain regions, although these same activities are quite important for other regions. One of the illustrative regional tables used below in the exercises of Part III is for the five county boroughs; this table has negligible activity in agriculture and solid fuel (peat mostly) as might be expected. The other regional table is for the rest of the State and in this table agriculture and solid fuel are important activities. Three comments on the number of sectors for regional models will complete this part of the discussion:

(i) If we have a large number of regions for our model, we presumably would be satisfied with 15 to 30 sectors in each. Attempting to compile, for example, a 92-sector table for each of nine regions of Ireland would be a very large and frustrating task, and probably not worth the effort. But if we had decided on only two or three regions, then a

50 - or 60 - sector table for each is not unreasonable, *provided one has a national table of similar or greater detail to begin with.*

(ii) There is much to be said for complete consistency of design throughout the regions, if one is dealing with only a few regions and is compiling an I/O table of say 60 sectors. Regional sub-totals are directly additive so as to give national corresponding figures, and the converse property of disaggregation assists considerably in compiling the regional tables. We can get consistent national results if we solve our regional model as one simultaneous linear equation problem for all regions together; in this case we show imports and exports in full regional sectoral detail; our employment multipliers etc. are in ideal detail and give full regional implications of the overall national solution. But there may be a computing problem, through inverting a large matrix, to solve the set of equations. There is, of course, also a large volume of data input: a 200-sector matrix has 40,000 elements, needing 4,000 punched cards at 10 elements per card.

(iii) If we have six to nine regions and choose 15 to 30 sectors, then there is an argument in favour of elaborating on important activities within each region and aggregating unimportant activities. It is now obvious that the design is inconsistent between regions. We have to solve the model's equations for each region separately. So we have between six and nine compact sets of equations, one for each region, and the computing is relatively simple. There are two disadvantages:

(a) we cannot follow through the import implications in full detail because we have suppressed information by aggregating sectors;

(b) we get smaller answers at the national level, if we use each regional model separately, than if we use the full set of regional models simultaneously. This has to do with use of the regional results for modelling and will be more clearly explained below in discussion of the modelling aspects. It needs to be mentioned here, however, since changes in sectoring between one region and another mean future trouble, at the modelling stage.

Thus it appears that the better system of sectoring, with a view to modelling, is perhaps 40 to 60 sectors used consistently for a few regions, thus enabling simultaneous solutions to be got at the modelling stage.

Knowledge of Regional Input Structures

We supposedly start with a national transactions table of 40 to 60 sectors. This table has all "Similar" imports from abroad included in the flows along the upper rows unless such imports have been extracted already. Imports denoted "Similar" are more comprehensive than competitive imports and are intended to allow for present and foreseen substitution between native products and imports. The rest of the imports, denoted "complimentary", are shown in one or more rows, usually near the bottom of the table, and include items neither produced in Ireland nor likely to be produced in the near future (10 years).

We now consider four developments, to give us the most detailed regional model, and requiring progressively more information:

(1) We subdivide each column, to give a sub-column for each region. We require CSO data, county income data, etc. Some balancing estimates and assumptions will probably be necessary, to fill out the equivalents of rows and columns (19) to (22) of the illustrative 1974 national transactions table already referred to. We have now for each region a table corresponding to the national table.

(2) We next take out similar imports from abroad, to leave only Irish products in the upper rows of each regional table. This procedure could in fact also be done at the national level, before (1). Transport costs should play an important part in determining the origin of purchases, since local products have minimum transport costs. It is likely, however, that no special information is available on transport costs of purchased inputs, since CSO usually asks for them at purchaser cost, without distinction of source. Thus we may have to take out the similar imports as a fixed proportion of total flows (except exports) along each row, but in much greater detail, i.e., for perhaps 20 or 30 sub-items going to form each row. We may take exports as of purely domestic origin. The similar import content of a row has to be estimated by this method, unless we have specific information on purchases of these imports.

(3) We take out flows from other Irish regions outside the region, along each row. We must first know or estimate exports of the region for each row. We can then estimate the distribution of the remainder of the region's output along a row in the same way as for similar imports, lacking better information.

(4) The final possible detail is to break down imports from all other regions along each row so as to show a separate row for each region. This would be required if one were solving the equations for all regions together as one simultaneous set. The breakdown into rows for imports from different regions can be done as for (2) and (3), if we do not have specific information.

Flows Across Regional Boundaries

We are talking here about imports to and exports from a region, for a particular row, say footwear. We may expect that if we had full information we would find simultaneous imports and exports even for a fairly precise category such as footwear.* Our problem is how to treat simultaneous imports and exports of, say, footwear. There are four methods of treatment, corresponding exactly to points (1) to (4) immediately above; each such treatment implies different assumptions about our regional model, to be considered below in the next sub-section.

*Such simultaneous imports and exports are hardly meaningful as a single net flow if we take an extreme amalgamation such as "food, drink and tobacco", although they necessarily occur in such a model, for instance Dublin County Borough exports beer and manufactured tobacco to other regions, but imports food manufactures.

(1) We consider only the net flow, positive or negative, over the boundary of the region. So much footwear is produced within the region, so much is purchased, and the *net* balance is either exported or imported. There is no information sought or given on the detailed allocation of the footwear by source.

(2) We take out of the row in detail the gross similar imports from abroad, and show a single net flow of exports, given by regional output less regional demand.

(3) We break down further the Irish row left for (2), by showing gross exports abroad, gross exports to all other regions combined and regional output alone; the gross imports from all other regions combined have been separated out as a single row. Thus the region's footwear row now includes only its own output, if any. All other footwear, being imports, is one or more primary input rows.

(4) We develop (3) to show separate rows for gross imports from each other region and to show the region's own output row exporting gross amounts abroad and to other regions.

In the case of (2), (3) and (4), the imports as defined are treated as primary inputs, so that the region's output row for footwear becomes progressively smaller in value as we go from (1) to (3).

Let us consider flows which cannot be measured directly. Throughout the year, and especially before Christmas, people from all parts of Ireland purchase large amounts of goods in Dublin and take them home. Thus there is a large gross export of consumer goods over the boundary of the Dublin region. There is no direct way of measuring such exports. But if we have precise expenditure data for each region together with data on regional production, exports abroad and similar imports from abroad, then the large outflow from Dublin to other Irish regions must necessarily show up as a large *invisible* export from Dublin matched by large necessary *invisible* imports of other regions. Tourist expenditure is another cause of invisible exports from a region. One may conclude that flows over boundaries are subject to measurement problems and should be treated as residuals rather than as definitive amounts; one should at least allow for invisible exports or imports, in addition to known merchandise trade.

Problems Arising in Using the Regional Models

The easiest approach to a brief discussion of using regional I/O models is to examine the two main kinds of use: (a) analysis of past (historic) regional structures, (b) modelling of economic projections.

(a) *Analysis of past structures*

This analysis is done via the Leontief inverse obtained for each region; only the region's own output is included in the inter-industry or interacting square matrix. Thus all imports are treated as primary inputs, in greater or lesser detail; we can get 'total

'requirements' multipliers in great detail if we want them. Part III below gives numerical examples of this kind of analysis so we shall not discuss it here. We may include a row and column, for household income and expenditure plus savings, respectively, within the interacting matrix, and get Keynesian-type multipliers for each region. We may do this analysis for each region by itself, since the historic data are necessarily consistent for regions of the State, if the regional figures aggregate to national figures, as they should. This particular kind of analysis and the simple model assumed by it, type (3) or (4) of the previous two subsections of this part of the paper, have no problems. They clearly show the carry-over between regions, e.g., we may find that a food factory in Dublin generates more household income in the rural area than in Dublin - we multiply the agricultural input 'total requirements' coefficient for Dublin food manufactures by the rural household income Keynesian-type multiplier for agricultural exports, and compare the result with the Dublin food manufacturers' household income multiplier, to get these kind of answers.

(b) *Modelling of economic projections*

We now suppose we want to use this type (4) model to find regional outputs etc. necessary to meet specified final demands upon regions. Chenery and Clark (1959) have used such a two-region model for Italy. It is advisable to note that we cannot get fully consistent answers unless we solve a model of this kind for all regions simultaneously; this is the only guarantee that imports into one region are in fact the exports of another region. The Leontief inverse is a square matrix and this means that if we have three consistent 50-sector matrices, one for each of three regions, then we must solve 150 simultaneous equations. The final demands would be government expenditures, capital formation and exports abroad, necessarily shown for each region separately; we assume a row and column for households included as inter-industry structure of each region.

The big handicap with this structure is that it is completely rigid and allows no substitution between regional output and similar commodities imported into the region. Let us now consider the opposite extreme, namely the most stable structure imaginable, which is that of type (1) of the previous subsection and contains both the regional produce and all similar imports (from abroad and from other regions) along each row. Let us furthermore assume a one-to-one value substitution* within each row, between regional output and imports. Let us also assume that we want to project at constant prices. We now have, therefore, the economic equivalent of technical input coefficients and cannot hope to improve on stability from this aspect.

But how about other possible changes? Any new large activity in a region should be given a new row and column; any known large structural input changes, e.g., from wool to synthetic fibres in textile piece-goods, should be incorporated in the old structure. There may be other changes in regional structure due to economies of scale, if some industry in

*Let us note, in passing, that we are thus ignoring the problem of differential transport costs of imports: we are by default assuming that such costs do not affect substitutions between a region's own output and similar imports.

a region greatly increases its output. We ought to use as much real information as possible to update the old structure in each region. This also applies to both exports and imports.

We now have to specify the exogenous final demands *for all regions together,* as a single set of aggregates or algebraic variables. An important sub-set are the similar imports from abroad for each row of our model.

It is important to realise that this model has only one set of rows of output common to all regions, but a corresponding set of columns for each region; thus it has far more columns than rows. Since the model does not consist of a square matrix we cannot solve the problem via the Leontief inverse, to get regional sectoral outputs etc. Neither can we trace in detail the carry-over between regions. Thus the cost of maximum stability of structure seems to be an unsolvable problem.

Fortunately we have Linear Programming to solve the kind of rectangular problem just mentioned. We pick, as an objective function to be maximised or minimised, any weighted sum of the variables of the problem. We should add upper and lower bounds on sector outputs within each region, as desired. We may, if we wish, allow the aggregate similar imports from abroad in any row to be a separate variable and likewise for exports. The Linear Programming approach is surprisingly flexible.

We supposedly thus get a feasible economic structure for each region, as the solution for our problem of economic projection. We may have some real-world information already incorporated in the model's structure; the remaining unknown quantities may be estimated as follows. By means of proportionate allocation of similar imports, and then of imports from other regions, we can estimate what this structure means for each region as a type (3) or (4) structure. Presumably as we are allocating imports among all regions we can be consistent. Thus we may perform analysis (a), as described above, on each region's estimated structure, and so estimate inter-regional stimuli etc. via the usual Leontief inverse.

PART III: NUMERICAL ILLUSTRATION USING 1974 DATA FOR A TWO-REGION MODEL

This final part of the paper has four subsections. We first look at figures abstracted from two regional transactions tables for 1974. Next we compare regional results with each other. We then compare them with 1974 State or national results. Lastly we consider some conclusions on the numerical analysis. Readers are asked to note that the national and regional tables are illustrative only and not to be taken as factual for 1974. The national table has been published as background data to the Henry (1977) paper. The regional tables are available on request at the Economic and Social Research Institute.

Transactions Tables for the State and Two Regions

The 22-sector 1974 transactions table for the State, which is the national table just referred to, was compiled for work on energy problems. Each row total is matched by a column total. Row (22) contains all imports. There is a further row showing how estimated 1974 employment is distributed among economic activity, via 1971 Census of Population results updated to 1974. Rows and columns (19) to (22) are in perfect agreement with preliminary 1974 National Accounts.

A 1974 transactions table for the five boroughs (Dublin, Dun Laoghaire, Cork, Limerick, Waterford) is one of the regional tables. Via Census of Population employment data for 1971, updated to 1974, it was compiled via the following hypotheses: (i) within both regions of the State the output per man-year is the same for each of the 17 sectors having direct employment of labour; (ii) likewise the cost-structure of each sector is the same; (iii) the household expenditure and savings' pattern is the same in both regions; (iv) government current expenditure is the same per government employee; (v) government current transfers to households and persons and income from abroad is directly proportional to the 1971 populations in both regions; (vi) capital formation is equal to the available savings emerging from the results of the previous hypotheses with one or two further minor assumptions; (vii) net exports only are of significance for each sector within a region; (viii) net imports, where they arise for a row, are a constant proportion of each non-zero entry in that row, and thus can be abstracted as a row of imports from the other region, leaving a row of output of the region having zero net exports; (ix) net exports in a row must first satisfy any demands arising in the other region, before having their residue allocated to exports abroad; (x) within a region each row total is set equal to the corresponding column total, except for the export columns and import rows (22) (A) and (22) (B), for which aggregate the equality also holds.

We note that this regional table has two export and two import rows, to distinguish trade with the other region from trade with foreign countries.

A transactions table for the Rest of the State, the other 1974 regional table, is got by subtracting figures for the five boroughs from corresponding figures of the national or State transactions table.

Inter-Regional Comparisons

(a) *Direct, from the transactions tables*

Table 1 sets out some inter-regional comparisons. The 1974 estimated Boro' employment, 322.5 thousand man-years, is 44 per cent of the Rest, 735.5 thousand. The Boro' household disposable income per man-year, £2,360 is 104 per cent of the Rest level, thus suggesting equitable income distribution generally, if children, old age pensioners, widows, unemployed and various non-employed persons are the same proportion of employed persons in both regions. The government income per man-year is 43 per cent higher in the Boro' region. Government savings appear as £120 per man-year in the Boro' area, compared with dis-savings of £145 per man-year in the Rest area; the absolute figures suggest a net inflow of £107 million of government funds in excess of government income within the Rest region. Total savings per man-year are 66 per cent higher in the Boro' than in the Rest region; the higher Boro' figure is partly due to the depreciation allowance of business being much more Boro' than Rest and agricultural depreciation being relatively small. Exports abroad per man-year are 117 per cent more for Boro', exports to the other region only 8 per cent higher for Boro' than for Rest, and total exports per man-year 91 per cent higher for Boro'. Total imports to the Boro' region are per man-year also 91 per cent higher than those per man-year for the Rest region.

(b) *Results from the Leontief Inverse analysis*

We now compare the Boro' and Rest magnitudes of aggregate multipliers, for household income, government income, employment. Table 2 sets out the data used and the aggregate multiplier results. Each multiplier is formed by the ratio of two entries, the numerator coming out of the Leontief analysis and the denominator being the aggregate value of transactions in one of columns (20) to (22) (B) or the grand total of all such transactions, originally appearing in the two regional tables. Corresponding multipliers could, of course, be formed for savings and for imports to either region.

Because the last row of Table 1 shows that imports per man-year for the Rest are only about half those of the Boro', we are not surprised to find Table 2 showing that the Rest multipliers are generally larger, and frequently much larger, than their Boro' counterparts. For final demand as a whole, the Rest household income multiplier is 0.78 versus 0.47 Boro', the government income multiplier 0.26 versus 0.21 and the employment multiplier (man-years per £1,000 expenditure) 0.34 versus 0.20. For total exports the Rest household income multiplier is 0.65 versus 0.37 Boro', the government income multiplier 0.19 versus 0.18 and the employment multiplier 0.36 versus 0.18. Results of other columns of Table 2 are in harmony with these quoted results.

TABLE 1: COMPARISON OF 1974 ILLUSTRATIVE DATA FOR TWO REGIONS OF IRELAND

Item	Five Boroughs (1)	Rest of State (2)	Boroughs as a percentage of Rest (1)/(2) (3)
Estimated employment in thousand man-years	322.5	735.5	44
Household disposable income:			
Value, £ million	761.25	1,668.75	46
per man-year, £	2,360	2,269	104
Government disposable income:			
Value, £ million	342.78	550.22	62
per man-year, £	1,063	745	143
Government savings within the region:			
Value, £ million	38.79	- 106.79	Not meaningful
per man-year, £	120	- 145	
Total savings:			
Value, £ million	329.07	452.93	73
per man-year, £	1,020	616	166
Exports abroad:			
Value, £ million	837.10	881.90	95
per man-year, £	2,596	1,199	217
Exports to the other region:			
Value, £ million	126.74	267.29	47
per man-year, £	393	363	108
Total exports from the region:			
Value, £ million	963.84	1,149.19	84
per man-year, £	2,989.	1,562.00	191
Total imports to the region:			
Value, £ million	963.84	1,149.19	84
per man-year, £	2,989	1,562	191

TABLE 2: AGGREGATE 1974 MULTIPLIERS FOR THE TWO REGIONS, DERIVED FROM ILLUSTRATIVE DATA

Region and Item	Government consumption etc.	Capital formation	Exports to other region	Exports abroad	Total exports	Total final demand
Five Boroughs	(20)	(21)	(22)(A)	(22)(B)	(22)(A)+(B)	(20)to(22)(B)
(1) Column Total, £ million	342.8	329.1	126.7	837.1	963.8	1,635.7
(2) Related household income	282.1	122.4	50.9	305.8	356.7	761.2
(3) Related government income	95.7	77.8	26.2	143.1	169.3	342.8
(4) Related employment	77.7	66.2	24.6	154.0	178.6	322.5
(5) Savings	114.0	- 29.7	18.0	226.8	244.8	329.1
(6) Imports from Rest of State	39.0	69.2	7.3	151.8	159.1	267.3
(7) Imports from Abroad	94.0	211.8	75.3	315.4	390.7	696.5
Aggregate Multipliers						
Household income (2)/(1)	0.82	0.37	0.40	0.37	0.37	0.47
Government income (3)/(1)	0.28	0.24	0.21	0.17	0.18	0.21
Employment (4)/(1)	0.23	0.20	0.19	0.18	0.18	0.20
Rest of State						
(1) Column Total, £ million	550.2	452.9	267.3	881.9	1,149.2	2,152.3
(2) Related household income	696.0	230.4	245.7	496.7	742.4	1,668.8
(3) Related government income	202.0	132.5	52.9	162.9	215.8	550.3
(4) Related employment	198.2	126.4	153.4	257.5	410.9	735.5
(5) Savings	73.5	- 22.0	76.2	325.2	401.4	452.9
(6) Imports from Five Boroughs	50.4	24.2	16.5	35.6	52.1	126.7
(7) Imports from Abroad	224.3	318.3	121.7	358.1	479.8	1,022.4
Aggregate Multipliers						
Household income (2)/(1)	1.26	0.51	0.92	0.56	0.65	0.78
Government income (3)/(1)	0.37	0.29	0.20	0.18	0.19	0.26
Employment (4)/(1)	0.36	0.28	0.57	0.29	0.36	0.34

Comparison of Regional and National Results

We can compare national and regional results in two ways: (i) by looking at Keynesian multipliers and commenting on the differences; (ii) by examining and commenting on the primary input components of final demands.

(i) Keynesian Multipliers

Out of the 19-sector Leontief inverse results for the State and two regions, three kinds of Keynesian-type multipliers have been selected as illustrations, namely, those for employment, household income, government income. Of the 19 sectors ten have been further selected, namely, those sectors having the largest State or national employment multipliers; their results are shown in Table 3, arranged in decreasing order of magnitude of their State employment multipliers. Corresponding Boro' and Rest multipliers are also shown in Table 3.

The first impression one receives from Table 3 is that the State multipliers are always greater than, or equal to, their regional counterparts. This truth can be illuminated in two ways:

(a) if imports occur from the other region (in addition to imports from abroad at average national intensity) they will reduce the State levels of inter-industry coefficients and thus scale down the Leontief inverse;

(b) final demand at the regional level is necessarily larger than final demand at the State level because of inter-regional exports in addition to exports abroad, thus for given State aggregates such as household income, the regional multipliers must be smaller than their State counterparts. This result is quite general, for similarity of structure assumed in both regions and imports from abroad likewise distributed uniformly.

The second impression one receives from Table 3 is that the Rest multipliers for employment and household income are larger than corresponding Boro' multipliers, in all ten selected sectors. This aspect has already been commented on as due to imports per man-year for the Rest, being only about half that of the Boro'. The difference in multiplier size is particular to the Boro' and Rest transactions tables being analysed, but emerges so strongly in the multiplier detail that it would probably hold true for serious estimates of Boro' and Rest tables. What this means for regional planning is that a stimulus, such as £1 million of exports, yields much higher Rest responses in employment and household income than if it were the corresponding Boro' exports. But of course this is not the full answer; the carry-over by the regional import stimulus to the other region should also be considered, if one wishes to measure the full two-region effect.

TABLE 3: COMPARISON OF ILLUSTRATIVE KEYNESIAN MULTIPLIERS OF EMPLOYMENT, HOUSEHOLD INCOME, GOVERNMENT INCOME: STATE VERSUS REGIONS

Ten sectors, arranged in decreasing order of magnitude of column (1) entries		Employment multipliers			Household income Multipliers			Government income Multipliers		
		State (1)	Boro's (2)	Rest (3)	State (4)	Boro's (5)	Rest (6)	State (7)	Boro's (8)	Rest (9)
(1)	Agriculture etc.	0.65	0.41	0.64	1.01	0.62	0.99	0.18	0.11	0.17
(2)	Solid Fuel	0.55	0.51	0.54	0.87	0.80	0.85	0.35	0.33	0.34
(4)	Food, Drink, Tobacco	0.52	0.13	0.51	0.88	0.28	0.86	0.15	0.05	0.14
(15)	Trade Margin	0.51	0.45	0.49	0.82	0.73	0.80	0.36	0.35	0.35
(17)	Services	0.40	0.34	0.39	0.79	0.69	0.77	0.40	0.38	0.39
(12)	Construction	0.39	0.32	0.38	0.73	0.62	0.71	0.29	0.27	0.28
(6)	Wood, Furniture, Paper, Print	0.38	0.33	0.37	0.56	0.49	0.54	0.22	0.21	0.21
(16)	Transport	0.36	0.31	0.35	0.59	0.51	0.56	0.29	0.27	0.28
(5)	Textiles, Clothing etc.	0.35	0.29	0.34	0.53	0.44	0.51	0.21	0.19	0.20
(9)	Clay, Cement etc.	0.33	0.27	0.31	0.62	0.54	0.60	0.26	0.23	0.24

(ii) Primary Input Components of Final Demand

The data for comparison are arranged in Table 4. The figures emerging from the State model are generally larger than corresponding regional figures. The regional (Boro's plus Rest) figures for each component (e.g., government income row) have however an extra entry, namely that in the column "Exports to the Other Region" comprising the response to inter-regional trade, which has no meaning and does not exist for the national model. We also see a row for "Imports from Other Region", which do not exist for the national model. Each of the two approaches, national and regional, gives the correct aggregate national result for each component. One can see, therefore, that in breaking down a national transactions table into regional tables, the bigger the inter-regional exports, the smaller will be the regional responses to government consumption, etc., capital formation, exports abroad, and the larger will be the regional response to the stimuli of inter-regional trade.

TABLE 4: PRIMARY INPUT COMPONENTS OF FINAL DEMANDS: STATE RESULTS COMPARED WITH REGIONAL AGGREGATES, ILLUSTRATIVE DATA

Item	Government consumption etc.		Capital formation		Exports abroad		Exports to other region	Total final demand	
	State	Boro's plus Rest	State	Boro's plus Rest	State	Boro's plus Rest	Boro's plus Rest	State	Boro's plus Rest
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Government Income, £ million	319	298	234	210	340	306	79	893	893
Savings, £ million	209	188	- 31	- 52	604	552	94	782	782
Imports from Abroad, £ million	365	318	579	530	775	674	197	1,719	1,719
Imports from Other Region, £ million		90		93		187	24		394
Household Income, £ million	1,044	978	417	353	969	803	296	2,430	2,430
Employment, thousand man-years	314	276	228	193	516	411	178	1,058	1,058

The regional models and their summary information, of the kind illustrated by Table 4, provide information not otherwise available. By means of the data on "Exports to Other Region" in column (7) we can see how the economic activity in one region is linked to that of another. Column (7) entries of Table 4, expressed as percentages of the State total column (8) or (9) entries are as follows: government income 8.8, savings 12.0, imports from abroad 11.5, household income 12.2, employment 16.8. Employment, therefore, is the most dependent on inter-regional trade, one person in six being thus directly and indirectly employed. We find indeed that of the 178 thousand man-years generated thus in both regions, 153 thousand occurs in the Rest region (Table 2) and 25 thousand in the Boro' region. Thus this stimulus mostly benefits the Rest region.

CONCLUSIONS

Some six conclusions are presented, about the model and its regional and national results.

(1) The exercise of estimating the two regional tables of expected values and computing the analysis was worthwhile. The results suggest some plausible large real-world differences; for instance the computed Boro' support of 153 thousand man-years in the Rest area is quite possible, since all agricultural activity is there. Likewise the Rest support of 25 thousand Boro' man-years, in services mostly, makes sense.

(2) Multipliers for one sector can differ significantly between the two regions. This has been clearly demonstrated. Thus there is a strong case to be made for the need of regional tables, even of expected values, to estimate the multipliers. The implications for regional development policy would seem to be that the optimum policy is to stimulate the sectors having maximum multipliers for (say) employment in a specified region, while also taking account of carry-over or stimulus effects on other regions.

(3) The 23-sector model presented above is far too aggregate. One might do better with a matrix of up to 60 sectors. This would provide an analysis of regional differences in much finer detail than that used above.

(4) For the assumptions of uniform distribution of imports from abroad and similarity of input structure throughout all regions, the State multipliers for a given system of sectors are necessarily maxima. Regional multipliers will be smaller, matched by larger final demands upon the region. Thus we need to specify the final demand stimuli for regions, as well as the multipliers themselves. The best arrangement would seem to be a State table and set of results, to be reviewed together with regional results. More accurate information on regional structure might show some regional multipliers larger than their national counterparts.

(5) Developments over time should be considered, to see how regional multiplier magnitudes change, and how one region's activity affects another region's activity and employment. If the treatment of data is consistent, i.e., the same methods used to get expected transactions for several years, it would seem valid to compare results.

(6) The employment approach to defining a region avoids awkward problems of workers and their earnings and spendings crossing geographical boundaries; if the latter are used to define a region such problems occur.

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DISCUSSION

David Hurley: May I preface my remarks by extending the apologies of Dr Noel Whelan and Dr Eamonn Clarke who cannot attend to-night as they are both abroad. However, they have asked me to convey their admiration of this paper, and their appreciation of all of Eamon Henry's work in the Input-Output field ranging from the compilation of the basic tables, to the application of Input-Output based models.

In this paper, Dr Henry demonstrates the possible use of regional models in planning and discusses the difficulties involved in building such models. Coincidentally, the paper appears at a time when renewed interest is being taken in regional planning. The establishment of the new Department of Economic Planning and Development gives a new emphasis to economic planning activities and the Department's functions relate not only to policies for the economy generally, but also for the different sectors and regions of the country. The Minister has stated that he will be taking a fresh look at many activities in the planning and development sphere. Any such fresh appraisal of regional policies could be aided by the sort of analytic instruments which Dr Henry has outlined in his paper and consequently we are grateful to him for initiating discussion in this field.

He gives a full exposition of the difficulties involved in developing this type of model. Indeed he is to be congratulated on his perseverance in reaching any results through the maze of difficulties with which he had to contend. He overcame these difficulties by a mixture of ingenuity and heroic assumptions. For instance, the employment definition of the regions cleverly avoids the difficulties associated with a strictly geographical division. On the other hand such assumptions as dividing net imports in constant proportions of all inputs are doubtful, and justified only by the absence of detailed data at a regional level.

Dr Henry uses two interesting regions in his illustrative model. The choice of just two regions reduces the complexity of the model and enables the inter-regional trade to be given in detail, while using two regions with such wide divergence in their characteristics increases the chances of interesting results. However, some of the differences in the characteristics of the two regions could perhaps have been reflected more in the assumptions underlying the compilation of the tables.

For example, the third in the list of assumptions is that the household expenditure and savings pattern is the same in both regions. This is unlikely to be true in view of the

relatively high savings propensity of the farming community, which is almost totally confined to one region. This assumption probably accounts in part for the figure in Table 1 showing that savings per man-year are two-thirds higher in the Boro' region. This result is not what one would expect and may account for some of the disparity between multipliers.

It may also be that the possible preponderance of high technology industry in the Boro' area invalidates the assumptions of similar productivity and costs structures in the two regions. Analysis of the location of these industries may enable adjustments to be made to the assumptions. In fact, the sample surveys mentioned by Dr McKeown could be used to complement the Input-Output method, by using the information gained from the survey analysis to adjust the definitions underlying the Input-Output tables. It is possible that adjustments along these lines may reduce the differences between the multipliers for the two regions.

Clearly, Dr Henry's own warning, that the tables and results presented in the paper were purely illustrative, should be heeded. It could be misleading to use these results for planning purposes. However, I do not mean to say that the exercise was not worth while. On the contrary, this paper performs the very useful function of examining experimentally the capabilities of regional Input-Output models in providing useful information for planning. It is also of benefit in outlining the difficulties involved in designing such models, and in pointing out the gaps in Irish data, which render difficult the task of estimating regional models. This paper will provide food for thought for economic planners seeking analytic tools to aid them in the formulation of regional policies.

It is my great honour to propose the vote of thanks to Dr Henry.

Dr R.C. Geary: As the oldest ex-President I salute the new President at his first General Meeting. I wish him a successful term of office, as much success, in fact, as he has had with Home Farm and his other activities.

And the lecturer: I come to praise Caesar and not to bury him. Eamon Henry is the Mr Input Output of Ireland. He is our national Wassily Leontief. I have been working on his 1974 table closely for the past month, indeed this very day. I cannot see how anyone interested in national or regional economics can do without the relevant I/O tables, or something approximating to them. There is far more to I/O than "inverting the matrix".

The table contains a lot of what one wants for analysis, the figures arranged ingeniously in their relation to one another. Of course I agree with the first speaker that they don't contain all the planner needs. No statistical system can. But I cannot agree that the I/O system is misleading to anyone who understands it. Of course it is inaccurate. All statistics are. It does not give precisely what the analyst wants – because the collecting agency can ask only what the respondent knows and is willing to tell. As to accuracy, it fortunately happens that wise decisions can be made on imprecise figures. Otherwise there would be no justification for official statistics.

As to sensitivity analysis, I recall in my 1956 Society paper (in which I had invaluable assistance from Eamon Henry) trying the effect on the results of systematically altering I/O coefficients, generally to be reassured that the alternations would not affect the outcome to the point of misleading decisions from it.

Observing the presence of my friend and successor the Director of CSO, I would appeal to him to consider favourably the setting-up of an annual series of national I/O tables, with regional tables at intervals. I know he will be too polite to give me the party politician's rejoiner: "Why didn't you do it when you were in?"

As to the methodology of regional I/O, the main difficulty is that for regions, external trade figures are non-existent. The lecturer and I have papers designed for estimating inter-industry coefficients knowing the margins, i.e. the totals of final demand and primary input, for application in time at the national level. What does he think of using something like this for regions in a given year, using the national table as a basis?

His treatment of multipliers in the paper naturally displays scientific austerity. I suggest however, that in the printed version he spells out, in the tabular section, what the figures mean, by way of illustration, e.g. (as an imaginary sample) "the x means that £1 million additional spent in agriculture will lead to 100x employment in man-years". Multiplier theory is essential for policy makers who, rarely I/O experts, will otherwise tend to ignore such important statistical instruments.

Tom Ferris: I would like to congratulate Dr Henry on his very interesting and stimulating paper. In particular, working with co-operatives, I welcome the emphasis which Dr. Henry has put on the practical, rather than theoretical, dimensions of regional input-output models.

There are six points I would like to make on the paper – three general points and three specific ones. Taking the *general* points first:-

(a) Regional input-output models help to highlight the significance of the different types of economic activity in the overall economy, not only in terms of value added but also in terms of employment. For example, such models provide a facility for identifying the significance of agricultural co-operatives, in terms of the contribution they make to the economy through the processing and marketing of the various forms of primary agricultural production, as well as the provision of inputs to agriculture.

(b) By developing data for 1974, Dr Henry has provided planners and economists with fairly up-to-date information, albeit illustrative. The illustrative data provide some useful indications of how the "urban" and "rural" regions differ under a range of economic parameters (income, savings, trade etc.).

(c) Dr Henry stated in his introduction that one of the purposes of his paper was to show how regional input-output models can complement county income studies of Miceál Ross (1971 and 1972) and the associated employment findings of Baker and Ross (1975). In this regard, the recent publication by the National Economic and Social Council of *Personal Incomes by County in 1973* (M. Ross, R. Jones and E. O'Malley) can be seen to be an additional contribution to economic information on a county/ regional basis.

The three *specific* points that I have to make on Dr Henry's paper are as follows:-

(a) In discussing the stimulus effects of one region on another, Dr Henry states on page 5 of his paper that, "If a new factory or industry imports most of its raw materials from abroad and exports its products to foreign countries, there will still be inter-regional effects within Ireland, due to the spending of the household income generated by the factory. If the new factory uses Irish materials (either from its own region or from another Irish region) the inter-regional effects will be more complicated." I am sure that in the second sentence quoted, Dr Henry is concerned with problems in model-building and is not inferring that new factories in fact experience complications where they use Irish materials. Indeed, from a regional (or national) viewpoint, the higher the percentage of indigenous inputs used in exports, the greater the contribution to the regional (or national) economy. An example, of the bigger contribution made by exports containing a lower percentage of imports, is given in an earlier ESRI paper, which Dr Henry wrote in conjunction with the late John Copeland *(Irish Input-Output Multipliers, 1964 and 1968,* August 1975, page 45):

> "....a £1 increase in agricultural livestock exports.... led to an increase of about £1.3 in disposable household income generated in the economy, whereas the corresponding figure for a £1 change in chemical exports was less than £0.6".

(b) On Page 14, Dr Henry states that his illustrative data suggest "equitable income distribution", as between the "Boro" area and the "Rest of the State". The incomes of different counties in 1974 were affected by economic developments which had a different impact as between counties. For example, it would seem that the world recession of 1974 had a greater impact on the manufacturing sector - which is mainly located in the counties of the East and North-East region. To that extent, these regions would have been more affected by the downturn in activity than other regions. Again, while the high cattle prices of 1973 would have helped to increase agricultural incomes in counties in the "Rest of the State", the sharp fall in cattle prices would have had the opposite effect in 1974. Therefore, it is important to recognise that in any one year the relationship between the incomes in different regions can change as a consequence of economic factors having a different impact as between regions.

(c) Mr D. Hurley of the Office of the Minister for Economic Planning and Development has already made reference to Dr Henry's assumption regarding the savings' pattern in the "Boro" and "Rest of the State". I would also like to refer to this point. Dr Henry used a simplifying assumption regarding savings' pattern in the context of *illustrative* data. Even if he had refined his assumption to reflect the specific regional patterns of savings in 1974, it is unlikely that the results would be descriptive of the underlying regional trends. This is because 1974 was an exceptional year as regards savings generally, to the extent that the world recession caused a boom in savings. In effect, consumers reacted to high inflation and the threat of unemployment by spending proportionately less of their income than previously. As regards the relative savings position between regions, there is some evidence to suggest that the savings ratio is lower in the "Boro" than in the "Rest of the State". I refer here to a recent article by Robert Kelleher, *(The Influence of Liquid Assets and the Sectoral Distribution of Income on Aggregate Consumers' Behaviour in Ireland: Economic and Social Review,* Vol. 8, No. 3). For, in the conclusion to his paper, Mr Kelleher states that:

> "The hypothesis that the marginal propensity to consume out of agricultural incomes was lower than that out of non-agricultural incomes, was....borne out by the empirical work in the paper".

A corollary to this is that the marginal propensity to save, is higher for agricultural incomes. In the context of Dr Henry's paper, this would seem to point to the marginal propensity to save being higher in the "Rest of the State" than in the "Boro".

In conclusion, I would again like to congratulate Dr Henry on his excellent paper.

L.P. O.Reilly: Dr Henry presented his paper "input-output" to indicate its possibilities as a method of regional analysis and projection. It was not put forward as the method, but one of many. As such it has some particular virtues, but also some serious defects. As a tool of static analysis, it involves the collection of considerable amounts of data, which must be accurate. This is a very powerful mathematical technique requiring factual data inputs both to do justice to the technique itself and to allow for the credibility which will attach to the analysis results, reservations and small print notwithstanding. Numerical information and particularly projections derived from complicated mathematical techniques tend to be taken as truth, despite all qualifications included in the text or in footnotes. In the case of "input-output" the collection of the masses of data required for proper functioning of the model is a major consideration, which must be weighed against the results obtainable from cruder but less time and data consuming techniques. As Dr Geary has remarked, research should not concern itself with minor benefits or dis-benefits but with major elements. As a practicing town and regional planner my criterion for good research technique, admittedly with an operational bias, is that which most quickly, with least data discloses major differences in costs or benefits in varying actions. As a technique, input-output is too time and data consuming and its refinement is at odds with the very crude levels of control exercised in regional planning.

Dr Henry's paper quite rightly raised the regional definition problem. This issue has generated much discussion and hypothesis but little general agreement. This paper has used two regions; the five county boroughs and the rest of the State. In an Irish context, I would suggest that there is at least as great a difference in areal function between Dublin C.B. and Waterford C.B. as between Waterford C.B. and the rest of the State. Likewise, to use the county borough boundaries as statistical entities is to ignore their immediate hinterlands. Dublin County Borough and Dublin County, for instance, must be seen, on any interaction scale, as operating as one unit.

On a more general level, input-output assumes homogeneity of intra-regional conditions. This is less likely to be the real position as regions grow larger. In real world situations, industries do not locate in regions; rather factories locate in particular sites. Therefore neither generalised regional or industrial co-efficients need apply to a new factory in a given location. The use of large regions obviously assists in matters of data collection and detailed analysis, but the results may be of little assistance to intra-regional location. This is not to suggest that the present nine administrative regions, which the IDA also accepted as industrial planning regions, make a great deal of sense in planning terms. The degree of intra-regional interaction in many of them is limited, sometimes due to physical barriers and sometimes due to the lack of urban units of sufficient scale.

Using input-output analysis as a forecasting tool in regional development bestows no particular advantage over other methods. Given the fairly long time scale of most regional projections, the construction of a sophisticated input-output network, whilst it provides detailed monitoring facilities, seems rather wasteful, when cruder methods of analysis will suffice.

This paper is a most useful exploratory exercise in the use of input-output analysis at the regional level and Dr Henry's efforts in this respect are most welcome. The lack of reliable regional data at the present time postpones its use in practical planning. Even if such data existed, the difficulties associated with its assembly and upkeep, the absence of realistic regions in a planning sense and the limited degree of control by planning authorities at national, regional and local level on development, and particularly industrial and commercial development, places a major question mark on the utility of input-output techniques in development planning.

J. Higgins: It appears to me that input-output (I - 0) models are substitutes for a proper economic model of an economy and it's regions. Such a model would be a general equilibrium or quasi-general equilibrium model. In it's formulation one would take account of the resources available in the regions, regional production functions and regional demand and supply functions for both factor inputs and final commodities. There are conceptual problems associated with the construction of such a model and almost insurmountable problems associated with estimating the parameters of such a model.

The adequacy of an I - 0 model as a substitute for a more general economic model depends on the prupose for which the I - 0 model is used. For describing existing inter-dependencies in the economy, the I - 0 model performs reasonably well, although it does not take into account the existence of excess capacity or underemployment of resources in sectors of the economy. If there is underemployed labour or excess capital in a sector, output expansion may lead to no direct expansion in the employment of labour or capital. Perhaps more detailed knowledge about industrial sectors, and their constituent industries. could be used to adjust I - 0 coefficients so as to allow for the above situation.

The usefulness of the I - 0 models for prediction purposes depends to a large degree on (a) whether the basic assumption of fixed coefficient production functions, which underlies I - 0 models, is valid and (b) the degree to which I - O coefficients are stable over time. Both of these properties of I - 0 models could be tested and if these were found wanting, suitable adjustment could be made to the I - 0 coefficients.

Finally I wonder if we can avoid getting data on inter-regional trade flows in order to be sure that we have constructed valid I - 0 tables for the regions.