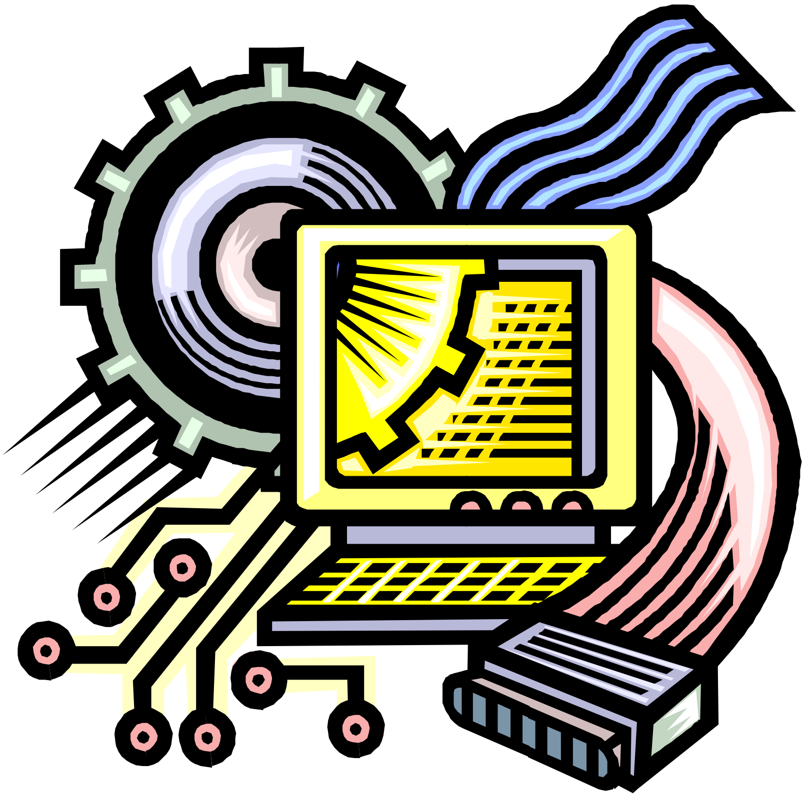
RALE Lecture 2b 16/02/10 Introduction to econometric and input-output models



Regional Econometric models

Whilst regional multiplier models can give estimates of changes in total regional employment and income they are not capable of providing more detailed predictions, which estimate the effect of alternative policy strategies. Typically the planner wishes to know the effect of a given policy change on a wider range of economic, demographic and social variables.

Regional econometric models should possess several characteristics if they are to be effective:

- The model must be **sufficiently detailed** so that the major planning authorities can be provided with the sort of data they need to carry out their functions. –
    1. Forecasts of output and employment to inform industrial development plans.
    2. Demographic breakdown and forecasts, for the provision of public services.
    3. Occupational breakdown and forecasts, for the development of effective training packages.

- Regional models need to be **constructed for differing spatial areas** usually corresponding with administrative areas.
    1. For example education authorities will require demographic information at district levels for the provision of schools and staffing,
    2. Training and business organisations may require information at the local labour market level (Travel to Work Area).
    3. Where a number of spatial disaggregations are required this means modelling at the lowest level of disaggregation and aggregating up into larger spatial units – this can be problematic as it is generally accepted that a degree of accuracy is sacrificed at lower levels of disaggregation.

- Models must be **internally consistent**.
  This means that the region must be treated as a set of interdependent elements, (for example the Northern Ireland Economic Research Centre (NIERC) model is comprised of about 300 separate but inter-linked equations). If one part of the system is affected by an exogenous shock (change in interest rates, influx of migrants) then the reverberations will be felt throughout the regional economy and the model must be capable of predicting "full system effects".

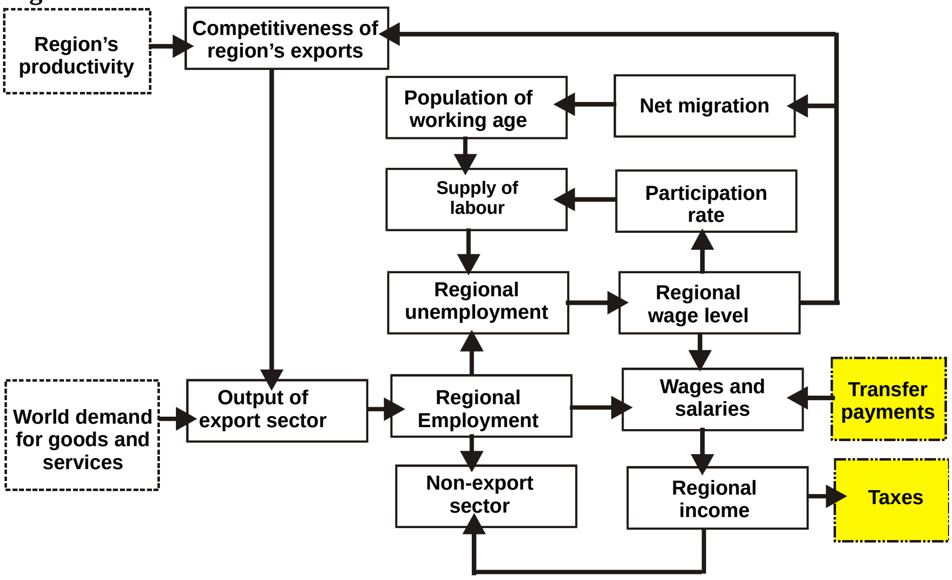
Regional econometric models vary in size and content of for a number of reasons.

1. **They are constructed for different purposes.**
   I.e. estimating the differing impact of alternative fiscal policies in different sectors of the regional economy or providing forecasts of economic and demographic variables based on pre-determined scenarios.
2. **The availability of data.**
   The researcher may have to compromise on the optimum construct of the model simply because data is not available or alternatively may have to use surrogate data as a second-best option. This problem becomes more acute with finer spatial disaggregation, for instance, annual GDP is not available from CSO below the NUTs 3 level in the UK.
3. **Researchers are often reduced to ad-hoc devises to make their models work.**
   Armstrong & Taylor use the example of discarding the well-established theoretical link between private investment and interest rates from the model's investment function if the researcher finds that the determinant does not in practice help to explain the variations in investment. Therefore, it can be expected that equations in models may not always correspond with a priori theorising.

Econometric models are interdependent sets of equations. Each equation determines the numerical value of one of the regions economic variables. The right-hand side may include exogenous variables such as the national wage rate, taxation and birth and death rates within the region or endogenous variables (determined within the model).
Such models attempt to measure economic linkages that exist within the region and between the region and the outside world. These links are estimated by econometric methods and represented as equations for the purpose of predictions

Armstrong & Taylor use a simplified model based broadly on one developed by Adams, Brooking and Glickman (1975) to demonstrate the effect of an exogenous shock. See page 32 of Armstrong and Taylor

Figure 4.1 Regional Econometric Model



Schematic regional econometric model
Based on: Armstrong and Taylor (2000) Regional Economics and Policy

The model suggests that both migration and competitiveness act as equilibrating mechanisms offsetting the effect of the initial shock to the regional economy.

Improvements
Armstrong & Taylor suggest that a number of improvements could be made to the basic model to make it more realistic. Such as, making taxes partly dependent on wages and salaries, taking account of the fall in transfer payments in line with a reduction in unemployment. Further, disaggregation of the export sector helps to take account of the differing responses to changes in world demand and disaggregation of industry sectors and population profiles helps to take account of differing responses to changes in income and varying levels of competitiveness.

Evaluation of Rival Econometric Models
A number of attempts have been made to compare the effectiveness of regional and local econometric models. Hunt, Slaymaker and Snell (1996)[i] set out to compare three of the best-known regional econometric models in the UK, Cambridge Econometrics (CE) model, Northern Ireland Economic Research Centre (NIERC) model and Business Strategies Ltd (BSL) model.

In the event they were only able to examine two; NIERC and BSL. Both models are similar, complex and rely on a vast number of interdependent equations.

The researchers ran standard fiscal simulations on both models
- **1% reduction in the standard rate of income tax**
- **1% reduction in the VAT rate**
- **1% reduction in interest rates.**

The output was for standard planning regions in the UK in terms of percentage change in GDP from base level, percentage change in manufacturing output from base level and the absolute difference in unemployment from the base level.

The results were conflicting with wide differences in the prediction of wining and losing regions. For instance, in response to the 1% cut in interest rates the NIERC model suggests that Wales is the largest gainer resulting in a 1.05% increase in regional GDP, whereas the BSL Model suggests that the East Midlands is the main beneficiary with an increase of 0.97%. Indeed, the authors found little or no consistency across the results.

They suggest that the differences can only be explained by detailed analysis of the model's underlying structures, the data sets used, the way the modellers derive their regional data and the treatment of regional and sector productivity and estimating techniques. They conclude that it is possible with current data availability that the modellers may be attempting to model the impossible, particularly because of the lack of differentiated data on marginal propensities to consume locally produce goods and import levels. Gloomily, they see little prospect of significant improvements in the shorter-term.

In a follow-up study two of the authors, Hunt and Snell (1997) examine local econometric models[ii]. This time they concentrated on the structure of the models rather than attempting simulations. The two models' under the microscope are the Liverpool – Cardiff suit of models (L-C) and Cambridge Econometrics' Local Economy Forecasting Model (LEFM). The former consists of three separate models for Merseyside, Wales and a combined model for Gwynedd, Clwyd and Cheshire the latter is a commercial bespoke package customised to the client's requirements.

There are a number of other differences, a selection of which, are set out below: -

- The L-C model has been subjected to considerable academic scrutiny the LEFM has not (because of its commercial status).
- The LFEM is much more disaggregated than the L-C model
- The L-C model is supply-side driven i.e. the region's growth depends on upon supply of factors (mainly labour) the LEFM is demand driven.
- The L-C is based on a system of inter-linked equations whereas the LEFM has an input-output approach as its' underlying philosophy.

Hunt and Snell conclude that the two models present contrasting extremes in local economy modelling. Whilst the LFEM is described as "bold" and "ambitious" it is suggested that the level of sector disaggregation may be too great and that there is a need for a more "detail" about the assumptions used within the model. On the other hand, the L-C model is described as a "neat" approach but contains very restrictive assumptions and depends on faith in supply-side economics. They conclude that the potential user has to make a decision based on which model to use based on four criteria:

Theoretical viewpoint
Belief that changes in demand will work through and directly effect the local economy or that such an effect can only be temporary until a new equilibrium is attained.
Methodology
Whether to use the econometric approach including dynamics at the local level, or the input-output approach backed by econometric forecasts at national or regional level.
Level of aggregation
The LEFM forecasts for 49 industry sectors whereas the L-C only provides a manufacturing/non-manufacturing split.
Expertise required
The LEFM is an off the shelf package (with support) and is effectively a black box, in contrast L-C is comprised of a set of transparent equations requiring standard econometric software and relevant data ideal for the DIY economic enthusiast!!!!

For a more up-to-date review of Regional economic impact models (yes these can be used for forecasting) see Loveridge S, A Typology and Assessment of Multi-sector Regional Economic Models, Regional Studies Vol. 38.3 pp 305-317. This is well written and gives an insight to the Economic Base Model, I-O Social Accounting Matrices, Integrated econometric and I-O models and Computable General Equilibrium Models. (A copy of this paper is available on the L Drive).

The input-output method:

Regional econometric models require a large amount of time-series data ideally stretching back over 20 years or more. There are therefore two major problems with econometric models, first the availability of the data over such a long time-span and secondly the consistency of the data set (governments habitually change the way variables are calculated and the range of data that are collect – probably for good reasons).

The alternative is to construct a detailed snapshot of the input-output linkages that occur in the regional/local economy. This can then be used to predict the consequences of a change in regional/local output. The technique was developed by the Nobel prise winner Leontief in the 1930s and has been used for a wide range of applications since then, including regional and local impact analysis.

The approach is based on the simple but fundamental notion that the production of output requires inputs. These may take the form of raw materials, semi-manufactured goods or services (e.g. households supply labour). Having purchased inputs from other industry sectors, households and government, firms sell their products (output) to other producing sectors or final demanders such as, households, government, or households and firms in other regions.

The input-output linkages in an economy are formalised by constructing a transaction table (known as a flow or transaction matrix) this records all the payments to and from a sector in any given year. It works on the principle of double-entry book keeping whereby there is equality between the gross inputs and gross outputs of a sector. The total output of a sector must be accounted for by the inputs used in production, any excess of the value of gross output over payment made for inputs is profit (or loss) and is shown in the payments sector.

Navigating the transaction matrix.

The disaggregation of models varies considerably, the main UK input-output model uses 123 sectors, Armstrong and Taylor cite the 17 sector model used by McNicoll to model the economy of the Shetlands, most including CLREA's 30 sector model fall somewhere in between. For an example see Armstrong and Taylor Regional Economics and Policy (2000) Table 2.1. However, for explanation purposes their simplified version with three productive sectors will suffice (see below).

Table 4.1 - The transaction table with technical coefficients

	Inputs purchased by			Final demand sectors				
	Agriculture	Manufacturing	Services	Households	Government	Exports	Investment	Gross output
Output produced by								
Agriculture	20 (0.2)	40 (0.2)	0 (0)	20	0	20	0	100
Manufacturing	20 (0.2)	20 (0.1)	10 (0.1)	75	10	55	10	200
Services	0 (0)	40 (0.2)	10 (0.1)	25	20	5	0	100
Payments for								
Household services	40 (0.4)	45 (0.225)	70 (0.7)	5	0	0	0	160
Government Services	10 (0.1)	15 (0.075)	5 (0.05)	0	0	0	0	30
Imports into region	10 (0.1)	40 (0.2)	5 (0.05)	0	0	0	5	60
Gross inputs	100	200	100	125	30	80	15	650
() = technical coefficients								

Source: Armstrong & Taylor (2000)

In simple terms the cells in the columns represent the purchases that a sector makes and the cells in the rows represent the sales of product from the same sector. Thus Agriculture purchases £20 from itself, £20 from manufacturing, £40 from households (labour services), £10 worth of services from Government and £10 worth of inputs from other regions. Making a total of £100. It sells £20 to itself, £40 to manufacturing, £20 to households (as consumption) and exports £20 worth of produce to other regions. Making a total of £100. Thus, the transaction table records exactly where inputs of an industry come from and where its output goes.

The transaction table (Table 5.1) also contains other information about the underlying structure of the economy. Examining the bottom right-hand portion of the table we can see the relationship between the final demand and the payments sectors. In the example government expenditure equates to payments (i.e. the government's current account is balanced), there is an external balance of payments surplus (exports = £80 imports = £60) and value added by residents (GDP) is £160. This is the difference between payments to government and imports from total final demand (see Armstrong and Taylor, 2000 page 40).
There are two methods of constructing the transaction table the one above is the domestic-flow approach (inter-industry flows are measured exclusive of their import content), which only records inputs originating in the region itself. The alternative is the total-flows approach (inter-industry flows are measured inclusive of their import content), which records all inputs. In the total-flows approach the import content is shown as a negative entry in the final demand sector. For an example see Armstrong and Taylor, Regional Economics and Policy (1993) Table 2.3.

There are a number of assumptions underlying the input-output technique that should be noted:

1. It is assumed that production technology is one of fixed proportions. Thus inputs would have to double if output doubled. This relationship is assumed to be constant over the period for which forecasts are to be made.
2. There are assumed to be no constraints on productive capacity, in other words the supply of factor inputs is perfectly elastic.

Estimating the effect of a change in final demand on the entire system.

The technical coefficients (in parenthesis in table 4.1) allow us to calculate the effect of an increase in final demand on the entire sector. Technical coefficients are calculated by dividing the flow of output from industry *(i the row)* to industry *(j the column)* by the gross output of the industry *(j column total)*. The technical coefficient thus relates input to output. In algebraic form:

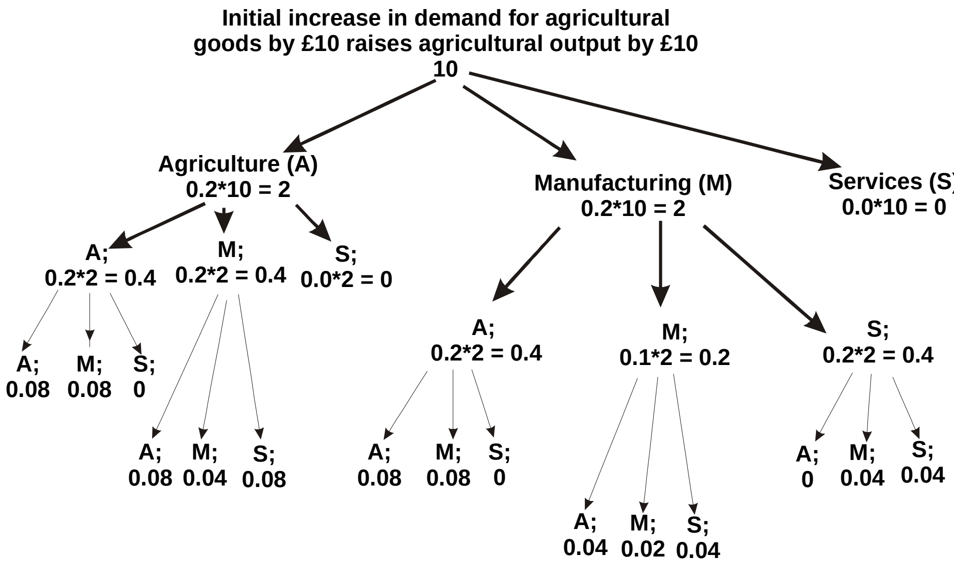
$a_{ij} = x_{ij} / X_j$ From table 5.1 the technical coefficient for cell x_{32} is 40/200 = 0.2 highlighted in yellow.

Suppose final demand for agricultural output in Table 5.1 increased by £10, the increased demand originates in the export sector, there is spare capacity in all sectors and there is no effect on household consumption (households are exogenous). In the first round the agricultural sector requires:

Additional output from			**Additional output from**		
Agriculture	0.2*£10	£2	Household services	0.4*£10	£4
Manufacturing	0.2*£10	£2	Government services	0.1*£10	£1
Services	0.0*£10	£0	Imports into the region	0.1*£10	£1

Any extra output by the three industry sectors will also generate further output effects through the inter-industry linkages for the second and subsequent rounds. These are shown graphically below:

Figure 4.2 Schematic of the effect of a £10 increase in Agricultural output



Injection A =10
First round A = 2, M = 2
Second Round A = 0.8, M = 0.6, S = 0.4
Third Round A = 0.28, M = 0.026, S = 0.16

Agriculture	13.26
Manufacturing	3.03
Services	0.67
Total	16.95

With each round the net additions become smaller and smaller eventually converging to zero. The cumulative effect on each industry's output of an increase in agricultural sales is shown in the box above.

However this is not the total effect of the extra sales, there is also additional income earned by household services, government services and imports. This extra income is calculated by multiplying the additional gross output of each sector by the coefficients (i.e. increased gross agricultural output * agriculture's household services coefficient = 13.26 * 0.4 = 5.304, Similarly for Government services and Imports). The total effect is shown in Table 2.3 in Armstrong and Taylor 2000 a summary is shown in Table 4.2.

Table 4.2 Effect of £10 increase in agricultural output (households exogenous)

Output produced by	Gross output	Output produced by	Gross output
Agriculture	13.26	Household services	6.45
Manufacturing	3.02	Government Services	1.59
Services	0.67	Imports into region	1.96
	16.95		10.00
Total effect			26.95

Source: Armstrong and Taylor Regional economics and policy (2000)

Type 1 multipliers

Although input-output models are able to show the full effect of changes in output across the whole economy industry by industry, what is often required is a summary of these effects. The most usual of these are sectoral output multipliers and household income multipliers.

The Type 1 multiplier is the ratio of direct + indirect effects to the direct effect:

$$\frac{Direct + Indirect}{Direct}$$

In the three-sector economy model example we used we found the affect of a £10 increase in agricultural demand, thus the effect of a £1 increase (in agricultural demand) on each sector will be:
Agriculture 1.326; Manufacturing 0.302 and Services 0.067.

Summed these equate to the direct and indirect effects on gross output (1.695) dividing this by the direct effect on output (£1) gives the sectoral output multiplier for agriculture of 1.695.

A similar exercise would have to be carried out for each of the other sectors. There is however another way. These can also be obtained by calculating the *inverse matrix* this shows how the output of each sector will be affected when final demand for a region's output is increased by £1. *(You will need a computer to invert anything other than a small matrix*).

The inverse matrix is known as the matrix of multipliers. The steps to calculate the inverse matrix are as follows:

Take the A matrix which is the input-output matrix of technical coefficients in Table 5.1

A matrix I-O technical coefficients matrix

	Agriculture	Manufacturing	Services
Agriculture	0.200	0.200	0.000
Manufacturing	0.200	0.100	0.100
Services	0.000	0.200	0.100

Other input coefficients (*see later*)

Households	0.400	0.225	0.700
Government	0.100	0.075	0.050
Imports	0.100	0.2	0.050

Calculate I-A matrix (*the I matrix is the identity matrix- the diagonal cells going from top left to bottom right contain the figure 1 all other cells contain 0s*)

	Agriculture	Manufacturing	Services
Agriculture	1	0	0
Manufacturing	0	1	0
Services	0	0	1

Thus the I-A matrix becomes

	Agriculture	Manufacturing	Services
Agriculture	0.80	-0.20	0.00
Manufacturing	-0.20	0.90	-0.10
Services	0.00	-0.20	0.90

Inverting the I-A matrix gives the matrix of coefficients and summing the columns gives the sectoral output multipliers.

Table 4.3 - Matrix of multipliers

	Agriculture	Manufacturing	Services
Agriculture	1.326	0.302	0.034
Manufacturing	0.302	1.208	0.134
Services	0.067	0.268	1.141
Output Multipliers	Agriculture	Manufacturing	Services
	1.695	1.779	1.309

Using the information in the inverse matrix we are also able to calculate household income multipliers. These refer only to the effect of output changes on the income of the household sector. First the result on the household sector of increasing a given sectors output by £1 is calculated, this is then divided by the increase in household income of the sector experiencing the increase in demand of £1. In other words:

Type 1 household income (household) multiplier (for agriculture)

$$= \frac{\text{Direct +Indirect effects}}{\text{Direct effect}}$$

Using our same 3sector economy example, we know that if agriculture output increases by £1 then agricultural output increases by 1.326, Manufacturing by 0.302 and Services by 0.067. The proportion of each sector's increased output accounted for by household services is Agriculture 0.4, Manufacturing 0.225 and Services 0.7 (this is the household services coefficient row). Thus the additional amount of household services *(direct and indirect*) required is

Agriculture	Manufacturing	Services	Total
£1.326*0.4	£0.302*0.225	£0.067*0.7	
= £0.530	=£0.068	=0.047	=£0.645

The direct effect on household services of the £1 gross increase in Agriculture is £0.4 (*household coefficient for agriculture*). Thus, the Type 1 household income multiplier is: $£0.645 / £0.4 = 1.61$

Similar calculations for the other two sectors give multipliers of 2.58 for manufacturing and 1.20 for services. It is also possible to create an employment multiplier using the output/ employment ratio.

Type 2 Multipliers

However, we already know that an increase in household income will also lead to a further increase in the consumption of locally produced goods and services (see lecture 3). In order to measure the size of the induced effect, it is assumed that a proportional relationship exists between consumption and income and that this can be accounted for in the model. Thus the household sector is treated as a producing sector rather than a final demander, their consumption being regarded as intermediate inputs used to produce an output of household services.

Using the example set out in Table 3.1 and Figure 3.2 in the first round the increase in agricultural exports of £10 would require £4 (0.4*£10) of household services. In the second round this increased demand for household services will lead to increased demand from other producing sectors (including household services).

2^{nd} round

Agriculture	(20/160)*£4 = £0.50
Manufacturing	(75/160)*£4 = £1.87
Services	(25/160)*£4 = £0.62
Households	(5/160)*£4 = £0.12

The type 2 sectoral output and household multipliers are calculated in the same way as for a type 1 multiplier except that the induced effect is also taken into account thus

Type 2 household income multiplier $= \frac{\text{Direct +Indirect + Induced effects}}{\text{Direct effect}}$

The type 2 $(I-A)^{-1}$ becomes

	Agriculture	Manufacturing	Services	Households
Agriculture	1.7417	0.6766	0.5770	0.6452
Manufacturing	1.1344	1.9571	1.2210	1.2903
Services	0.4833	0.6430	1.6843	0.6452
Households	1.3319	1.1985	1.7389	2.0645

Giving a Type 2 household income multiplier for agriculture of £1.332/£0.4 = 3.33
(the Type 1 multiplier was 1.61).

To obtain the sectoral output multipliers we sum the first three rows in each column thus

	Agriculture	Manufacturing	Services
Sectoral output multipliers Type 2	3.36 (1.70)	3.28 (1.78)	3.48 (1.30)

( ) = sectoral output multipliers where households are exogenous

A comparison between type 1 and 2 household income multipliers is shown below notice that when households are treated as endogenous the effect is considerably greater.

	Household income multipliers					
		Agriculture		Manufacturing		Services
Type 1		1.61		2.58		1.20
Type 2	(1.3319/0.4)	3.33	(1.1985/0.225)	5.33	(1.7389/0.7)	2.48

For differences in type 1 and 2 multipliers see Harris (1997) and Alexander and Martin (1997). Quoted in Armstrong and Taylor (2000).

Applications of regional/local input-output analysis:

Armstrong and Taylor use several examples to show the type of applications to which input-output modelling can be put. They examine a number of studies related to island economies (Western Isles and Orkney), which produce fairly accurate estimates of multiplier effects because they are self contained and do not suffer spill over effects in the same way as mainland economies.

They also examine the effect of the oil industry on the economy of the Shetlands. This looks at 3 types of activity; On-shore supply bases (for the oil industry); Operation of Sullom Voe oil terminal and; The construction of the bases and terminal.

Since there was no available hard data the study authors (Lewis and McNicholl) had to construct a transaction table based on the experiences of companies in other oil industry operating areas and forecasts of the proportion of their expenditure that would be spent in the local economy. Leakages from the initial injection were high (85%) and most of the jobs associated with construction were taken by temporary in-migrants.

They obtained both income and employment multipliers for the supply base, the terminal and the construction phase and found that despite the fact that the terminal requires a large change in output to create a small number of direct jobs it has the largest employment multiplier (3.9). This is because of the induced effect (i.e. it creates few jobs in the terminal itself but a large number in the wider Shetland economy. When looking at the total effect across all sectors they found that nearly two thirds of the jobs provided by the terminal were in the service sectors (e.g. Transport and communications, other services and distribution).

A further, more recent, study by the same authors looked at the impact of the forestry industry on other sectors (in an attempt to placate the environmental lobby). They estimated the effect of complete cessation of forestry activity under two scenarios. In the first home produced timber was replaced by imports, in the second there is no international market in certain types of timber. These provided upper and lower estimates for the effect on downstream industries. As might be expected the second simulation provides the largest multipliers with the loss of each £1 of forestry sector output resulting in a further reduction of £4.1 in the wider economy.

A number of studies have been undertaken to examine the effects of universities on their respective local economies, one of the more recent by R Harris (1997) analyses Portsmouth University. He used the input-output method to calculate employment, output and income effects of the University with the household sector treated as exogenous and endogenous. From direct spending of £38.5 million the University generated some £66.4 million for the local economy. Thus for every £1 that the University directly spends in the local economy a further 73p is generated in indirect and induced effects.

Armstrong and Taylor also use other examples of input-output analyses in the university sector particularly the effect of foreign students studying in institutions. In a study by Hill (1998) it was estimated that impact of foreign students together with research and consultancy undertaken for overseas organisations had a multiplier effect of 1.65 and generated 2,500 FTE job equivalents, 60% of these were in the wider economy of Wales.

See also Bishop et al (2000), The use of input-output models in local impact analysis Local Economy, for the effects of the naval base at Devonport.

Advantages and Disadvantages

The main advantages of input-output technique are:

- It is very good at showing the supply chain linkages
- It captures full system effects including the induced effect if the household sector is made endogenous.
- It is transparent
- Can produce results sector by sector.
- Allows scenarios to be modelled

The main disadvantages are:

- The availability of reliable primary data for the transaction table
- Differences in production techniques and thus productivity
- Differing propensities to import (can be partially overcome)
- Changes in the inter-industry linkages
- The assumption of constant returns to scale.
- The assumption that there are no supply constraints

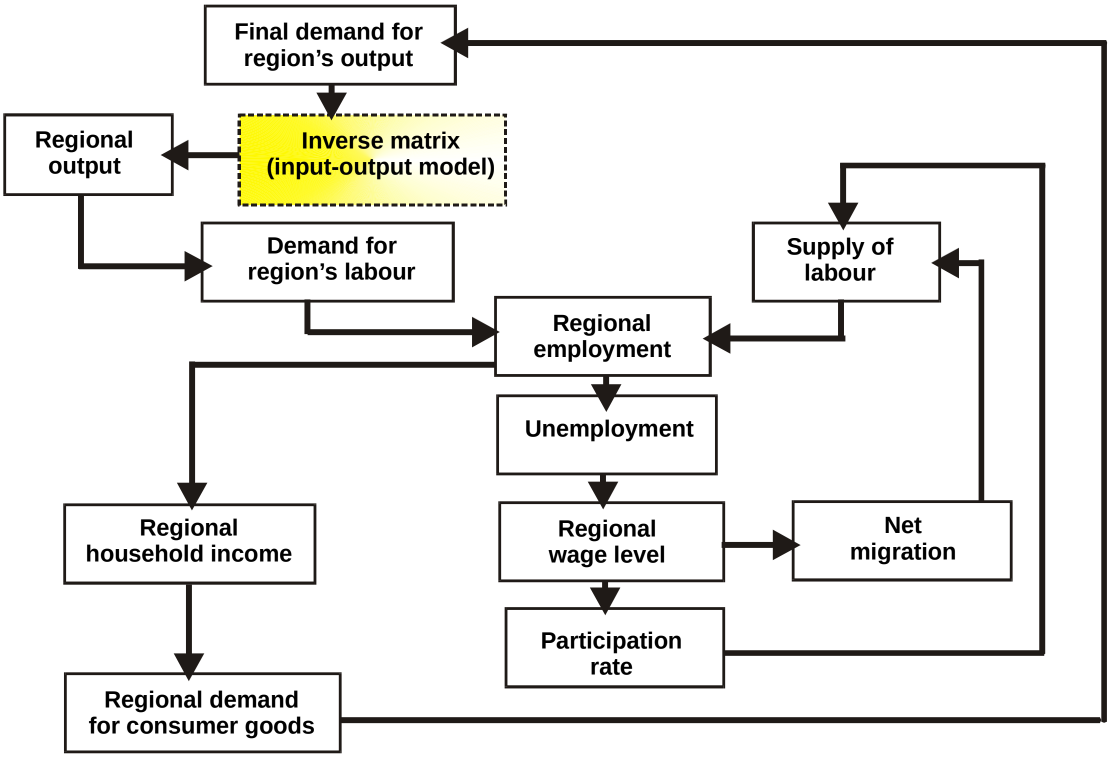
New developments

To get round the two of the major weaknesses (the assumed proportional relationship -fixed technology and excess supply in all factor markets) an alternative approach is to incorporate a supply-side constraints into the model. This means that excess demand for a factor (labour or capital) will result in an increase in price for that factor relative to the other. Thus both price and quantity adjustments take place. In addition, changes in income will effect household consumption patterns and the flow of government transfer payments into the region.

The basic input-output model is expanded in two directions

- By adding labour and capital markets
- By adding a time dimension through an econometric time-series model.

Figure 4.3. Integrating I-O and the regional economtric model



Integrating the input-output model into the econometric model
Source: Armstrong and Taylor (2000) Regional Economics and Policy

See Armstrong and Taylor (2000) Figure 2.2.

The centre of the model is the Leonief inverse matrix (this is the set of multipliers).
The proces is that an injection (or increase) in final demand is conveted into increased output via the I-O model. This leads to increased employment through the output labour ratio, which leads to a decrease in unemployment. Increased labour demand pushes up the real wage which, inturn, increases both the participation rate and net inward migration thus increasing the labour supply. In addition, the increase in employment and wages leads to a rise in household income which leads to an increase in regional consumption. Some of this will be supplied from winthin and some from outside the region. The extra intra regional demand will generate another round of output providing there are no supply-side bottlenecks.

Advantages
It converststhe static model into a dynamic model. For instance, the output/ employment ratio changes because productivity improves over time and household consumption patterns change over time. These changes in consumption can be tracked by the econometric model.

An investigation into the effect of varying the proportional relationship between inputs and output was conducted by Harrigan et al, they allowed for different types of technology and factor markets responding to demand supply conditions via a computable general equilibrium model of the Scottish economy which examined the sensitivity of I-O multipliers to alternative assumptions. They looked particularly at manufactured exports increasing these under 3 sets of assumtions:

1. (I-O) Fixed-coefficent technology, unlimited factor supplies, fixed factor prices
2. (Keynesian) Variable factor proportions (Cobb Douglas), unlimited labour supplies, fixed wages, fixed capital stock
3. (Neoclassical) Variable factor proportions, competitive labour market, regionally determined wages, fixed capital stock

The impact of a 10% increase in the demand for Scottish manufacturing exports			
	% increase in each variable resulting from a 10% increase in demand for exports		
	Input-output simulation	**Keynesian simulation**	**Neoclassical simulation**
GDP	4.5	2.1	1.0
Value added in manufacturing	8.5	5.0	2.7
Employment	4.8	3.0	1.5
Price of commodities	0.0	1.2	2.2
Household disposable income	3.0	1.1	1.8

Source Armstrong and Taylor (2000) taken from original by Harrigan et al (1991)

The results show that the impact of an exogenous increase in demand is less under the more realistic assumptions. Armstrong and Taylor however suggest that whilst input-output models may overestimate output and employment effects in the short-run they are good predictors of the effect over the long-run (20 years or more) (see Table 2.13 Armstrong and Taylor Regional Economics and Policy (2000).

Conclusions.

- Armstrong and Taylor draw a number of conclusions regarding input-output analysis.
- It provides detailed information about the regional economy, which is useful in economic development, by providing details of the interactions between a region's industries and is valuable and precise tool for forecasting the impact of exogenous shocks.
- Whilst other methods of calculating regional multipliers requiring less data, the input-output technique is the only one that provides detailed sectoral information.
- The modern practice of integrating econometric models with input-output models improves their predictive performance over the short-run and turns them from static to dynamic models.

Next week: Regional growth disparities - the neoclassical and Keynesian perspectives.

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[i] Comparative Properties of UK Regional Econometric Models, Hunt LC, Slaymaker JE and Snell MC, Regional Studies Vol 30 Number 8, 1996, p773.

[ii] Comparative properties of local econometric models in the UK, Hunt LC and Snell MC, Regional Studies Vol. 31 Number 9, 1997, p891.