A Comparison of National Accounts, Survey and Location Quotient based Local Area models and multipliers.

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1. Background

During the summer of 2003, the authors were involved in two studies of the economic impact of water based tourism. The sponsors of this work required estimates of the impact at "local" area level. In the first study there were seven defined areas covering the whole of Scotland; Dumfries and Galloway, Borders, Central, North East, Highlands, Western Isles and Northern Isles. After a number of attempts to integrate previous estimates, a decision was taken to build a comprehensive model based on some 43 areas in Scotland and then combine these to create the required local area models. The assumptions and construction of this model, hereafter referred to as the CogentSI model, are described in section 3 of this paper.

The second study was concerned with the area covered by the Moray, Badenoch and Strathspey Local Enterprise Company, which lies in the eastern Highlands of Scotland. Because of the delays in the production of the CogentSI model a decision was made to develop a local area model based on survey. Details of the construction and description of this model, henceforth known as the Survey model, are given in section 4.

Before the end of the second project the CogentSI model was complete and was able to produce local area tables for any geography in Scotland. The production of a model for the MBSE area quickly followed. Unsurprisingly the Survey and CogentSI models differed. As part of the general analysis of the differences it was then decided to examine tables produced by modifying the Scottish Tables to reflect local employment. These Location Quotient models are discussed in section 2.

Section 5 identifies advantages and disadvantages of the approaches and uses this analysis to suggest how both models might be reconciled and developed. Section 6 concludes.

2. Local Input Output Tables and Location Quotients

The original Leontieff structure envisaged a closed economy with industries responsible for single commodities and with a technology stable over time. The reality, of course, is significantly different. At the local level it is quite conceivable that none of the raw material input to a process is locally produced and equally that consumers in the local industry choose to consume goods that are not produced locally. Thus to understand the impact of an activity at the local level we require Local Use tables. However goods purchased from outside the region (imported) and locally produced goods may be perfect

substitutes; with slight changes in price causing significant changes in the input coefficients. Thus, for reasons of stability the UK tables combine UK and imported commodities to produce products. These Combined Use tables are likely to be more stable over time or between regions because they reflect the underlying technology. The coefficients are also transferable between regions of vastly different size under the not wholly unrealistic assumption of similar technologies.

At the Scottish Level, however, the level of import penetration is such that only Local Use tables are deemed to be of use and published. For regions within Scotland it is sometimes assumed that import penetration is similar to Scotland as a whole and that the Scottish coefficients are suitable for measuring Impact (e.g. Shiel *et.al*. 2002).

However since local economies are normally very open, the effect of a rise in local demand is normally very small. For example, although there is local production of beer in the MBSE, the result of a rise in demand for beer will largely be to increase imports of beer into the region i.e. the technical coefficient linking hospitality services and brewing will be low. However if there is substantially more local production than the norm, as in the case of whisky in the MBSE area, then the effect will be more pronounced. Thus, it is argued that the propensity to import is a direct function of the relative importance of local production and coefficients should be adjusted up where a sector is above the norm and adjusted down when beneath. Flegg and Webber (2000) discuss such procedures.

The *Simple Location Quotient* (SLQ) measures specialization by the labour involved and utilises the relative proportion of employment in an industry. It is given by : LQ_{ik} = *ratio of local employment in industry i in region k to employment in k / ratio of national employment in industry i to total employment* = $(n_{ik}/n_k)/(n_i/n)$. The adjustment is then applied equally to all using industries. Thus the coefficient in a local I-O table for region k linking supplying industry i to producing industry j $a_{ijk} = a_{ij} * LQ_{ik}$

The SLQ however takes no account of the size of the consuming industry. If the consuming industry is large then we would expect a smaller proportion to be exported from the region than the norm i.e. the technical coefficient would be larger and the consequent local absorption larger. The *Cross Industry Local Quotient* thus adjusts the SLQ by the relative size of the consuming industry *:* $CILQ_{ijk} = LQ_{ik} * [(n_{jk}/n_k)/n_j/n)]$
The resulting coefficient is thus $a_{ijk} = a_{ij} * CILQ_{ik}$ with trade as simply the balance between production and local consumption.

Whilst selected elements will change, the overall level of import penetration remains constant. This appears difficult to justify. On average smaller areas will be less self sufficient than large and almost certainly less self sufficient than Scotland as a whole i.e. we would expect multipliers at the Scottish level to exceed local multipliers simply because of the much larger range of goods that will be supplied at that level. However, importantly, some island communities may have levels of self sufficiency that far exceed similarly sized areas close to urban centres. Equally a multiplier for a development in an area in which there already exists a cluster of suppliers might well be larger than the Scottish norm. As an example the tourist multiplier for a local area featuring a National Park could well be larger

than for Scotland as a whole if the import penetration in the key sectors is lower. What is unclear is the significance, in terms of the size of multipliers, of trying to estimate import penetration on a case by case basis and the difficulties and problems of a case by case approach.

3. The CogentSI Model

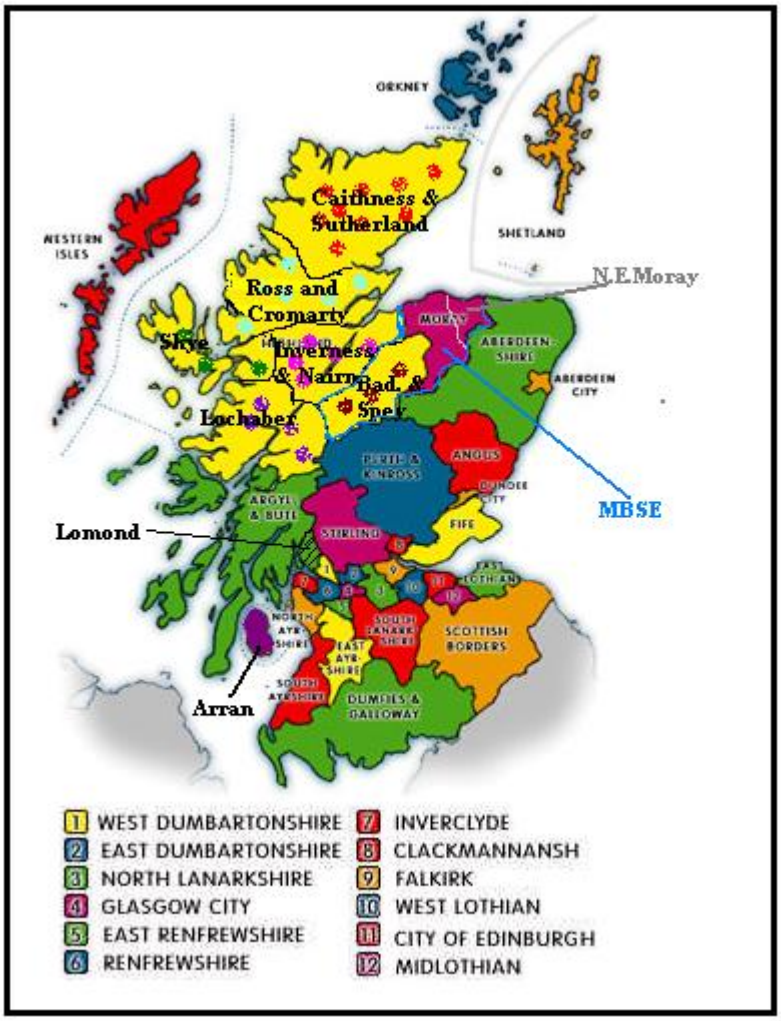
3.1 Introduction

Scotland is a nation with a developing set of accounts and economic statistics. It has had Input-Output tables for a number of years and has been developing databases on production and exports in manufactured products, agriculture and fisheries. It is not however comprehensive and there remain gaps in areas like trade in financial or educational services. The only capital account available was estimated by Gibson et al (1997).

Institutionally there are a number of defined geographies. At the political level there are 32 unitary authorities. For development purposes there are two networks of Local Enterprise Companies. Highlands and Island Enterprise (HIE) is responsible for ten Local Enterprise Companies (LECs): Argyll and the Islands, Caithness and Sutherland, Inverness and Nairn, Lochaber, Moray Badenoch and Strathspey, Orkney , Ross and Cromarty , Shetland , Skye and Lochalsh and Western Isles. The rest of Scotland is covered by the Scottish Enterprise Network (SE), and has responsibility for twelve LECs. It is important to recognize that LEC boundaries do not follow political boundaries. In the case of Argyll and Islands LEC it excludes the Lomond area of the council (which is in Scottish Enterprise Dumbartonshire) and includes the Isle of Arran.

For statistical reporting (and EU regional support) Scotland has yet another internal geography (known as the NUTS (National Territorial Units) level 3). These often combine LECs but there are peculiarities such as the exclusion of North East Moray from the Highland area. Any comprehensive system for Scotland should allow the production of local tables for UA, LEC or NUTS3 areas or combinations thereof. This was the objective of the CogentSI model development. As a result tables were constructed for some 40 base areas. 29 of which correspond to Unitary Authority Areas. Highland Council Area was subdivided into six, corresponding to the six LEC areas. To correspond with the LEC boundary, Argyll and Bute is split between Lomond and the Rest, and the Isle of Arran is extracted from North Ayrshire. For NUTS purposes Moray is split between North East Moray and the Rest. Thus the MBSE is the result of combining 3 tables, the Badenoch and Strathspey area of Highland, North East Moray and the Rest of Moray. Fig 1 gives a map of the base units and the MBSE area.

Fig 1: Map of Base Areas



The resulting tables cover all of the 123 products identified in UK IO tables plus the five specific Scottish sub-divisions; fishing and fish farming; forestry planting and harvesting; brewing and distilling; Financial Services and Auxiliary Financial Services; Insurances Services and Auxiliary Insurance Services (the latter two splits to identify call centre work). For specific tasks these can be split further e.g. between oil and gas processing and between education and higher education.

For each product the tables show how much of local demand is sourced from within the area, from within the same region of Scotland, from the rest of Scotland, from the rest of the UK, and as imports from abroad.

2.2 Principles of Construction

An important principle of the system is that at any time it should be based on the best and most detailed consistent information that is available. Because many government statistics

are continually updated, it is often the case that official statistics are not completely consistent. Two main reference markers were adopted:

1. The basic benchmark for Scottish data was an adjusted version of the latest Scottish Input Output tables, which cover 1999. The adjustments made were solely to take account of a small number of known errors in the published tables.
2. For the other UK regions the references are the UK Input Output balances and the revised 1999 Regional Accounts published in September 2003. These superseded the 1998 figures published in February 2001.

Because of the radical nature of the change to the Regional Accounts, and the fact that a spate of other updated statistics is about to be issued, the estimates are continually updated

2.3 Estimating production

There are three data sets of direct relevance. The Scottish Production Database (SPD) presents output by area but at an aggregated level. The Scottish Input Output Tables produce output by industry for the whole of Scotland and the Annual Business Inquiry (ABI) the employment by industry by local area. The main method of estimating production for each local unit was to utilise this employment data (mainly collected in the first section of the ONS Annual Business Inquiry ABI1) to disaggregate output information (collected in the second section, ABI2 and published or Scotland in the Scottish Production Database and related series). In the iteration process illustrated in Fig 2, labour productivity is successively modified to match the totals in the SPD and I-O tables. Further details are given in Appendix 1.

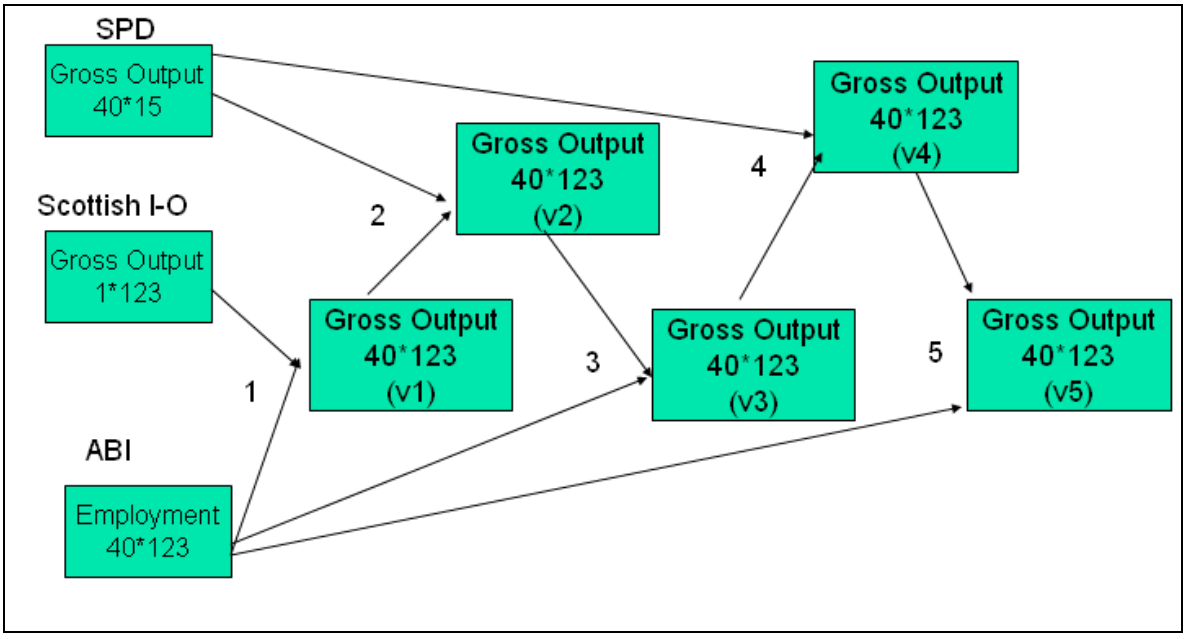


Fig 2: Iterative Process to disaggregate total industrial output.

2.4 Estimating Product Supply

For each area estimates of industry output are obtained. These are transformed into the local production of products using a Scottish Make Matrix. Because the Make matrix is typically very sparse for reasons of commercial confidentiality it has not been published in Scotland since 1989 and the last UK Make Matrix was a very condensed table relating to 1995.

The 1989 matrix was used as a base but there were immediate problems in that this table was based on the SIC80 classification and needed to be adjusted to SIC92. A converter had been developed for the Caledonian Blue Book (Gibson *et al* 1997) and was utilised. Published tables provide Row and Column totals and the diagonals (percentage of product produced by principal industry). The off-diagonals were then estimated utilising the 1989 matrix and the UK 1995 matrix as guides.

Once produced the Make Matrix is combined with local industry output to estimate the local supply of products in each of the areas

2.5 Estimating Consumption

The Make Matrix is also used to estimate the intermediate demand for local products given industry output. Gross fixed capital formation is also assumed to be directly related to local output. Elsewhere the Scottish Household Survey is used to disaggregate total Scottish Household demand, Higher Education employees to estimate HE demand (NPISH) and population to split government spend. The procedures are summarised in Fig 3.

Fig 3 Processes to estimate Local Consumption

Source Data	**Operation**	**Level**	**Resulting Data**
UK Input –Output **Scottish Input-Output** **Scottish Imports (SPD)**	Reconciliation	128 Industry	*Scottish Make Matrix*
Scottish Make Matrix *Local Output & GVA* ***5***	Product		*Local Industry Absorption*
Scottish Input-Output (Domestic Use) **Scottish Imports**	Aggregate		*Scottish Household Demand*
Scottish Household Demand **Scottish Household Survey**	Disaggregate		*Local Household Demand*
Scottish NSIH Expenditure **Census** (Pop, Pop 18-24,) **Local HE Employees** (ABI)	Disaggregate		*Local NSIH Demand*
Government Spend in Scotland **Census** (Population)	Disaggregate		*Local Spend by government*
Scottish fixed capital	Disaggregate		*Local fixed capital formation*

formation *Local Turnover/GVA 5*			
Scottish Stockbuilding *Local Turnover/GVA 5* *Local Industry Absorption*	Disaggregate		*Local Stockbuilding*

2.6 Trade

The most novel part of the CogentSI approach is the use of gravity models to estimate trade between each local area. These estimates are needed to identify the extent to which economic activity will be absorbed or leak from the local economy. To ensure compatibility with the IO tables it was decided at the outset to work at the 123 product level. The outcome is an estimate of trade flows between 53 local regions for 123 products; some 175,000 data points.

The estimation procedure utilises 3 levels:

1. **National** with 3 sectors: Scotland, Rest of the UK (RUK), Rest of the World (ROW).
2. **Regional** with 18 sectors: 5 Scottish (Highland, Argyll & the Islands , Moray, the Islands, Rest of Scotland), 11 in RUK, 'extra regio' (mainly the UK Continental Shelf) and ROW.
3. **Local** with 53 sectors : the 40 Scottish areas defined in 2.1 , 11 RUK, 1 *extra*, and ROW.

For trade it is not possible to simply disaggregate on the basis of some external pattern. The approach taken is to generate estimates from a trade model and then reconcile them with the total flows identified at the higher level.

The gravity model is based upon three key factors: the productive capacity in the source area, the demand in the destination area and the transport cost between them as proxied by the distance. This relationship is identified by a regression model of the form:

$$ln(trade\ flow_{ij}) = \alpha + \beta * ln(local\ production\ at\ source_i) + \gamma * ln(local\ absorption\ at\ destination_j) + \delta * ln(distance\ from\ source_i\ to\ destination_j) + \varepsilon_{ij}$$

Thus the table estimation procedure **for each product** utilises 4 basic elements

1. Parameter Identification: Estimated by regression
2. Flow estimation: Forecasting trade flows F^r_{ij} on the basis of the estimated parameters and the distance d^k_{ij}
3. RAS iteration: The row and column totals of the individual estimated flows in the matrix are reconciled to known row and column totals by successively adjusting all the elements in the row and then all the elements in the column *pro rata* until convergence giving F^s_{ij}
4. Distance iteration: The mean distance travelled between any identified source/destination d^k_{ij} will vary by product. For any product we assume that the price is roughly constant, that consequently the value of the flow is a good proxy for the volume and that the value of flow*distance (d^k_{ij} * F^r_{ij}) is a reasonable proxy for transport costs. Once the flow has been adjusted by the RAS iteration a

new estimate of distance can be obtained by taking the old estimate of transport cost and dividing it by the new estimate of flow $d^{k+1}_{ij} = (d^{k}_{ij} * F^{r}_{ij}) / F^{s}_{ij}$. This iteration continues until there is convergence.

The initial basic data is shown schematically in Fig 4.

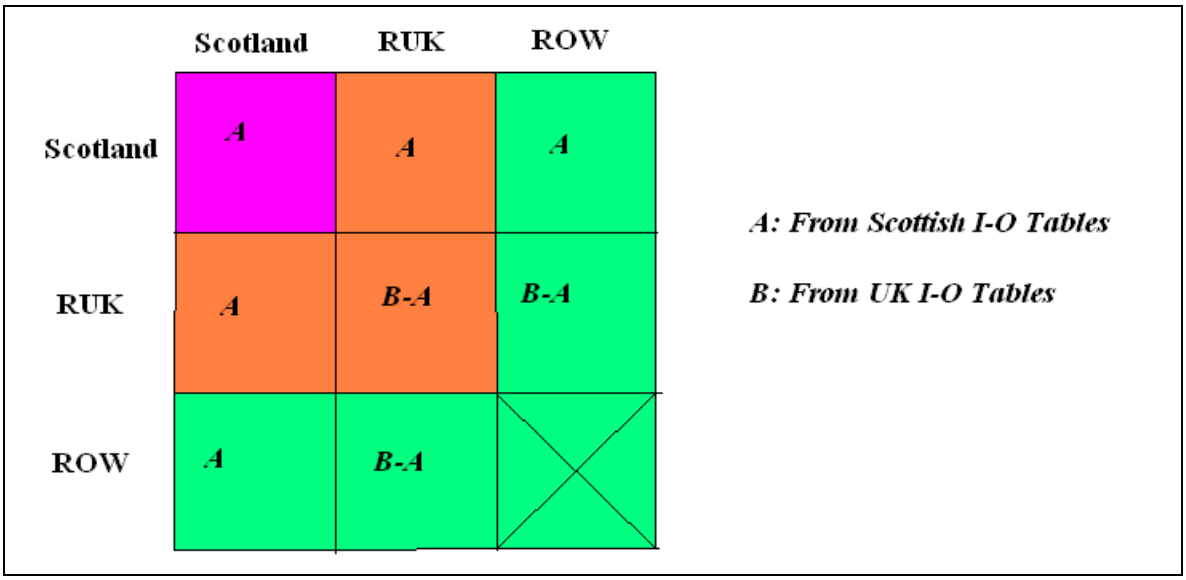


Fig 4: Trade Flows and Data Sources

Although data on flows to the Rest of the World is available, in practice attempts to utilise it failed for two reasons

1. It was not possible to make a meaningful initial assumption about distance
2. The Borders effect (see Helliwell 1998 or Fennstra(2002)) is likely to magnify the real distance effect by a significant but unknown factor. In the case of US/Canada this was estimated to be as much as a factor of 12.

However McCallum (1995), Wagner et al (2002) and others have shown that the parameters for size β and γ are close to unity i.e. an area with twice the population/income will tend to import twice as much *ceteris paribus.* Thus, by assuming unity and making initial estimates of distance it is possible to estimate the two remaining parameters from the four data points. The initial values were Scotland-Scotland 50 miles, Scotland –RUK 400miles, RUK-RUK 80 miles and RUK to Scotland 350miles, but these distances are successively revised and end up unique to each product.

Fig 5 shows the estimation process in two stages. Stage 1 estimates national distances and regional flows and involves iterating distances "w" times. RAS iteration occurs within that loop typically around eight times. For most products only two or three distance iterations are required ("w" =2 or 3) for convergence.

Stage 2 repeats this basic procedure utilising the regional flow estimates obtained at stage 1 as controls which are modified in the light of changes in estimated regional distances. In this case the distance estimation rarely exceeds two iterations for convergence.

Fig 5: Estimation of Trade

Source Data	**Operation**	**Level**	**Resulting Data**
Stage 1			
UK Input –Output **Scottish Input-Output**	Reconciliation[1]	3 sector	*National Trade Matrix*
National Trade Matrix(k) **Scottish & RUK Output,** **Scottish & RUK Consumption** ***National Distance*** nd_{ij} *(k)*	Regression	3 sector	*Parameters* α,β,γ *&* δ *(k)*
Parameters α,β,γ *&* δ *(k)* **Regional Output** **Regional Consumption** **Regional Distances** rd_{ij}[2] ***(1)***	Estimation	18 sector	*Regional Trade Matrix (k)*
Regional Trade Matrix k *National Trade Matrix k*	RAS Iteration	18	*Regional Trade Matrix (k+1)*
Regional Trade Matrix (k+1)	Aggregate	3	*National Trade Matrix (k+1)*
National Trade Matrix (k+1) ***National Distance*** nd_{ij} *(k)* *National Trade Matrix k*	Product and Division	3	*National Distance* nd_{ij} *(k+1)*
National Distance nd_{ij} *(k)* ***National Distance*** nd_{ij} *(k+1)*	Compare		*If close proceed to STAGE 2 else Re-estimate parameters* α,β,γ *&* δ *Re-estimate Regional Trade Matrix (k)*

[1] The UK and Scottish IO tables are adjusted to a common price basis (allocating transport and distribution margins and some taxes between imports, trade within Scotland, and trade within UK). For a few commodities there is a clear incompatibility between the Scottish and the UK IO tables in one of four forms:

a) Within-Scotland trade plus RUK imports to Scotland plus RUK exports from Scotland (as shown in the Scottish tables) exceeds the total of within-UK trade as shown in the UK tables.
b) A less extreme version, in which the residual (within-RUK trade) is implausibly small.
c) Scotland purchases from RUK, but RUK does not purchase from Scotland (or vice versa) even though there is no particular reason for the trade to flow in one direction only.
d) Trade between RUK and the rest of the world (calculated as a residual) is implausible in relation to trade between Scotland and the rest of the world.

In these cases ad-hoc adjustments are made. Often this comprises adding to the diagonal (sales to own industry) in the UK tables, on the grounds that inter-establishment trade within the industry has been omitted.

[2]Initially between main centres using AutoRoute distances

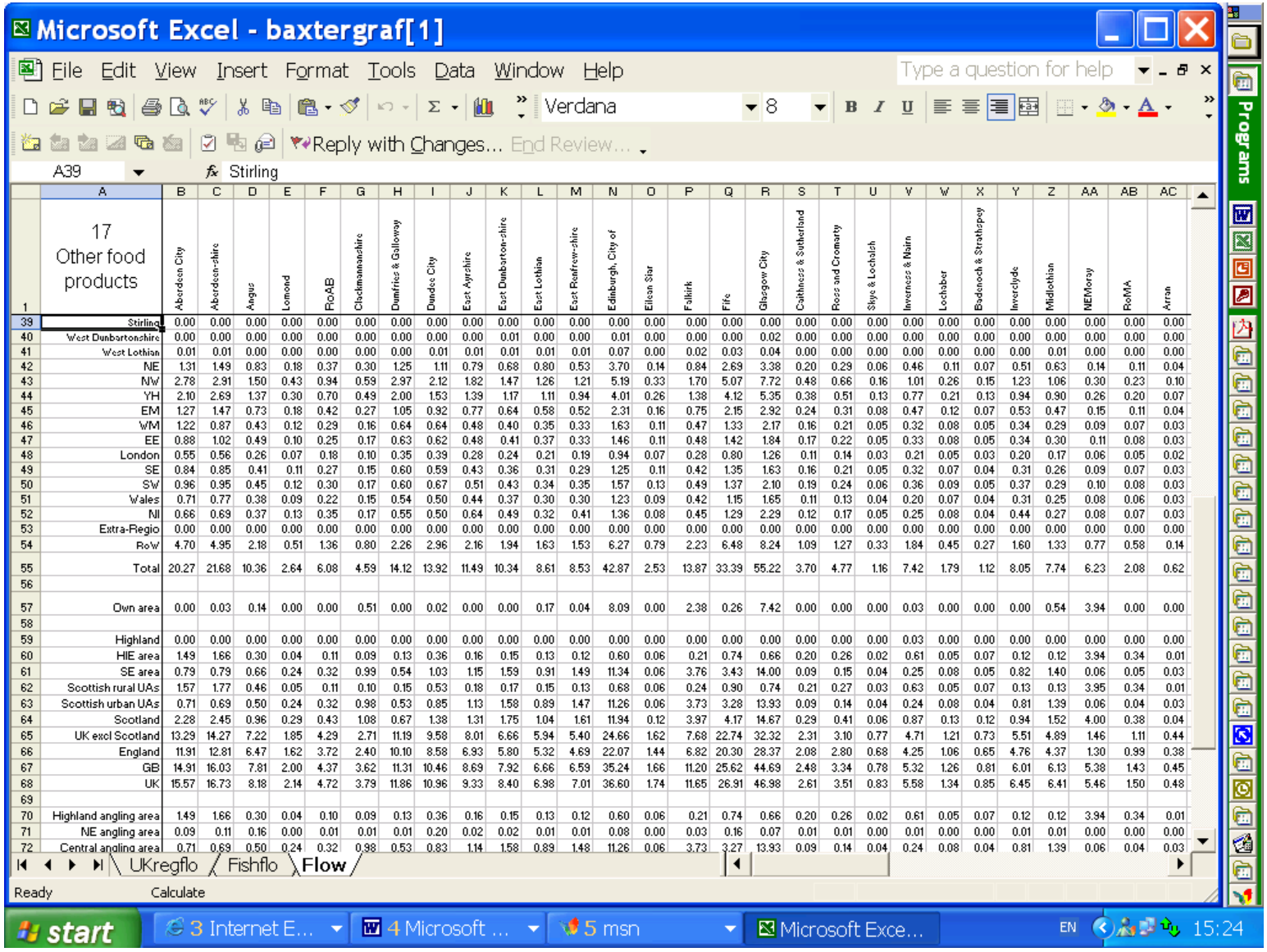
STAGE 2			
Regional Trade Matrix(r) *Regional Output*, ***Regional Distance*** rd_{ij} *(r)*	Regression	3 sector	*Parameters* α,β,γ *&* δ *(r)*
Parameters α,β,γ *&* δ *(r)* **Local Output** **Local Consumption** **Local Distances** d_{ij}[3]	Estimation	54 sector	*Local Trade Matrix(r)*
Local Trade Matrix (r) *Regional Trade Matrix(r)*	RAS Iteration	54	***Local Trade Matrix (r+1)***
Local Trade Matrix (r+1)	Aggregate	18	*Regional Trade Matrix (r+1)*
Regional Trade Matrix (r+1) ***Regional Distance*** rd_{ij} *(r)* *Regional Trade Matrix (r)*	Product and Division	18	*Regional Distance* rd_{ij} *(r+1)*
Regional Distance rd_{ij} *(r)* *Regional Distance* rd_{ij} *(r+1)*	Compare	18	*If close Finish Else Re-estimate Parameters* α,β,γ *&* δ *Re-estimate Local Trade Matrix (r).*

At each stage any external information available is used to ensure validity. The distance coefficients obtained, for example, are subjected to review on a number of bases. They have been compared with similar coefficients estimated in Canada (where the available input output tables distinguish several provinces, so there are more degrees of freedom); they have been compared with international and intercontinental gravity coefficients estimated in models of world trade; they have been compared with 'physical' distance regressions based on transport statistics; and they have been ranked across commodities, and reviewed in the light of such factors as diversity of source and destination, physical characteristics of the product and its 'transportability'.

Similarly data at regional level is available for some commodities (albeit not at 128 level) and the relevant regional estimates have been aggregated and compared. These totals can either generate a new round of iteration or are disaggregated pro rata and enter the local model as survey data.

An example of the resulting Trade Matrix for Food Products, a particularly important sector for the MBSE, is given in Fig 6. The diagonals of each matrix give an estimate of the local production of the commodity in the specific region which can be compared with the total input to the region (the column total) and the total output from the region. Fig 6 gives a section of the resulting matrix for the MBSE. These in turn are used to construct Combined Use and Local Use tables and consequently, for any pattern of spend, the local Multipliers.

[3]Initially between main centres using AutoRoute distances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Scottish urban UAs 0.71 0.69 0.50 0.24 0.32 0.98 0.53 0.85 1.13 1.58 0.89 1.47 11.26 0.06 3.73 3.28 13.93 0.09 0.14 0.04 0.24 0.08 0.04 0.81 1.39 0.06 0.04 0.03
Scotland 2.28 2.45 0.96 0.29 0.43 1.08 0.67 1.38 1.31 1.75 1.04 1.61 11.94 0.12 3.97 4.17 14.67 0.29 0.41 0.06 0.87 0.13 0.12 0.94 1.52 4.00 0.38 0.04
UK excl Scotland 13.29 14.27 7.22 1.85 4.29 2.71 11.19 9.58 8.01 6.66 5.94 5.40 24.66 1.62 7.68 22.74 32.32 2.31 3.10 0.77 4.71 1.21 0.73 5.51 4.89 1.46 1.11 0.44
England 11.91 12.81 6.47 1.62 3.72 2.40 10.10 8.58 6.93 5.80 5.32 4.69 22.07 1.44 6.82 20.30 28.37 2.08 2.80 0.68 4.25 1.06 0.65 4.76 4.37 1.30 0.99 0.38
GB 14.91 16.03 7.81 2.00 4.37 3.62 11.31 10.46 8.69 7.92 6.66 6.59 35.24 1.66 11.20 25.62 44.69 2.48 3.34 0.78 5.32 1.26 0.81 6.01 6.13 5.38 1.43 0.45
UK 15.57 16.73 8.18 2.14 4.72 3.79 11.86 10.96 9.33 8.40 6.98 7.01 36.60 1.74 11.65 26.91 46.98 2.61 3.51 0.83 5.58 1.34 0.85 6.45 6.41 5.46 1.50 0.48
Highland angling area 1.49 1.66 0.30 0.04 0.10 0.09 0.13 0.36 0.16 0.15 0.13 0.12 0.60 0.06 0.21 0.74 0.66 0.20 0.26 0.02 0.61 0.05 0.07 0.12 0.12 3.94 0.34 0.01
NE angling area 0.09 0.11 0.16 0.00 0.01 0.01 0.01 0.20 0.02 0.02 0.01 0.01 0.08 0.00 0.03 0.16 0.07 0.01 0.01 0.00 0.01 0.00 0.00 0.01 0.01 0.00 0.00 0.00
Central angling area 0.71 0.69 0.50 0.24 0.32 0.98 0.53 0.83 1.14 1.58 0.89 1.48 11.26 0.06 3.73 3.27 13.93 0.09 0.14 0.04 0.24 0.08 0.04 0.81 1.39 0.06 0.04 0.03
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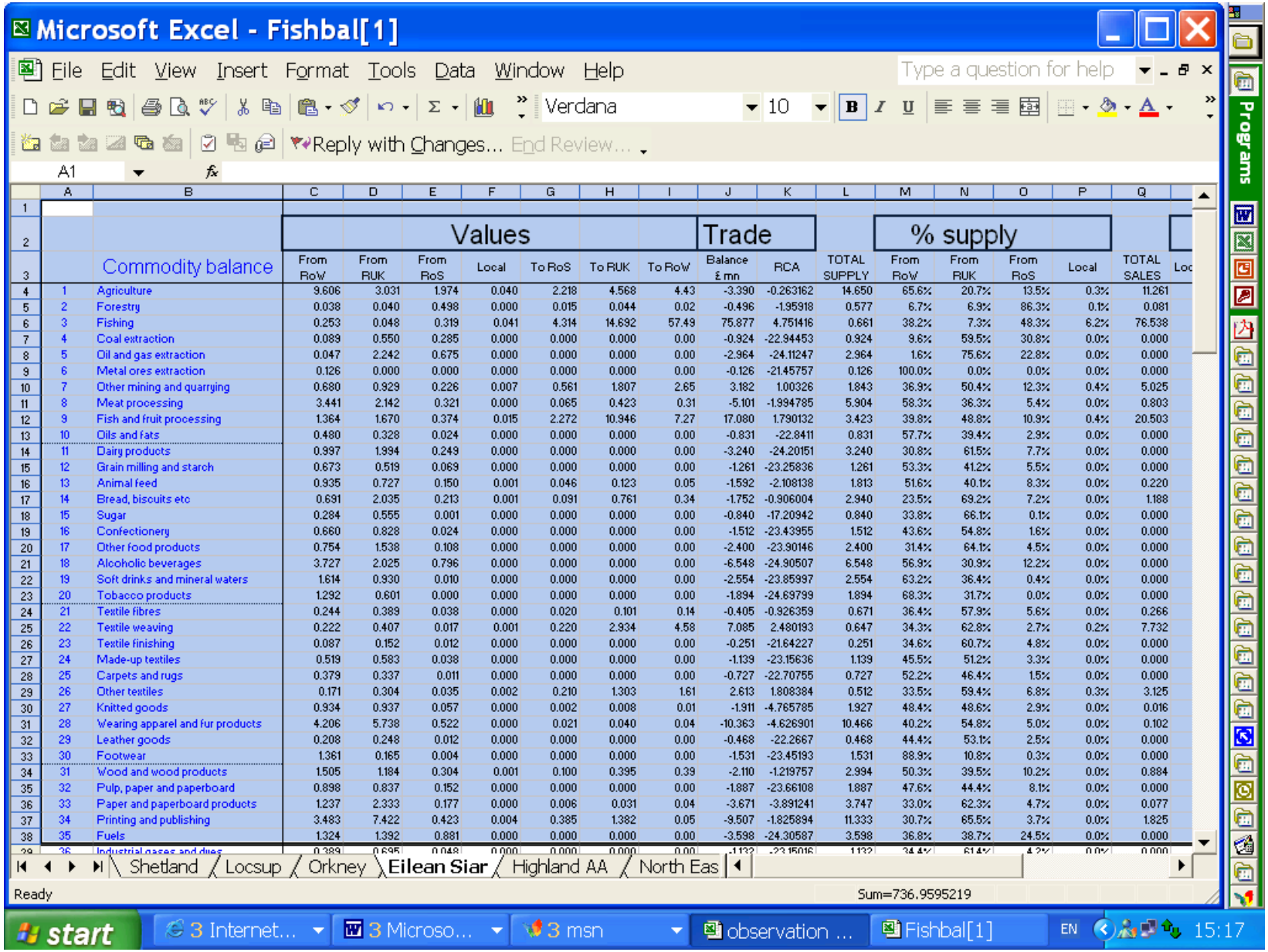
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Local
TOTAL SALES
1 Agriculture 9.606 3.031 1.974 0.040 2.218 4.568 4.43 -3.390 -0.263162 14.650 65.6% 20.7% 13.5% 0.3% 11.261
2 Forestry 0.038 0.040 0.498 0.000 0.015 0.044 0.02 -0.496 -1.95918 0.577 6.7% 6.9% 86.3% 0.1% 0.081
3 Fishing 0.253 0.048 0.319 0.041 4.314 14.692 57.49 75.877 4.751416 0.661 38.2% 7.3% 48.3% 6.2% 76.538
4 Coal extraction 0.089 0.550 0.285 0.000 0.000 0.000 0.00 -0.924 -22.94453 0.924 9.6% 59.5% 30.8% 0.0% 0.000
5 Oil and gas extraction 0.047 2.242 0.675 0.000 0.000 0.000 0.00 -2.964 -24.11247 2.964 1.6% 75.6% 22.8% 0.0% 0.000
6 Metal ores extraction 0.126 0.000 0.000 0.000 0.000 0.000 0.00 -0.126 -21.45757 0.126 100.0% 0.0% 0.0% 0.0% 0.000
7 Other mining and quarrying 0.680 0.929 0.226 0.007 0.561 1.807 2.65 3.182 1.00326 1.843 36.9% 50.4% 12.3% 0.4% 5.025
8 Meat processing 3.441 2.142 0.321 0.000 0.065 0.423 0.31 -5.101 -1.994785 5.904 58.3% 36.3% 5.4% 0.0% 0.803
9 Fish and fruit processing 1.364 1.670 0.374 0.015 2.272 10.946 7.27 17.080 1.790132 3.423 39.8% 48.8% 10.9% 0.4% 20.503
10 Oils and fats 0.480 0.328 0.024 0.000 0.000 0.000 0.00 -0.831 -22.8411 0.831 57.7% 39.4% 2.9% 0.0% 0.000
11 Dairy products 0.997 1.994 0.249 0.000 0.000 0.000 0.00 -3.240 -24.20151 3.240 30.8% 61.5% 7.7% 0.0% 0.000
12 Grain milling and starch 0.673 0.519 0.069 0.000 0.000 0.000 0.00 -1.261 -23.25836 1.261 53.3% 41.2% 5.5% 0.0% 0.000
13 Animal feed 0.935 0.727 0.150 0.001 0.046 0.123 0.05 -1.592 -2.108138 1.813 51.6% 40.1% 8.3% 0.0% 0.220
14 Bread, biscuits etc 0.691 2.035 0.213 0.001 0.091 0.761 0.34 -1.752 -0.906004 2.940 23.5% 69.2% 7.2% 0.0% 1.188
15 Sugar 0.284 0.555 0.001 0.000 0.000 0.000 0.00 -0.840 -17.20942 0.840 33.8% 66.1% 0.1% 0.0% 0.000
16 Confectionery 0.660 0.828 0.024 0.000 0.000 0.000 0.00 -1.512 -23.43955 1.512 43.6% 54.8% 1.6% 0.0% 0.000
17 Other food products 0.754 1.538 0.108 0.000 0.000 0.000 0.00 -2.400 -23.90146 2.400 31.4% 64.1% 4.5% 0.0% 0.000
18 Alcoholic beverages 3.727 2.025 0.796 0.000 0.000 0.000 0.00 -6.548 -24.90507 6.548 56.9% 30.9% 12.2% 0.0% 0.000
19 Soft drinks and mineral waters 1.614 0.930 0.010 0.000 0.000 0.000 0.00 -2.554 -23.85997 2.554 63.2% 36.4% 0.4% 0.0% 0.000
20 Tobacco products 1.292 0.601 0.000 0.000 0.000 0.000 0.00 -1.894 -24.69799 1.894 68.3% 31.7% 0.0% 0.0% 0.000
21 Textile fibres 0.244 0.389 0.038 0.000 0.020 0.101 0.14 -0.405 -0.926359 0.671 36.4% 57.9% 5.6% 0.0% 0.266
22 Textile weaving 0.222 0.407 0.017 0.001 0.220 2.934 4.58 7.085 2.480193 0.647 34.3% 62.8% 2.7% 0.2% 7.732
23 Textile finishing 0.087 0.152 0.012 0.000 0.000 0.000 0.00 -0.251 -21.64227 0.251 34.6% 60.7% 4.8% 0.0% 0.000
24 Made-up textiles 0.519 0.583 0.038 0.000 0.000 0.000 0.00 -1.139 -23.15636 1.139 45.5% 51.2% 3.3% 0.0% 0.000
25 Carpets and rugs 0.379 0.337 0.011 0.000 0.000 0.000 0.00 -0.727 -22.70755 0.727 52.2% 46.4% 1.5% 0.0% 0.000
26 Other textiles 0.171 0.304 0.035 0.002 0.210 1.303 1.61 2.613 1.808384 0.512 33.5% 59.4% 6.8% 0.3% 3.125
27 Knitted goods 0.934 0.937 0.057 0.000 0.002 0.008 0.01 -1.911 -4.765785 1.927 48.4% 48.6% 2.9% 0.0% 0.016
28 Wearing apparel and fur products 4.206 5.738 0.522 0.000 0.021 0.040 0.04 -10.363 -4.626901 10.466 40.2% 54.8% 5.0% 0.0% 0.102
29 Leather goods 0.208 0.248 0.012 0.000 0.000 0.000 0.00 -0.468 -22.2667 0.468 44.4% 53.1% 2.5% 0.0% 0.000
30 Footwear 1.361 0.165 0.004 0.000 0.000 0.000 0.00 -1.531 -23.45193 1.531 88.9% 10.8% 0.3% 0.0% 0.000
31 Wood and wood products 1.505 1.184 0.304 0.001 0.100 0.395 0.39 -2.110 -1.219757 2.994 50.3% 39.5% 10.2% 0.0% 0.884
32 Pulp, paper and paperboard 0.898 0.837 0.152 0.000 0.000 0.000 0.00 -1.887 -23.66108 1.887 47.6% 44.4% 8.1% 0.0% 0.000
33 Paper and paperboard products 1.237 2.333 0.177 0.000 0.006 0.031 0.04 -3.671 -3.891241 3.747 33.0% 62.3% 4.7% 0.0% 0.077
34 Printing and publishing 3.483 7.422 0.423 0.004 0.385 1.382 0.05 -9.507 -1.825894 11.333 30.7% 65.5% 3.7% 0.0% 1.825
35 Fuels 1.324 1.392 0.881 0.000 0.000 0.000 0.00 -3.598 -24.30587 3.598 36.8% 38.7% 24.5% 0.0% 0.000
Shetland Locsup Orkney Eilean Siar Highland AA North Eas
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4. The Survey Method.

The most common method of trying to establish the impact of expenditure at a local level is to try to trace the effects through the local economy by surveying those who are directly or indirectly involved. As a result these tend to be focused on the sectors of most interest and industry links regarded as unimportant gathered in groups or in an "other" category. The resulting I-O table is typically very limited in the number of sectors and these sectors may not correspond with the SIC classifications.

The MBSE survey was initially confined to 9 sectoral groupings but as the survey progressed more were added (e.g. mining and quarrying) to give a total of 14. Fig 7 shows the resulting table with the 14 sectors. One obvious feature is the number of missing values in the table. It would be both extremely time consuming and inefficient in terms of estimating impact to try to cover in detail those industries which are at the far end of the chain of effects. An important conclusion therefore is that the transfer of survey based tables from one study to another in a different industry can be extremely dangerous.

For the Type 2 multiplier the local spend by local labour on products from each sector is required. Where this expenditure occurred in local retail, data estimates had already been obtained. However a substantial proportion of spending by locals occurs outside the area in both retail and services. Some limited information was obtained by survey but it could not be claimed to be large enough for a confident claim on accuracy or representation. Here again the limitations of the survey approach become obvious.

Fig 6 The MBSE Survey Table

Industry Expenditure (MBSE Survey Data)	Agriculture, forestry & fishing	Mining	fa g	Food	Energy and water	Constru ction	Distribution, catering & Hospitality	Transport & Commun ication	Finance and business	Public admin etc.	Scientific services	Recrea Tional Services	Retail Trade	Other services
Agriculture, forestry & fishing	5.00%									2.00%				
Mining		3.00%				2.00%								0.04%
Manufacturing	10.00%		2.00%		1.00%	2.00%	1.00%							
Food				4.00%			5.00%						2.50%	
Energy and water	1.00%	2.00%	1.53%			3.00%	1.00%	1.00%	1.00%	1.00%	0.30%	0.50%		0.07%
Construction	2.00%	1.00%		1.00%			2.00%				1.00%	3.00%		0.41%
Distribution, catering & Hospitality								5.00%					8.00%	
Transport & communication		5.00%		5.00%	1.00%	5.00%	1.00%		1.00%			6.00%		
Finance and business	5.00%	1.00%	2.00%	2.00%	1.00%		1.50%	5.00%	5.00%	5.00%	2.00%	15.00%	7.00%	0.82%
Public admin etc.												3.00%		
Scientific services	0.50%									0.50%	2.50%	4.00%		
Recreational Services														
								20.00%	25.00%		0.50%		1.00%	
Other services	1.00%		1.00%							3.00%				
CONSUMPTION	24.50%	12.00%	6.53%	12.00%	3.00%	12.00%	11.50%	31.00%	32.00%	11.50%	6.30%	31.50%	18.50%	1.34%

5. Comparison of Results

Although the I-O based and CogentSI models are full 128 industry models for comparison purposes these have been condensed to be compatible with the Survey model. Appendix 2 gives the elements in each sector.

Type 2 multipliers have been calculated rather than Type 1. At the local level it is difficult to understand why the impact of spending by the local labour force employed as a result of the activity should not be counted. For tourism the induced effect is as important as the indirect effect.

Because the Survey model was focused on the impact of angling the expenditure vector utilized was based on total angling expenditure in the MBSE. Table 1 shows the impact of this expenditure as estimated by the various models.

Table 1:
Estimates of the Impact of Angling Expenditure obtained from the five models

Sectors	Tourist Expenditure	Effective Local Demand	Scottish I-O	SLQ	CILQ	CogentSI	MBSE Survey
Agriculture, forestry & fishing	£46,371	£20,902	£311,122	£619,140	£481,279	£173,559	£102,502
Mining			£75,470	£62,069	£11,058	£4,648	£10,933
Manufacturing			£895,116	£686,930	£311,553	£15,197	£46,418
Food Processing			£584,412	£393,664	£1,551,422	£131,364	£267,587
Energy and water			£939,169	£210,859	£405,346	£291,967	£280,002
Construction	£306,645	£213,177	£946,245	£492,094	£946,781	£687,211	£524,364
Distribution, catering & Hospitality	£2,419,496	£1,968,175	£2,028,516	£1,993,139	£2,036,520	£2,016,880	£2,195,169
Transport & communication	£943,213	£272,885	£876,228	£411,087	£724,826	£639,621	£728,953
Finance and business			£2,006,448	£639,182	£890,947	£2,118,393	£1,507,975
Public admin etc.			£393,341	£231,897	£404,785	£936,785	£378,048
Scientific services			£18,361	£1,849	£2,966	£116,994	£194,664
Recreational Services	£5,334,566	£4,544,748	£4,797,637	£4,674,895	£4,823,785	£4,709,378	£4,684,859
Retail Trade	£1,441,985	£590,337	£1,574,866	£1,428,509	£1,637,699	£1,678,334	£2,084,954
Other services	£875,009	£213,177	£298,462	£273,810	£303,257	£299,350	£293,888
Total	**£11,367,284**	**£7,823,400**	**£15,745,392**	**£12,119,125**	**£14,532,224**	**£13,819,682**	**£13,300,314**
Type 2 Output Multiplier			**2.013**	**1.549**	**1.858**	**1.766**	**1.700**
Type 2 Expenditure Multiplier			**1.385**	**1.066**	**1.278**	**1.216**	**1.170**

The results show significant differences between the models. As expected, estimates generated from the Scottish table are substantially larger than for the "local" models. As a result the multiplier of 2 is almost undoubtedly too high.

The effect of the adjustment for location as applied to the producing industry only has a surprising effect in reducing impacts. The unlikely larger impact on agriculture does not

compensate for reductions in locally based construction and business and scientific services. In particular scientific services supporting angling are known to exceed over £100,000 in value, as opposed to the SLQ estimate of £1,900.

The most noticeable feature of the CILQ is in the Food Manufacturing sector. This reflects the substantial employment in this sector in two plants. In reality the vast majority (if not 100%) is exported from the area and the vast majority of processed foods imported from plants throughout Scotland. The Scottish table reflects a breadth of production and relatively low import penetration whilst in a local area the plants in the sector are specialized and hence import penetration very high.

It is difficult to understand how tourist spending has a major impact on the very limited manufacturing in the local area. In this context the returns from the CogentSI and Survey models appear more plausible than the Scottish Table based models.

Differences between CogentSI and the Survey model are relatively small. The biggest difference is in public administration which the CogentSI model estimates to be close to £1m on tourist expenditure of under £12m compared to between £230,000 and £340,000 for the other models. Within the MBSE area, in addition to Moray Council and the MBSE company itself, there are offices for SNH, Forestry Commission, Tourist Offices and the National Park which all support tourism in some form or other. Whilst £937,000 might appear over large, a figure in excess of £500,000 would not seem unreasonable.

6. Some Conclusions

With some reservations, unlike the table based models, the CogentSI model appears to generate sectoral estimates that are plausible and type 2 multipliers of the right order of magnitude. Whilst the survey model equally produces “reasonable” estimates, because it was built for a specific purpose, unlike the CogentSI model, it cannot be used outside that context. For example it would be interesting to examine in detail the impact of the Cairngorm funicular but the survey model would need considerable enhancement to cope with the engineering and construction sectors.

Outside the MBSE, the limited evidence here suggests that better estimates are likely to be obtained than from the other table based models, and almost certainly better than applying an MBSE based survey model. Most importantly, because the individual local models have to be consistent with each other and, when aggregated, comply with national totals errors cannot be massive. At every stage the data itself generates the checks and balances.

It is not yet possible to state that the CogentSI model has no major weaknesses and/or deficiencies but this paper suggests that the approach does have much to commend it. Further research, however, is required.

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Appendix 1: Estimation Procedure for Local Output

Source Data	**Operation**	**Resulting Level**	**Resulting Data**
UK Turnover/GVA (ABI) **UK Employees UK (ABI)**	Division	SIC 4	*UK Labour Productivity*
UK Labour Productivity **Employees Scotland (ABI)**	Product	SIC4	*Scottish Output & GVA 1*
Scottish Output & GVA 1	Aggregation	128 Industry	*Scottish Output & GVA 2*
Scottish Output & GVA 2 **Scottish IO Tables**	Division Disaggregation	SIC4	*Productivity Scale Factor 1*
Labour Productivity UK **Employees Scotland (ABI)** *Productivity Scale Factor 1*	Product	SIC4	*Scottish Output & GVA 2* *Scottish Productivity*
Scottish Productivity **Employees Local (ABI)**	Product	SIC4	*Local Output & GVA 1*
Local Output & GVA 1	Aggregation	SPD et al	*Local Output & GVA AGG*
Local Output & GVA AGG **Local Production (SPD)**	Division Disaggregation	SIC4	*Productivity Scale Factor 2*
Productivity Scale Factor 2 *Local Output & GVA 1*	Product	SIC4	*Local Output & GVA 2*
Local Output & GVA 2	Aggregation	128 Industry	*Local Output & GVA 3*
Local Output & GVA 3 **Scottish IO Tables**	Rescaling from Totals	128 Industry	*Local Output & GVA 4*
Local Output & GVA 4 **Local Production (SPD)**	Rescaling from Aggregates	128 Industry	*Local Output & GVA **5***
Local Output & GVA 5 ***Scottish Make Matrix (see Table 4)***	Product	128 Industry	***Scottish Supply of commodities to Local Industry***

Appendix 2: Condensed Sector Construction

	Scottish I-O tables	
1	Agriculture	1
1	Forestry Planting	2.1
1	Forestry Harvesting	2.2
1	Sea Fishing	3.1
1	Fish Farming	3.2
2	Coal Extraction etc	4
2	Extraction - Oil and Gas	5
2	Extraction - Metal Ores	6
2	Other Mining and Quarrying	7
4	Meat Processing	8
4	Fish and Fruit Processing	9
4	Oils and Fats	10
4	Dairy Products	11
4	Grain Milling and Starch	12
4	Animal Feeding Stuffs	13
4	Bread, Biscuits, etc	14
4	Sugar	15
4	Confectionery	16
4	Miscellaneous Foods	17
4	Spirits and Wines, etc	18.1
4	Beer Brewing	18.2
4	Soft Drinks	19
4	Tobacco	20
3	Textile Fibres	21
3	Textile Weaving	22
3	Textile Finishing	23
3	Made-up Textiles	24
3	Carpets and Rugs	25
3	Other Textiles	26
3	Knitted Goods	27
3	Wearing Apparel	28
3	Leather Tanning	29
3	Footwear	30
3	Timber and Wood Products	31
3	Pulp, Paper and Board	32
3	Paper and Board Products	33
3	Printing and Publishing	34
3	Oil Process, Nuclear Fuel	35
3	Industrial Gases	36
3	Inorganic Chemicals	37
3	Organic Chemicals	38
3	Fertilisers	39
3	Synthetic Resins	40
3	Pesticides	41
3	Paints, Dyes, Printing Ink, etc	42
3	Pharmaceuticals	43
3	Soap and Toilet Preperations	44
3	Chemical Products nes	45
3	Man-Made Fibres	46

3	Rubber Products	47
3	Plastic Products	48
3	Glass and Glass Products	49
3	Ceramic Goods	50
3	Structural Clay Products	51
3	Cement, Lime and Plaster	52
3	Articles of Concrete etc	53
3	Iron and Steel	54
3	Non-ferrous Metals	55
3	Metal Castings	56
3	Structural Metal Products	57
3	Metal Containers, etc	58
3	Metal Forging, Pressing, etc	59
3	Cutlery and Tools	60
3	Metal Goods nes	61
3	Mech Power Transmission Equipment	62
3	General Purpose Machinery	63
3	Agricultural Machinery	64
3	Machine Tools	65
3	Special Purpose Machinery	66
3	Weapons and Ammunition	67
3	Domestic Appliances nes	68
3	Office Machinery	69
3	Electric Motors and Generators	70
3	Insulated Wire and Cable	71
3	Electrical Equipment nes	72
3	Electronic Components	73
3	Transmitters for TV, Radio and Phone	74
3	Receivers for TV and Radio	75
3	Medical and Precision Instruments	76
3	Motor Vehicles	77
3	Shipbuilding and Repair	78
3	Other Transport Equipment	79
3	Aircraft and Spacecraft	80
3	Furniture	81
3	Jewellery and Related Products	82
3	Sports Goods and Toys	83
3	Miscellaneous Manufacturing nes	84
5	Electricity Production and Distribution	85
5	Gas Distribution	86
5	Water Supply	87
6	Construction	88
13	Distribution and Motor Repair, etc	89
13	Wholesale Distribution	90
13	Retail Distribution	91
7	Hotels, Catering, Pubs, etc	92
8	Railways	93
8	Other Land Transport	94
8	Water Transport	95
8	Air Transport	96
8	Transport Services	97
8	Postal Services	98
8	Telecommunications	99

9	Banking	100.1
9	Other Financial Institutions	100.2
9	Insurance and Pension Funds	101
9	Auxiliary Financial Services nes	102.1
9	Auxiliary to Insurance	102.2
9	Owning and Dealing in Real Estate	103
9	Letting of Dwellings	104
9	Estate Agent Activities	105
9	Renting of Machinery	106
9	Computing Services	107
11	Research and Development	108
9	Legal Activities	109
9	Accountancy Services	110
9	Market Research	111
9	Architectural etc Activities	112
9	Advertising	113
9	Other Business Services	114
10	Public Administration	115
10	Education	116
10	Health and Veterinary Services	117
10	Social Work	118
10	Sanitary Services	119
10	Membership Organisations	120
12	Recreational Services	121
14	Other Service Activities	122
14	Private Households with employed persons	123