REGIONAL ECONOMIC IMPACTS OF PLURIACTIVITY IN SCOTTISH FARM HOUSEHOLDS

MORAG McGREGOR MITCHELL

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DEPARTMENT OF SOCIAL SCIENCES
UNIVERSITY OF GLASGOW

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ProQuest LLC.
789 East Eisenhower Parkway
P.O. Box 1346
Ann Arbor, MI 48106 – 1346

ABSTRACT

This study examined the regional economic impacts of pluriactivity in Scottish farm households. This has become an important issue in a climate of falling farm incomes, and increased moves towards integrated rural development policies. Methodologies included:

i) developing a model, which combines and extends existing techniques, capable of estimating and spatially distributing the economic impacts of on-farm pluriactivity;

ii) identifying which types of activity have the greatest benefit in terms of a) local and b) regional income generation and employment, measured by size and spatial distribution;

iii) assessing the economic impact of the RDP; and

iv) identifying those areas in the regions studied, which offer the greatest and least potential for pluriactivity, as a step towards policy targeting.

A model was produced combining techniques from input-output analysis and a gravity model. This model can be used to predict the income and employment impacts of on-farm enterprises, and spatially distribute the results

The gravity model was extended to allow multiple payments, and could then be used to assess the economic impacts of the RDP grants in Dumfries & Galloway and Grampian. It was found that the regional economy comprises a complex set of relationships, and the outcomes were influenced by the presence, or absence, of centres of population large enough to draw economic benefits away from rural areas.

Factor analysis was used to identify which geographical, physical, economic and location variables explain the success of various on-farm enterprises. This analysis was found to be particularly suited to tourism and leisure & recreation related activities, which at present account for the majority of on-farm enterprises. Some areas were found to exhibit the correct conditions for developing several different enterprises, but some of the remote areas were, unfortunately, shown to have very few diversification opportunities.

The results of the study clearly provide information relevant to policy makers interested in an integrated approach to rural development.

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CHAPTER 1

Chapter 1: Introduction

1.1 Background

This dissertation will examine the economic and employment impacts of pluriactivity in Scottish farm households, resulting in the development of a model which spatially distributes these impacts at a regional level and which is capable of giving policy makers some valuable insights into policy targeting. Pluriactivity has become an important issue in the recent climate of falling farm incomes, and an examination of the role that agriculture plays in the rural economy is examined in section 1.2.

The EU and UK governments are looking to pluriactivity to alleviate some of the problems facing agriculture, particularly in areas where farms may require restructuring and enlargement, or where farm incomes may be particularly affected by demand for their product or changes in support measures though recent reforms of the Common Agriculture Policy (CAP) (Ministry of Agriculture, Fisheries and Food (MAFF), 2000; Appleton, 1994; Keeble *et al*, 1992; Rural Forum, 1991; Slee, 1990).

Previous studies have looked at the factors which determine the behaviour of farm households (Austin *et al*, 1996, 1998; Shucksmith 1993, 1999), the incidence of pluriactivity in UK farm households (McInerney & Turner, 1991; McInerney *et al*, 1989; Dalton & Wilson, 1989; Leat, 1990; Moss, 1992; Arkleton, 1988, Brun & Fuller, 1991) and the types of activity in which they engage (Dalton & Wilson, 1989; Davies *et al*, 1994; Gasson *et al*, 1988; Harrison, 1992; Ilbery *et al*, 1996). However, no work has been carried out into the economic impacts of pluriactivity. If it is to be seriously considered as a mechanism for the survival of farm households, it is necessary to examine: i) the levels of income derived from different enterprises; ii) the knock-on effects that they have on regional economies;

and iii) the locational factors which influence success of different enterprises. This study, therefore, develops a methodology to examine the economic impact of, and opportunity for, the development of various on-farm enterprises in three regions in Scotland - Dumfries & Galloway, Fife and Grampian, the results of which may be translated more generally. Specifically, pluriactivity within farm households will have upstream and downstream effects on already vulnerable rural economies, and so the ability to quantify and spatially distribute these effects will be useful to policy makers wishing to target various support and diversification policies on specific areas.

1.2 The role of agriculture in the rural economy

1.2.1 Definition of rural areas

Various methods have been used to define "rural" areas. Whitby (1985) used the Office of Population Census and Surveys (OPCS) method of identifying rural areas as the parts left when urban areas are removed, based on population densities. Table 1.1 shows the structure of rural employment compared to Great Britain as a whole for each single digit Standard Industrial Classification (SIC).

Rural Employment 1981	GB %	Rural Mean %
Agriculture, forestry & fishing	2.2	10.3
Energy and Water	3.1	2.8
Manufacturing	27.0	13.7
Construction	7.0	7.9
Distribution & Catering	19.2	17.7
Transport	6.5	5.0
Other Services	34.0	31.9

source: Whitby, 1985.

Table 1.1. Employment structures in rural areas compared to GB

Using this method, the main differences between the rural areas and GB as a whole show up in the higher percentage employed in agriculture, and the lower percentage in manufacturing. However, it must be recognised that these are average figures, and hide a lot of variation between rural areas. In contrast, local authorities have tended to use very simple definitions. Thus, a rural area can be defined as a district which has less than 1 person per hectare, measured using statistics from the population census (Randall, 1985).

Both of these methods result in areas being defined as either urban or rural. However, an OECD (1992) report on rurality concluded that it was insufficient to classify rural areas as the residual of urban areas, rather there should be some kind of continuum, with regions reporting the proportion of the population living in rural communities within them. The OECD (1994) chose i) population and migration, ii) economic structure and performance, iii) social well being and equity and iv) environment and sustainability to provide a set of indicators to assess rural conditions and trends, but continued to use population density to identify rural areas *per se*.

Hodge and Monk (1992) classified areas in England according to a range of economic indicators, resulting in ten types of area ranging from 'Outer London Pressured' to 'Farming', but this raises the problem of which economic indicators should be used. Economic pressures do not come simply from within a region or district, as there can be enormous interactions at play. This is evidenced by the recent trade embargo threat by USA importers on the economy of the Borders region in Scotland, where cashmere is a major industry.

Further studies, Cloke (1977), Cloke & Edwards (1986) and Doyle & Mitchell (1994), also did not simply separate rural from urban areas, but presented a rural-urban classification based on a number of factors including employment structure, population characteristics, migration patterns, housing conditions, land-use patterns

and remoteness. This allowed areas to be placed on a rural-urban continuum. Table 1.2 presents the percentage of the population employed in agriculture, forestry and fishing (SIC 0) for each urban rural class in Dumfries & Galloway, according to the work carried out by Doyle & Mitchell (1994), where class I is the most rural and class VI is the most urban area.

Rural-Urban Class	% Employed in Agriculture, Forestry & Fishing
I	40.1
II	35.6
III	15.2
IV	10.8
V	6.2
VI	2.1

source: Doyle & Mitchell, 1994

Table 1.2. Employment in agriculture, forestry and fishing by rural-urban class in Dumfries & Galloway

It is evident that this method produced wider variations in the dependence on employment in agriculture, forestry & fishing, and this higher resolution allowed the identification of those areas which would be most vulnerable in a climate of falling farm incomes. The results of this work (for a full explanation of the methodology see Doyle & Mitchell, 1994) have been used later in this study when discussing the policy implications of supporting pluriactivity.

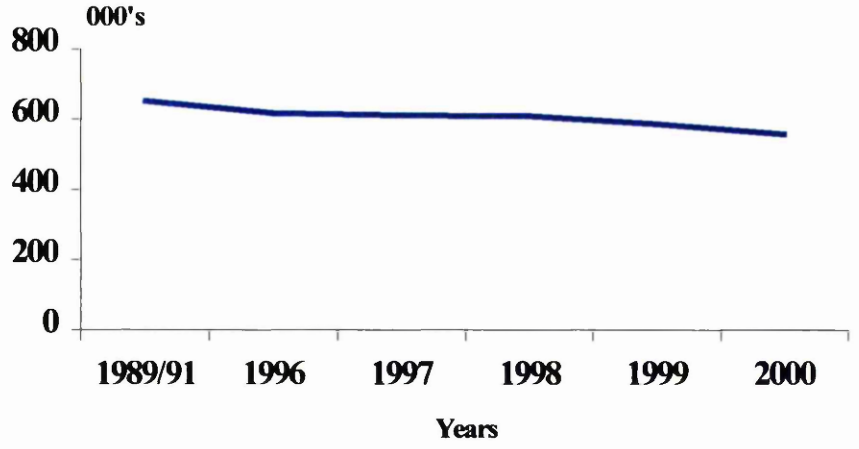
1.2.2 Agriculture in rural employment

Champion and Watkins (1991) examined changes in rural employment in Britain between 1981-87. Employment in manufacturing increased to become close to the national average, with the number of people employed in tourism increasing by 17% and in banking, insurance and finance by 32%. Again it must be noted that these increases have not been uniformly distributed across all areas, with for example opportunities in tourism and oil-related industries not being evenly apportioned. Also, many jobs are part-time, temporary and seasonal, and therefore they do not reduce the fragility of some rural areas (Bryden, 1997; Rural Forum, 1997).

The OECD (1996a) undertook a Project on Rural Employment Indicators (REMI), and found that "unemployment rates are higher in rural than urban areas" and that "the vast majority of rural employment opportunities is in non-agricultural sectors". Certainly, the territorial disparities between countries are significant, but these very differences can be exploited, and rurality *per se* should not be seen as an obstacle to job creation, for example in the areas of tourism. The OECD study divided regions into three classes, according to the share of the regional population living in rural communities (population density below 150 inhabitants/km^2) - namely 'Predominantly Rural' with more than 50%, 'Significantly Rural' with between 15 and 50% and 'Predominantly Urbanised' with less than 15%. Applying this typology resulted in only 1% of the UK population being Predominantly Rural, 27% Significantly Rural and 72% Predominantly Urbanised. This compared to 28%, 40% and 32% respectively for the OECD members as a whole. It was found that agriculture accounted for 10.3% of employment in Predominantly Rural areas in the UK, 4.2% in Significantly Rural areas and only 1.0% in Predominantly Urbanised areas.

Figure 1.1 shows the downward trend in the numbers of people employed (including self-employed) in agriculture in the UK between 1989 and 2000

(MAFF, 2000). However, there have also been significant changes in the employment structure within agriculture signified by a fall in the proportion of full-time as opposed to part-time employment, and an increase in seasonal and temporary jobs (Scottish Office, 1992).



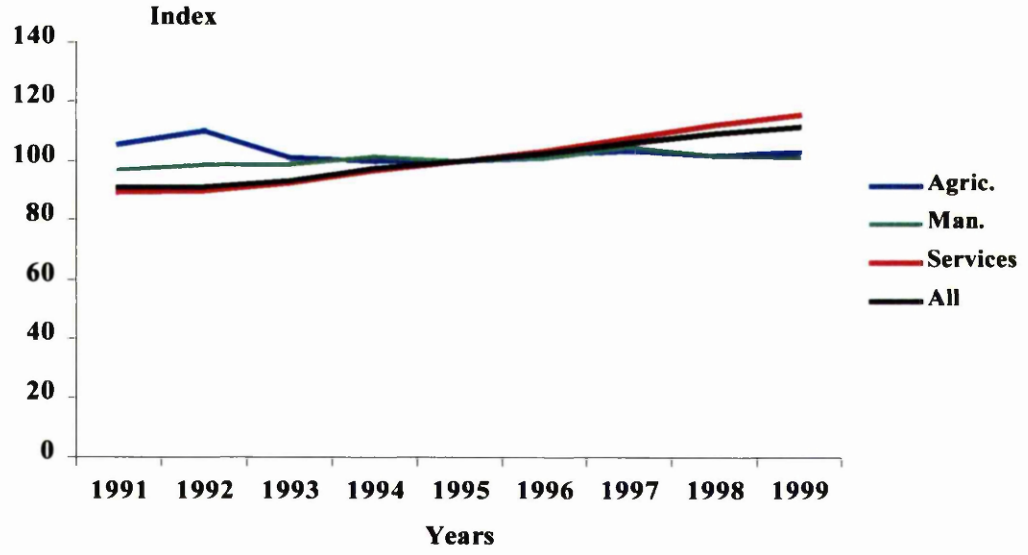
Source: MAFF, 2000

Figure 1.1. Total work force in UK Agriculture, employed and self-employed (1989-2000)

1.2.3. Agriculture in rural incomes

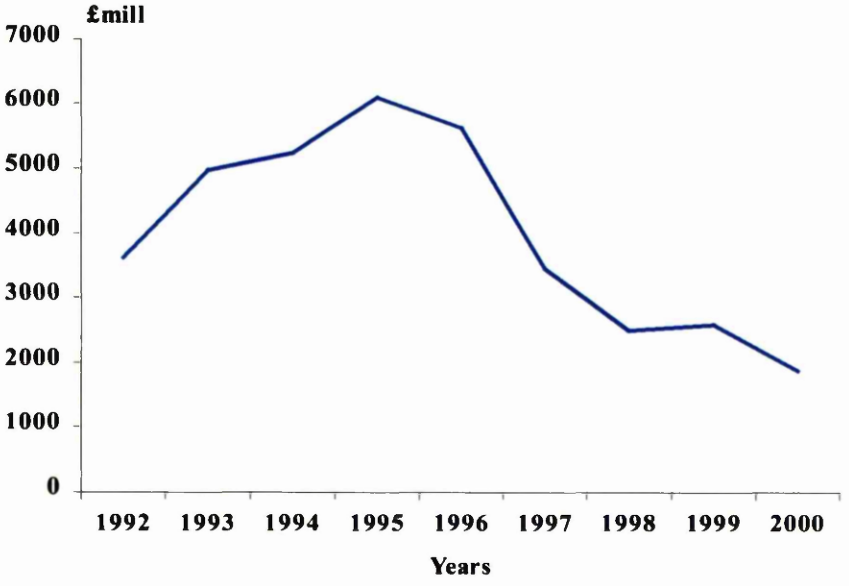
As well as the decline in numbers of people employed in agriculture, relative incomes in this sector are also falling behind (Scottish Office, 1992). Figure 1.2 shows the performance of UK agriculture, manufacturing and service sectors (Office for National Statistics (ONS), 2001), measured by an index (1995 = 100) of their gross value added compared to the value for all sectors of the economy. It can be seen that agriculture increased rapidly until 1992, decreased just as rapidly to 1995, and is now increasing at a very slow rate. In comparison, the rate of annual increase in value added in the service sector has risen steadily since 1991, and now has a rate of increase well above the average. Manufacturing has fared less well, experiencing a lower than average increase since 1992. The Farm Accounts Survey of 499 farms in Scotland has identified an even greater crisis

between reporting years 1996/97 and 1997/98, when net farm income fell by a massive 77.6% to an average income over all farm types of £4,615 (Scottish Office Agriculture, Environment and Fisheries Department (SOAEFD), 1999). MAFF (1999) stated that total income from farming was at its lowest level for 25 years in 1997/98.



Source: ONS, 2001

Figure 1.2. Index of gross value added in selected industries, 1991-1999



Source: MAFF, 2001

Figure 1.3. Total income from farming in the UK at constant (2000) prices

Figure 1.3 (MAFF, 2001) shows how these pressures have led to a decline in total incomes from farming at constant 2000 prices, following the same trends as employment.

Therefore the overall situation for agriculture in Scotland is now one of falling farm incomes and a decline in its contribution to Gross Domestic Product (GDP). External pressures for further change will continue with the implementation of Agenda 2000, impending World Trade Organisation (WTO) talks, European budgetary problems, and the collapse in product prices (National Farmers Union (NFU), 1999), as well as public and consumer groups placing farmers in the spotlight as never before. This situation has led to increasing farm sizes (Bryden, 1997) and the introduction of more intensive mechanisation and technologies to maintain and increase production levels. It can therefore be predicted that farms which traditionally supported the farmer's household will no longer be able to do so, and one or more members of the household will be forced to earn an income elsewhere. In other words, farm households will have to become 'pluriactive', which is discussed in the next section.

1.3 Pluriactivity in farm households

This section discusses previous studies on pluriactivity from three perspectives - the incidence of pluriactivity, the pluriactive household and the policy environment.

In general, and in this study in particular, unless otherwise stated, pluriactivity is defined as any member of a farm household earning income from a source other than agriculture production, both on- and off-farm. Since this study is concerned with the economic impact of pluriactivity, the actions of the whole household are taken into consideration. Wheelock & Oughton (1994) examined the case for using the farm household as the unit for research, rather than the economically rational, profit maximising individual. Their conclusion, that "if we are looking at economic

choices, the crucial unit is not the individual, but the household, not just for consumption decisions, but for labour supply decisions, too", is particularly relevant in a situation where a survival **strategy** is being considered, which combines the "thoughts, interests and objectives of the individuals of the household, both as individuals and as members of a household group" (Wheelock & Oughton, 1994). Indeed, the labour allocation of farm household members between agricultural and non-agricultural activities is complex, and "farm families are the key unit of analysis in both farming and pluriactivity" (Brun & Fuller, 1991). In addition, studies frequently observe that the farmer's sole objective is not invariably profit maximisation, (Austin *et al*, 1996, 1998; Gasson, 1973; Gasson *et al*, 1988; Shucksmith 1993), confirming that the more composite structure of the farm household should be the unit of analysis (Eikeland & Lie, 1999).

1.3.1 The incidence of pluriactivity

Pluriactivity is not a new phenomenon. Robson *et al* (1987) discussed developments in part-time farming since 1961, but said there was a lack of policy-oriented research until the 1980's, as it was not included within the policy environment of the CAP. There was also a tendency to equate part-time farming with non-viable holdings, giving it an inferior quality, and it did not fit in with the general objectives of agricultural policies. However, things have moved on, and an OECD study in 1978 stated that "part-time farming has taken on such proportions in the world's developed countries that it can no longer be ignored....A better knowledge of the facts and of the broad implications for agricultural, social, rural development and environmental policies may induce decision makers in governments and farmers' interest groups to define or to redefine their position with respect to part-time farming more precisely to the benefit of both the rural and urban society" (OECD, 1978).

The study by Robson *et al* (1987) of the results from the 1983 Farm Structure Survey in England and Wales found that 30.2% of farms over 4 European Size

Units (ESU), which in theory are full-time farms able to maintain one full-time person, reported other gainful activity. The incidence of off-farm work was three times as great as that of working on other farms or running on-farm enterprises. However, farm-based recreation and tourism activities in Britain were less important at that time than in other European countries (Robson *et al,* 1987; Arkleton Trust, 1985). A recent study in Norway (Eikeland & Lie, 1999) found that 53% of farm households were pluriactive. However, the activities of farm households are "still mainly associated with agricultural enterprise....based on land resources such as forestry, renting out property for fishing, hunting and other kinds of leisure activities" (Eikland & Lie, 1999).

Several other studies examined the incidence of and structure of pluriactivity in England and Wales (McInerney & Turner, 1991; McInerney *et al*, 1989), Scotland (Dalton & Wilson, 1989; Leat, 1990), Northern Ireland (Moss, 1992) and Europe (Arkleton, 1988, Brun & Fuller, 1991), describing who was involved and estimating levels of income. They described a situation where off-farm employment was the major source of income and on-farm activities fell into two major categories, namely many small enterprises which provided a low level of income, and relatively few major enterprises earning anything up to £1 million. Thus, in England and Wales "there appears to be quite a variation in the amount by which diversification adds to farm business income" (McInerney & Turner, 1991) and in 1989 in Scotland the top third of enterprises were reported to provide an average net income of £12,151, whereas the bottom two thirds provided £1,739 (Wilson, 1990).

Although the studies described a situation where there were large variations across farm types and regions, pluriactivity did make a significant contribution to farm incomes. For example, in Northern Ireland "for 26% of farm households at least half of the total income arose from off-farm employment" (Moss, 1992); in Scotland, 40.4% of farms were pluriactive, 18.9% having on-farm enterprises where "as a result of diversification some 4% is added to the aggregate income

earned from farming" (Wilson, 1990); and in England and Wales estimates "suggest that diversification contributes on aggregate something in the order of £230 million to the (net margin) income" (McInerney & Turner, 1991). In respect of the last of these studies, Exeter University carried out a survey of 10,000 farms in England and Wales between 1988 and 1990, and found that more than 40% of holdings had at least one non-farming enterprise (Farm Development Review, 1991). However, three quarters of these enterprises earned net profits of less than £5,200 per annum.

The decline in the agriculture sector in the late 1980's brought about a renewed interest in pluriactivity, and these studies were followed by the Pluriactivity in the Agricultural Sector in Scotland project, funded by the Economic and Social Research Council as part of the Joint Agriculture and the Environment Programme (JAEP), including projects in England, Wales, Northern Ireland and Europe.

A detailed survey of 506 farm households was carried out in three regions of Scotland during 1991 (Figure 1.4).

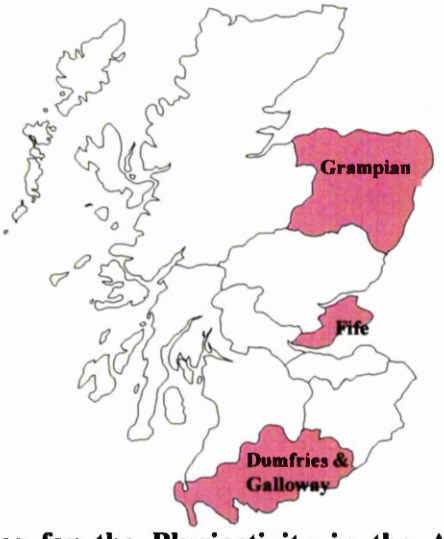


Figure 1.4 Study areas for the Pluriactivity in the Agricultural Sector in Scotland project

The survey was carried out on a stratified random sample of all farms in the three regions over the size of 4 Business Size Units (BSU). It is assumed by the Scottish Executive Rural Affairs Department (SERAD) that 4 BSU is the minimum financial measurement of business which equates to a full-time farm unit. The farms in each region were stratified by BSU and farm type, and a 7% sample of each cell was chosen at random from a list of farms supplied by SERAD.

The regions chosen were illustrative of different geographic and agriculture situations in Scotland, reflecting a cross section of farm types. Grampian was mostly Least Favoured Area (LFA), but had the highest incidence of arable farming, and it allowed the effect of a major city, Aberdeen, on pluriactivity to be studied. Fife was non-LFA and had mixed farm types but was a major tourist area. Dumfries & Galloway was also LFA. It had a large percentage of dairy farms and a strong agricultural base, but was weak on tourism and urban development.

The choice of study areas for this dissertation was based on information gathered during this project, and will be discussed in section 1.8.

Some comparative work was carried out on the Scottish, Welsh and N. Irish data (Davies *et al*, 1994, 1995) comparing pluriactivity in the peripheral regions of the UK. The survey data compared 2,100 farm households of varying sizes and types. Along with the 506 farms surveyed in three regions in Scotland, 427 farms were sampled from 7 regions in Wales and 1,174 in Northern Ireland. In both Scotland and Wales, the sample regions were chosen to capture a variety of different environmental, economic and legislative circumstances, and the locality of the farms ranged from peri-urban to the more remote rural areas. In contrast, in Northern Ireland, a random selection of grid squares was used to sample farm households from across the province. Table 1.3 summarises the main findings of this comparative work, along with results from a European study involving a longitudinal survey of 300 farms in each of 24 study areas across Europe, including 9 EC and 3 non-EC countries (Bryden *et al*, 1992).

It can be seen that the order of magnitude of pluriactivity is similar in each of the studies, with Wales slightly higher at 66% of households claiming to be pluriactive. One reason for this is the higher reported incidence (27%) of on-farm pluriactivity, whereas the European and Scottish studies reported noticeably lower percentages of 19.6% and 18% respectively. Northern Ireland had by far the lowest uptake of on-farm enterprises, at only 5%.

	Pluriactive	**Off-farm pluriactive**	**On-farm pluriactive**
Scotland	59	49	18
Wales	66	53	27
N. Ireland	56	53	5
Europe	62	47.9	19.6

source: Davies et al, 1995; Bryden*et al*, 1992.

Table 1.3. Distribution of pluriactivity among farm households (% of all farm households)

Between 1997 and 1998, the Scottish Agricultural College (SAC) conducted a number of studies examining the impact of Agenda 2000 on farming at a regional level (SAC, 1997; SAC, 1998a, b, c, d, e, f, g). Part of this analysis was to identify the potential impact that Agenda 2000 might have on the levels of pluriactivity, and the potential for pluriactivity as a future management solution to the crisis facing agriculture in Scotland. The results of these studies are summarised in Table 1.4. The incidence of pluriactivity varies considerably across the regions, from 21% in Kintyre to 69% in Orkney. Pluriactivity in Dumfries & Galloway has increased from 46.8% in 1991 (Dent *et al*, 1993) to 60% in 1998. Also, a

significant percent of farm households agreed that they would consider pluriactivity as a future option for increasing farm incomes.

Region	% Pluriactive households	% Considering pluriactivity as a future option
Lanarkshire	50	16
Kintyre	21	No data
Borders	28	46
Angus	46	58
Orkney	69	No data
Dumfries & Galloway	60	25
Perth & Kinross	40	No data
Skye & Lochalsh	69	No data

Source: SAC, 1997; SAC, 1998a, b, c, d, e, f, g

Table 1.4. Regional analysis of pluriactivity in Scotland, 1997/98

Therefore, it can be seen that pluriactivity has become an increasingly important factor in the behaviour of farm households, especially with the renewed concern about falling farm incomes. A fall in farm incomes has a knock-on effect on the rural economy, so must be replaced if overall economic activity is to be maintained. Although off-farm work continues to be the dominant form of pluriactivity, Edmond & Crabtree (1993) "concluded that policies and schemes supporting on-farm non-agricultural enterprises have potential to assist all farms in areas of suitable market opportunity irrespective of farm income".

1.3.2 The pluriactive household

Knowing the incidence and level of income from pluriactivity is important, but recent studies have also focused on motivation - specifically who becomes pluriactive and why? Table 1.5 shows the percentage of each group of household

members involved in pluriactivity in Scotland, Wales, Northern Ireland and Europe.

	Farmer	Spouse	Other
Scotland	28	33	39
Wales	31	44	41
N. Ireland	25	29	44
Europe	42.1	23.7	26

source: Davies *et al*, 1995; Bryden *et al*, 1992.

Table 1.5 Incidence of pluriactivity by household members, %of each household group

Comparison of the data shows differences in the level of involvement between household members. Europe has the highest level of pluriactive farmers, but the lowest level of involvement from spouses and "others". It should be noted that "others" includes children and adults of all ages. If only sons and daughter over 16 are included, the figure for Scotland rises to 61% being pluriactive.

Some work has also been carried out on which factors may influence farm households becoming pluriactive. Interestingly, farm size (in hectares) is not a significant factor (Austin *et al*, 1998; Brun & Fuller, 1991; Davies *et al*, 1994; Mitchell, 1994), but qualifications, and farm type are (Austin *et al*, 1998; Mitchell, 1994; Shucksmith, 1999). Thus, Mitchell (1994) analysed the data from the Scottish pluriactivity study of 506 farm households to assess which factors influenced a farm household's decision to become pluriactive. The survey contained several questions relating to household characteristics and attitudes, including asking the farmer to indicate on a scale of one to six what he/she thought of innovation, what influenced decisions and willingness to try new ideas, to what lengths capital would be risked on a new venture and his/her attitude to

diversification. Answers to these questions were combined to give a risk score, which in turn was one of the variables used to carry out discriminant analysis, comparing pluriactive and non-pluriactive households. The list of variables used for the analysis are listed in Table 1.6.

Variable	Description
RISK	Risk score
AGE	Age of farmer
QUAL	Post-school qualifications
GET	How the farm was acquired: bought, inherited etc.
BSU	Business size unit, based on income
HA	Hectares
FTYPE	Farm type
FFAMILY	Whether farmer & spouse consider themselves to have farm backgrounds
NO	Number of people in household
NO16	Number of people over 16 years in household

Table 1.6 List of variables used in discriminant analysis between groups of pluriactive and non-pluriactive households

SPSS Discriminant Analysis (SPSS, 1990) was used to test whether the means of the variables for the two groups of households were significantly different. If the observed significance value was small (i.e. less than 0.05), the hypothesis that the group means were equal was rejected. The results of the analysis are listed in Table 1.7. From this, it can be seen that the variables GET and HA were not significant at the 5% level, having a value greater than 0.05. Therefore it was concluded that

farm size (as measured in hectares) and how the farm was acquired did not influence the decision to become pluriactive.

The other factors, however, were significant. Specifically, pluriactive households had a higher mean risk score; they had more members, including those over 16 years; they were better qualified; the farmer was younger; they lived on farms with smaller Business Size Units (BSU), an economic measure of size; and they tended to be arable or smaller horticultural enterprises.

Variable	Significance level
RISK	0.0053
AGE	0.0004
QUAL	0.0013
GET	0.3708
BSU	0.0148
HA	0.1490
FTYPE	0.0109
FFAMILY	0.0013
NO	0.0000
NO16	0.0000

source: Mitchell, 1994

Table 1.7. Results of discriminant analysis on the groups of pluriactive and non-pluriactive households

Some of these results have been confirmed by other studies. Farm type, business size, qualifications, farm background and the presence of children have all been found to be relevant (Brun & Fuller, 1991; Ilbery *et al*, 1996; Shucksmith, 1999).

However, although the results may be expected, confirmation that there are indeed differences between pluriactive and non-pluriactive households means that measures aimed at encouraging farm households to use their land and resources for uses other than agriculture could be presented in a way that makes them attractive to households with similar characteristics.

1.3.3 The policy environment

As far back as the Stresa resolution of 1958, the need for farm households to have the ability to diversify was identified (Tracy, 1994). "The retraining of the agricultural labour force and the industrialisation of the rural regions under the greatest pressure would allow for a gradual settlement of the problems posed for marginal farms which are economically incapable of being made viable" (Davies *et al*, 1995). From an early stage, therefore, it was recognised that agricultural policy in its structural form should seek linkages with other policy areas.

The countryside makes up almost 80% of the European Community and more than 50% of the population live and work there. However, until the implementation of the 1992 reforms, the CAP had provided little help to those farmers who wished to diversify into non-agricultural activities (Davies *et al*, 1995). The situation was further aggravated by post-war attitudes towards landuse planning, especially the anti-development ethos of the Town and Country Planning Act of 1947. These attitudes protected agricultural land against development, and together with the limited funding of the Guidance section of the CAP, inhibited the opportunities for linkages between agriculture, farm households and the wider rural economy.

However, by 1984 it became clear that the political power of consumers and environmental interests was increasing (Brun & Fuller, 1991). The Green Paper on the CAP (Commission of the European Communities (CEC), 1985) led to a new set of structural policies (Errington, undated), explicitly recognising the positive role of pluriactivity in supporting and increasing farm household incomes,

alongside measures to maintain viable rural communities and conserve and protect the environment. Rural development was also identified as a priority by the Commission of European Communities (CEC) in 1988, with the publication of its document, "The Future of Rural Society". Its aims for rural development were:

- "economic and social cohesion in an enlarged community of very pronounced regional diversity;

- the unavoidable adjustment of farming in Europe to actual circumstances in the market and the implications of this adjustment not only for farmers and farm workers but also for the rural economy in general;

- the protection of the environment and the conservation of the communities' natural assets" (COM(88) 501 final).

To implement this, the Commission stressed the importance of building on local initiatives, integrating the efforts of national, regional and local bodies. Better planning was expected to strengthen the protection of rural areas and at the same time encourage diversification of the rural economy to lessen the dependence on agriculture. They recognised that these developments would more easily happen in small centres of population, but resisted increased centralisation. "The basic strategies must therefore, in each case, be tailored to the particular economic and social circumstances of the relevant regions" (COM(88) 501 final).

One of the main developments directed towards these aims was the introduction in 1991 of the LEADER (Liaison Entre Actions de Development de l'Economie Rurale) programme, funded through the EU Structural Funds in Objective 5b areas (see Appendix I for an explanation of Objective areas in the EU). This was not specifically aimed at agriculture, but enables rural communities to involve themselves directly in the development plans of their areas by drawing up and

implementing local, integrated business plans (Topp *et al*, 1997). The group's business plans could include such activities as rural tourism, small firms, craft enterprises and recreation services. LEADER II, in the most part, carries on the objectives of LEADER. There is, therefore, scope for farm households to get involved at a community level, rather than as individual households.

The 1992 CAP reform widened the scope of the Guidance sections of the European Agricultural Guidance and Guarantee Fund (EAGGF) to include:

- encouragement for tourist and craft investment;

- renovation and development of villages and the protection and conservation of the rural heritage; and

- protection of the environment, maintenance of the countryside and restoration of landscapes (Appleton, 1994).

To achieve this, a third of the Community budget was allocated to the Structural Funds to be spent in Objective 1 and 5b regions, which included large parts of Scotland.

The 1999 CAP reforms, Agenda 2000, again have highlighted rural development. The Objective areas have been restructured, with the new Objective 1 and 2 designations covering rural areas. The Rural Development Regulation has recommended structural spending in three areas:

- for creating a stronger, more competitive agriculture and forestry industries;

- for creating a living countryside, through the pursuit of increased competitiveness and an improved quality of life (farm and off-farm diversification to promote pluriactivity and pluri-income sources...); and

- for maintaining the environment and preserving Europe's unique rural heritage.

Therefore, it seems that at EU policy level, the benefits of pluriactivity have been accepted, but there are no blanket policies specifically aimed at promoting it, and there is a view in the UK "that the Government must move away from the assumption that the EU will provide most funding for rural development policy and specific initiatives" (House of Commons, 1999a). The Second Report by the Select Committee on Agriculture went on to say that "the vast majority of CAP resources continue (under Agenda 2000) to be directed into commodity-related or area-based payments" (House of Commons, 1999a). The Third Report, in May 1999, stated that "apart from an expected increase of around 140 million Euro per year in agri-environment expenditure across all member states, there is no Community funding to enable any significant change in the extent and range of rural development measures in the UK" (House of Commons, 1999b).

Therefore, from a policy perspective, support for pluriactivity must come from initiatives supported by national governments and agencies. In Scotland, farm households in the previous Objective 5b (new Objective 2) regions - Borders, Dumfries & Galloway, North and West Grampian, Rural Stirling and Upland Tayside - are currently assisted under the Rural Diversification Programme (RDP), jointly funded by SERAD (formerly SOAEFD) and the EU to "help those in agriculture to establish new economic enterprises or expand existing diversified activities" (SOAEFD, 1998). Part- and full-time farms may apply and receive a grant equivalent to 50% of eligible expenditure up to a maximum of £25,000. Eligible enterprises include on-farm processing, tourist accommodation and facilities, catering, leisure, recreation and sport and rural services, along with costs

of marketing to promote these activities. The economic impact of this scheme is discussed in Chapter 5.

Sources of other financial support in Scotland include local governments, Scottish Enterprise and the Scottish Tourist Board, but these are small, and were found to have no influence on decisions to set up enterprises (Dalton & Groves, 1990).

So, firstly, from a policy perspective, the frequency and multi-sectoral nature of pluriactivity in farm households implies careful examination of the degree to which agricultural policy is separated from wider rural policy and support measures. Whilst farming of course requires specific policies geared to consistent and reliable production, farm households are part of a wider economic framework, which itself influences the sustainability of farming communities. The CAP remains the main instrument of support to farm households, but its emphasis is changing away from productivity to a wider perspective of rural development. Agenda 2000, brought about by:

- internal budgetary pressures;
- proposed EU enlargement; and
- world trade negotiations

has not gone very far down this route. "To suggest that the current geographical distribution of area and headage payments could be justified on environmental or rural policy criteria is disingenuous" (Swinbank, 1999). There is also resistance from member states towards any restructuring that would affect their levels of welfare within the context of enlargement, and suggestions that the acceding member states should have limited access to structural funds (Stawarska, 1999). There is therefore some scope for future reform of the CAP to further integrate agriculture into the broader aims of rural development, both for existing members and those waiting to join.

Secondly, in implementing policies aimed at facilitating pluriactivity, there is reason to believe that separate, but integrated, support programmes may be required to accommodate the differences in objectives and aspirations of individual household members, but at the same time channel these aspirations towards realising sustainable developments in rural areas. In this instance, pluriactivity must be considered both in terms of on-farm non-agricultural enterprises and off-farm work, encouraging income flows which bring money into rural areas rather than simply displacing existing income, especially to those areas further away from urban centres. The OECD has particularly called for development methods which draw out the indigenous potential of an area, and has pointed to the need for facilitating or enabling adaptiveness and flexibility in the labour force to support new investment (OECD, 1996b). Both of these strategies draw attention to the kinds of training and support measures provided.

1.4 Aims

As discussed above, there has been a considerable amount written on the incidence of farm household pluriactivity, on who is involved and on the potential economic benefits to the household. However, there is not a lot of evidence on either:

i. the economic impact of pluriactivity at a local and regional level, or

ii. the potential of different locations for establishing on-farm enterprises.

The emphasis in this study is to provide a method for assessing the socio-economic impact at a parish and regional level of farm households engaging in a variety of non-agricultural activities in three regions of Scotland - Dumfries & Galloway, Grampian and Fife. The final result is a framework, combining statistical and geographic techniques, which provides policy makers with information which can inform decisions, both in terms of assessing the spatial distribution of the economic

impacts of on-farm non-agricultural enterprises and of identifying areas of potential development.

Five activities - caravan sites, B&B, farm shops, livery stables and clay pigeon shooting - highlighted in earlier studies as the main forms of pluriactivity on Scottish farms, are examined. The economic impact of the Scottish Rural Diversification Programme (RDP) as applied to these areas, will also be evaluated. Finally, the study will also construct an index of potential, identifying areas within the chosen regions which exhibit a previously untapped possibility of sustaining certain activities.

The specific aims include:

i. developing a model, which combines and extends existing techniques, capable of estimating and spatially distributing the economic impacts of on-farm pluriactivity;

ii. identifying which types of activity have the greatest benefit in terms of a) local and b) regional income generation and employment, measured by size and spatial distribution;

iii. assessing the economic impact of the RDP; and

iv. identifying those areas in the regions studied, which offer the greatest and least potential for pluriactivity, as a step towards policy targeting.

1.4.1 Hypotheses

The main hypotheses to be tested are that:

i. the activities which farm households most frequently engage in have a small regional economic impact;

ii. the RDP does not exhibit uniform economic benefits across different regions; and;

iii. different activities are better suited to areas with particular external geographic, locational and industrial factors.

1.5 Scope of study

The research has been carried out using the same three regions identified in the Pluriactivity in the Agricultural Sector in Scotland project, on the grounds that these represent a cross-section of agricultural and economic conditions in Scotland. Specifically, Dumfries & Galloway is used to develop the methodology, while Grampian and Fife are used to validate some of the results. The advantage of this approach is that the project collected data on the location of existing enterprises, income generated and the resources used, so the data collected in Grampian and Fife could be used to validate the methodology developed in order to identify areas for potential development.

The five enterprises discussed were chosen either because they were a very common type of pluriactivity (e.g. bed & breakfast) or because the expected income levels were relatively significant for on-farm enterprises (e.g. livery stables). Wilson (1990) also found that, although some enterprises individually contribute very little to farm income, the total earnings from some enterprises were large when summed over Scotland, and these may mean the difference between survival and leaving farming altogether.

Table 1.8 lists the enterprises chosen, and, from the data collected in the Scottish pluriactivity project, states the main reasons respondents gave for

starting the enterprise, their average annual income (in 1991), and the percentage of these who said the income from the enterprise contributed financially to supporting the farm business. The results are based on the responses of 56 farms across the three regions who stated they were involved in running these enterprises.

Enterprise	Why was the enterprise started?	Average Annual Income	Income supports farm business
bed & breakfast	81.8% - to maintain/ increase income	£3,279	45.45%
farm shop	60.0% - to maintain/ increase income	£1,417	60.00%
caravan site	66.7% - to maintain/ increase income	£2,010	66.67%
clay pigeon shooting	60.0% - to maintain/ increase income	£13,000	40.00%
livery stables	various	£14,062	50.00%

source: Mitchell & Doyle, 1993.

Table 1.8. Reasons for starting on-farm enterprises, average annual income and whether the farm business is supported.

These enterprises were also most likely to be run by the farmer and/or spouse, (Table 1.9), who are the most important people in terms of any discussion about pluriactivity providing alternative sources of income to farm households.

The range of regions and enterprises chosen is therefore broad enough to allow results from this study to be relevant to other regions in Scotland. This, combined with the information about areas that have potential for development, should provide the opportunity for policy makers to have some

influence on land management and land use by providing incentives for particular development in targeted areas.

Enterprise	Farmer (%)	Spouse (%)	Other (%)
bed & breakfast	15.4	69.2	15.4
farm shop	0	80.0	20.0
caravan site	57.1	42.9	0
clay pigeon shooting	57.1	0	16.7
livery stables	83.3	50.0	25.0

source: Mitchell & Doyle, 1993.

Table 1.9. Percentage of farm household members involved in enterprises.

1.6 Conclusions

This chapter has presented a review of the problems facing agriculture and the role pluriactivity may play in this. The main conclusions to be drawn are:

- The agriculture industry in Scotland may be facing a crisis situation, where incomes fell in 1997/98 by an average of 77.6%. As agriculture has strong linkages in the rural economy, therefore this decrease in income must be replaced by other means if the wider rural economy is not to suffer. One of these is on-farm pluriactivity.

- Pluriactivity is now recognised as an important development in maintaining farm incomes and diversifying rural economies. Fifty-nine per cent of farm households in Scotland in 1991 were found to be pluriactive, with 18% having on-farm enterprises. Surveys of Scottish farm households in 1998 found that a significant amount of farmers saw pluriactivity as a survival mechanism.

- Internal and external factors affect pluriactivity. Internal factors are related to farm household characteristics, farm type and farm size. External factors include the policy environment and market opportunity.

- Few rural development policies specifically address pluriactivity, although in Scotland there exists the RDP. A more integrated approach to rural development is required, where agriculture is incorporated into the wider context of the rural economy.

Chapters 2 & 3 go on to describe the development of the model used in fulfilling the first aim, with the results presented in Chapter 4. Chapter 5 presents a method for extending the gravity model, to allow the simultaneous distribution of the RDP grants paid in Grampian and Dumfries & Galloway regions, with the results presented in Chapter 6. Chapter 7 develops a method for identifying areas which may exhibit potential for developing on-farm enterprises, and overall conclusions are contained in the Chapter 8.

CHAPTER 2

Chapter 2 Methodological Considerations: Development of Regional Input-Output Tables

2.1 Introduction

As described in Chapter 1, the first step in developing a model capable of spatially distributing the economic impact of pluriactivity at a regional level involves developing regional input-output tables. This chapter examines the issues surrounding the use of input-out models, and describes the estimation of regional input-out tables. Firstly, it presents a critical review of the use of input-output models, including their choice within the context of this study. Secondly, it outlines the methodology used to estimate the local and regional impact of on-farm pluriactive enterprises, including i) the derivation of regional input-output tables and ii) the calculation of regional and enterprise multipliers.

2.2 Agriculture's linkage with the rest of the economy: input-output analysis

Agriculture, unlike almost any other industry, has a high degree of vertical linkage both upstream (with industries supplying inputs) and downstream (with industries which process and distribute farm output) (Errington, (undated); Midmore, 1993). Thus, for example in Scotland in 1995, intermediate inputs accounted for 50.1 per cent of the gross input of the agriculture and horticulture sector, compared to 16.0 per cent for the economy as a whole, while 50.1 per cent of the sector's output was sold to final demand, compared with 69.1 per cent overall (Scottish Office, 1998). Because of this interdependence, changes in farm business expenditure might be expected to have significant effects on the rest of the rural economy (Midmore, 1993).

The fact that input-output coefficients present average responses to a change in output, rather than marginal ones, may result in an overestimation of multipliers (Midmore, 1991a). However, this can be justified by the

recognition that, if input-output analysis is to be used, with all its inherent advantages, there is no method for rectifying this problem.

The establishment of any on-farm enterprise can therefore be expected to have an effect on the other industries in the regional economy. Input-output analysis, first applied by Wassily Leontief to an analysis of the United States economy in 1936 (Leontief, 1986), is one methodological tool which offers a means of identifying the magnitude of these linkages, and the associated multipliers can be used to estimate the overall impact on incomes and employment. Provided a number of restrictions are accepted, "which are not too onerous (at least in the short-run)" (Midmore, 1991a), it has the advantage of being conceptually simple (Midmore, 1991b), and yet able to forecast the impact of an enterprise on the economy as a whole. Certainly, the technique has been increasingly used to analyse the regional effects of developments (Gould & Kulshreshtha, 1985; Pederson, 1986; Leat *et al*, 1989; Leat and Chalmers, 1991; Midmore, 1993; Medcalf *et al*, 1995; Errington *et al*, 1996; Doyle *et al*, 1997). However, some of the limitations to using this method must be discussed.

2.2.1 Production function

There is an assumption in input-output analysis that the production functions of all industries are linearly homogeneous of degree one, and therefore a rise in output in one sector will create proportionately fixed increase in demand for inputs from all other sectors, implying that input substitution or economies of scale are ignored and there are no constraints on productive capacity. Hence, one of the main areas of contention centres on the highly restrictive technological structure imposed upon production within each sector (Bailey, 1994). Basically, the coefficients, a_{ij}, of the technical matrix, **A**, describe the ratio of the amount of input i required to produce one unit of output j. To forecast the consequences of an increase in the output of commodity j on the demands for input i, constant returns to scale must be assumed.

Whilst this may be acceptable for large national industries (Bailey, 1994), it is less easy to justify when the analysis is disaggregated to a regional level, or when the industry accounts for a very small proportion of the regional economy (Midmore, 1991a). However, "these can be mitigated through the argument that, in the short-run at least, modern productive units seem to operate as far as possible on a near-horizontal segment of their cost curves" (Midmore, 1991a).

At the same time, input-output analysis presumes that the factors of production are combined in fixed proportions, so that input substitution is ignored, constraining the elasticity of substitution between inputs to equal zero, implying that changes in factor price ratios result in no change in the input proportions. As a result, the observed relationships are "snap shots", specific to the state of technology, the input price ratios and the industry structure at the time of measurement. Leontief (1951) himself justified this on the grounds that manufacturing industries appeared to employ relatively inflexible capital technologies.

2.2.2 Elasticity of supply

There is a closely related assumption that any increase in demand for inputs will be met by the supplying industries concerned through increased production, and not merely by running down stocks or increasing imports from other regions (Mitchell, 1996). The input-output model, therefore assumes unit elasticity of supply, which means that any percentage increase in output will be met by the same percentage increase in inputs, in the same proportions as described in the coefficient matrix. This implies that the producers supplying inputs can easily increase production to meet demands and there is no substitution of inputs. In the short term, however, it may be unrealistic to expect this immediate response, but over the longer term it is possible.

In relation to this study, this assumption is not unrealistic. Individual enterprises make small demand on inputs from the various industrial sectors compared to their total output, and are unlikely to force industries to seek input adjustments. It is therefore acceptable to assume that any increased demand for inputs for a single enterprise will be met by the supplying industries.

2.2.3 Homogeneous outputs

Each industrial sector within an input-output table is composed of a variety of products and enterprises which are aggregated to produce the input requirements and output flows of that sector. This leads to the assumption that any increase in output from that sector will require the same input mix, regardless of the particular enterprise generating the increase in output (Midmore, 1993), and the technical coefficients of the input-output structure remain the same, regardless of the type of enterprise generating output. Thus, because input-output relationships describe average responses, rather than marginal ones, the derived multipliers may overstate the impact of any change in output (Midmore, 1991b).

The use of regional input-output tables also assumes that technology at the regional and national level can be compared using employment data. Midmore (1990) states that "at the level of detail required for an effective operational input-output model, the problem of industries producing more than one commodity emerges....Therefore, symmetric commodity by commodity or industry by industry input-output tables cannot be produced without making simplifying assumptions".

One solution to the problem would lie in desegregating the input-output table to an individual commodity or enterprise level. Work has been carried out in this area for farm enterprises (for example Lager & Schopp, 1985; Errington, 1989; Topp & Mitchell, 1997), but the data requirements to apply any of these methods to pluriactive enterprises within a regional economy would be prohibitive. Therefore,

the assumption is made that there is no substitution between inputs in producing the output of any one industry.

2.2.4 Time factor

The process of change over time is also largely ignored. "It is not unusual for an input-output table to appear in print about five years after the year it describes" (Vaccara, 1970), and, therefore, reliability "depends on stability, over time, in the basic technical relationships measured by the input-output coefficient table" (*ibid.*). "Given the inevitable time lag between the accumulation and the collection of data for any given year, the input-output table will always be a historical document" Leontief, 1986). Vacarra (1970) found, however, in his analysis of the US economy that "in ¾ of all cases the marginal coefficients are stable at the assumed level of significance". Midmore's (1991a) investigation of input-output tables also found that errors were relatively insignificant in the short run, and technological changes in the industries discussed here are relatively slow (Macfarlane, 1995). There is also no clue as to the time scale over which the adjustment will take place.

2.2.5 Price effects

Finally, there is an assumption that input and output prices are fixed (Topp *et al*, 1997; Medcalf, 1995), meaning that the input-output coefficients will disregard the effecta change in output has on price and *vica versa*.

2.2.6 Social Accounting Matrix

From this review it is clear that, while input-output coefficients and multipliers are being used to evaluate the economic impact of on-farm enterprises, there are a number of specific difficulties in this context. However, the alternatives, as recognised by Lager and Schöpp (1985), Midmore (1993) and Bailey (1994), are limited.

One alternative has been the development of the Social Accounting Matrix (SAM), which extends the input-output model to include a social dimension (Holst & Sancho, 1995; McDonald, 1996; Roberts, 1995) through examining the "distribution of value added between enterprises, households and the state, allowing issues relating to distributive justice to be examined" (Douglas & Horpman, 1995). Its framework incorporates a detailed classification of accounts, including different industrial sectors, categories of workers and institutional sub-sectors (Pradhan *et al*, 199). SAMs have been used to examine:

1. Growth strategies in developing countries (Roland-Holst & Sancho, 1995; Roberts, 1996);
2. Income distribution and redistribution (Pradhan *et al*, 1999; Roberts, 1995);
3. Impact of fiscal policy in national and regional settings (Bautista, 2001; Waters *et al*, 1999; Kilkenny, 1999); and
4. Incorporating the environment into input-output analysis (Xie, 2000).

Therefore, the main application of SAMS has been to examine the exogenous shocks to an economic system, such as changes in government expenditure or export systems; identifying changes in income distribution between household groups; and in calibrating Computerised General Equilibrium (CGE) models. However, SAM models exhibit many of the same criticisms as input-output models (Wagner, 1997; Roberts, 1996) and "it may therefore safely be presumed that extension [of the input-output model] incorporating more dimensions will require greater accuracy in detail from the data sources on which the approach is based, and this leads onto the second complication, the volume of data required" (Douglas & Horpman, 1995).

One criticism in particular is that the multipliers produced by SAM tend to be higher than those derived from input-output tables, and since input-output

analysis may already overstate their size (Using average rather than marginal responses), adoption of a SAM would be counterproductive.

Other criticisms include the type of data required to construct the model, which requires partitioning the household sector (and here the choice of classification is subjective) and assumes the availability of information on income distribution (Pradhan *et al*, 1999), which is not necessarily the case.

Issues of income distribution, the structure of demand for different types of households and the detailed response of government sectors are not relevant to this study, as it deals with aggregate regional impacts, not sectoral responses.

2.2.7 Conclusions

Theoretically it is not too difficult to generalise the input-output approach of inter-sectoral modelling, relaxing both the assumptions on elasticity of input substitution and returns to scale implicit in Leontief technology, but data limitations severely constrain the use of alternative approaches. "It is a method of analysis that takes advantage of the relatively stable pattern of the flow of goods and services among elements of our economy to bring a much more detailed statistical picture of the system into the range of manipulation by economic theory" (Leontief, 1986).

Moreover, in so far as the economic analysis of establishing a single enterprise involves fundamentally marginal changes, some of the concerns expressed about the use of input-output forecasts may be less critical. "Multi-sectoral modelling within the tradition established by Leontief is a flexible tool: opportunities for its use in a rural context are widespread, and it can be adapted to assist in the resolution of a number of urgently pressing problems" (Midmore, 1996).

Against the purported weaknesses of input-output analysis, its advantages include that:

- it provides a comprehensive view of the whole economy;
- it highlights the interdependencies between different sectors in the economy;
- it is flexible and can be easily modified to extract detail where required;
- it is policy neutral; and
- it enables policy impacts to be studied at the direct, indirect and induced levels.

These advantages of input-output analysis make it a powerful and comprehensive tool for studying the economic effects of individual industries (Richardson, 1972; McNicoll, 1985; Leontief, 1986; Fletcher, 1989; Medcalf *et al*, 1995).

The derivation of regional input-output matrices and their associated income and employment multipliers are discussed below.

2.3 Regional input-out tables

This study requires the use of regional input-output tables, but input-output tables are only published in Scotland at a national level, so a method was adopted to convert these to a regional level.

Jensen (1990) carried out a review of the development of regional tables. "The first stage of the development of regional input-output tables involved the use of unadjusted national coefficients. Both authors and subsequent commentators agreed that this approach was deficient. The second stage saw the use of national coefficients as first approximations of regional coefficients. The third stage, which could approximately be termed the classical era of regional input-

output, saw the emergence of "genuine" regional tables, based primarily on regional data" (Jensen, 1990). This was generally regarded as an important development and an "ideal would be national tables constructed by aggregating a set of complex, consistent, state [regional] tables" (Ozaki, 1970).

However, the quality and amount of data required to complete this task are immense. Jensen (1976) stated that in practice, a "survey based table was derived largely by non-statistical methods from survey data, which involved professional judgement....based on educated guesses and sometimes simple estimates of people in a better position to form judgements, and often based on fragmentary data". The quality of these tables was also questioned by McNicoll (1985), who stated that "the paucity of data on economic activity in UK local authority areas is well known".

Katz and Burford (1985) also criticised the scale of the problem, where "the data requirements make the construction of an accurate survey based input-output model extremely expensive", a view supported by Richardson (1972), McNicoll (1985), Hewings and Jensen (1988), Flegg *et al* (1995) and Medcalf *et al* (1995). Therefore, it was accepted that the cost of using survey methods to create regional input-output tables within this study was prohibitive and a non-survey technique was adopted.

Non-survey tables, relying on secondary data sources "appear destined to set the pace and the direction of regional input-output research for the foreseeable future"(Miernyk, 1987), and the Generation of Regional Input-Output Tables (GRIT) model has attracted considerable attention (Hubbard, 1982; Johns & Leat, 1986; Errington, 1989; Leat & Chalmers, 1991; Harrison-Mayfield, 1996). It is a hybrid method, which is sufficiently flexible to allow the insertion of 'superior data' where appropriate, and was devised by Jensen *et al* in 1979 to model the regional economy of Queensland, Australia. (Jensen *et al*, 1979). It relies on a series of mechanical steps to produce regional coefficients from the national tables (*ibid.*). The method was further described by Johns

and Leat (1986), who used it to produce a table for the Grampian region, Scotland. "The GRIT procedure thus allows considerable time-saving in the construction of reasonable estimates of regional input-output tables" (Medcalf *et al*, 1995),.

2.3.1 Development of a regional input-output table for Dumfries & Galloway

The first step was to construct a regional input-output matrix. This was derived from the Scottish input-output tables. To understand how this was done, it is necessary to discuss the nature of input-output tables. Basically, an input-output table traces the transaction flows for a given year, both between and within sectors of the economy. Each sector within the model is described in terms of its inputs and outputs expressed in monetary value. The inputs include raw materials, goods purchased from itself and from other sectors within the economy, and also payments for taxes, wages, interest, etc.. Outputs from the sector are sold to itself, other sectors within the economy, the government, households, or are exported. The effects on output, income and employment can be divided into *direct, indirect* and *induced.* The *direct* and *indirect* effects are due to the increase in the demand for inputs resulting from an increase in the final demand for a specified sector. The resultant employment and income effects will in turn increase the household demand for outputs from various sectors. This secondary effect on the income and employment levels within the economy is described as the *induced* effect.

In the input-output table a column and a row are assigned to each sector. This is usually presented in a matrix form. A simplified transaction table for a three sector economy is shown in Table 2.1. The values in the rows assigned to sector 1 are the monetary values of the output of that sector to all the producing sectors. Thus, £25,000 of its output are sold to firms in the same sector, £20,000 to firms in sector 2, £15,000 to sector 3 and £40,000 to the final users. The columns contain the value of the input for each sector allocated to the sector from which they originate. Thus, sector 1 purchases

£25,000 worth of inputs from firms in the same sector, £14,000 from sector 2, £20,000 from sector 3 and £41,000 in the form of primary inputs. (e.g. direct labour and interest on capital repayments.)

Selling Sectors	**Purchasing Sectors**				**Total Output**
	1	**2**	**3**	**Final Demand**	
	Quadrant I			*Quadrant II*	
1	25	20	15	40	100
2	14	6	10	20	50
3	20	12	43	25	100
	Quadrant III			*Quadrant IV*	
Primary Inputs	41	12	32	12	97
Total Inputs	100	50	100	97	347

Table 2.1 Hypothetical transaction table (£000's)

The flows of transactions between sectors is shown in Quadrant I, while the sales by each sector to final demand are presented in Quadrant II. Here 'final demand' includes personal consumption, investment, some government expenditure and exports (Jensen *et al.*, 1979). Depreciation, indirect taxes, wages and salaries, gross operating surplus, imports and "other value added" items are included in this quadrant. The absorption of primary inputs into final demand is shown in Quadrant IV. Together Quadrants II, III and IV form the *exogenous* sectors of the economy, while the *endogenous* sectors are represented in Quadrant I.

As input-output matrices for the study areas did not exist, it was necessary to construct a regional input-output table by converting the national table. The basic problem was that the economics of location and comparative advantage tended to encourage regional specialisation. Thus, regional economies were less diverse than national economies and so tended to be more dependent on imports. In order to disaggregate the national model to a regional level, the effect of the region being more dependent on imports had to be incorporated into the new table.

The first step was to amalgamate the national table into sectors for which reliable regional employment data could be obtained. This involved amalgamating the 123 original industrial sectors contained in the 1995 Scottish input-output tables (Scottish Office, 1998) into the ten principal single digit Standard Industrial Classifications (SIC) described in Table 2.2.

It is preferable to carry out this aggregation after the national table has been converted to the regional level (Flegg *et al*, 1995), but the GRIT technique uses employment data to complete the transformation, and regional employment data did not exist at the 123 sector level. However, reliable data existed for the 10 single digit SIC's and it has been found that any bias introduced by aggregation is less important than previously thought (Morimoto, 1970). Thus, a study by Sevaldson (1970) of Norwegian data between 1949 and 1960 found that the standard deviation of aggregated coefficients was smaller than the variance of detailed coefficients, especially if a relatively detailed table is used to start with (Sevaldson, 1970).

	Description of SIC:
SIC 0	agriculture, forestry, fishing
SIC 1	energy and water supply
SIC 2	extraction of minerals/ores, manufacture of metals, mineral products and chemicals
SIC 3	metal goods, engineering, vehicles
SIC 4	other manufacturing
SIC 5	construction
SIC 6	distribution, hotels, catering
SIC 7	transport, communication
SIC 8	banking, finance, insurance, business services
SIC 9	other services

Table 2.2. Single digit Standard Industrial Classification.

The ten sector input-output table was then converted to a coefficient matrix, where the column entries in this matrix described the proportion of inputs required by each sector from all sectors to produce one unit of output. Hence, a national coefficient, or 'A' matrix was produced, where reading down an industry column described the proportion of inputs required from all other industries to produce one unit of output, and reading across described what proportion of one unit of output went to each of the other industries. Using these technical coefficients, a_{ij}, (where *a* is the proportion of inputs required by industry *i* from industry *j*) it was then possible to measure the effect an increase in output in one industry had on others.

The next step was to reduce the national table to a regional one, using the GRIT technique. Basically, this method uses comparative national and regional employment rates in the form of location quotients to compare the relative regional importance of an industry with that in the national economy. There are two possible forms of the location quotient which can be used to carry this out. The first is the simple location quotient (SLQ), which relates the output of each industry in the region as a fraction of total regional output to national output of that industry as a proportion of total national output:

$$SLQ_i = \frac{E_i^r \Big/ \sum_{i=1}^{n} E_i^r}{E_i^N \Big/ \sum_{i=1}^{n} E_i^N} \quad (3)$$

where: E = employment

i = industry

r = regional

N = national

The second is to use cross-industry location quotients (CILQ), which take into account the relative importance of the purchasing industry as well as the selling industry, and therefore better reflects the relative regional importance of the input-output transactions and are used in this study. CILQ are given by the equation:

$$CILQ_{i,j} = \frac{E_i^r / E_i^N}{E_j^r / E_j^N} \quad (4)$$

where: E = employment

i = supplying industry

j = purchasing industry

r = regional

N = national

The method used here, therefore, was to create a 10x10 matrix of CILQ, using the single digit SIC employment data at regional and national levels to compare the importance of each industry in the region with the Scottish level. The data sources used for this process are outlined in Table 2.3

It is assumed that if any value in the CILQ matrix lies between 0 and 1, then the production within the region by that industry is insufficient to meet regional demand and imports are required. In that the case, the regional input coefficients were arrived at by multiplying the national coefficient by the

CILQ. If, however, the CILQ is greater than 1, then regional production is assumed to be meeting demand and the unmodified input coefficients of the Scottish matrix was used.

Data Source	Description of data
Input-Output Tables and Multipliers for Scotland 1995 (Scottish Office, 1998)	industry by industry domestic flows matrix
Population Census, 1991 (OPCS, 1994)	national and regional employment data

Table 2.3. Data sources for development of regional input-output tables.

The adjustments for the coefficients in the regional input-output table for Dumfries & Galloway are shown in Table 2.4 (to 3 significant figures (sig. fig.)). The resultant coefficient matrix for Dumfries & Galloway is given in Table 2.5 (4 sig. fig.). See Appendix 2 for the CILQ and coefficient matrices for Fife and Grampian regions.

CILQ	SIC 0	SIC 1	SIC 2	SIC 3	SIC 4	SIC 5	SIC 6	SIC 7	SIC 8	SIC 9
SIC 0	1.000	0.509	0.401	1.217	0.226	0.327	0.334	0.372	0.595	0.432
SIC 1	1.966	1.000	0.788	2.392	0.444	0.644	0.657	0.730	1.170	0.850
SIC 2	2.495	1.270	1.000	3.037	0.564	0.817	0.834	0.927	1.486	1.079
SIC 3	0.822	0.418	0.329	1.000	0.186	0.269	0.275	0.305	0.489	0.355
SIC 4	4.425	2.251	1.773	5.384	1.000	1.449	1.479	1.644	2.635	1.913
SIC 5	3.054	1.554	1.224	3.716	0.690	1.000	1.021	1.135	1.819	1.320
SIC 6	2.991	1.522	1.199	3.639	0.676	0.979	1.000	1.111	1.781	1.293
SIC 7	2.691	1.369	1.078	3.275	0.608	0.881	0.900	1.000	1.602	1.163
SIC 8	1.679	0.854	0.673	2.044	0.380	0.550	0.561	0.624	1.000	0.726
SIC 9	2.313	1.177	0.927	2.815	0.523	0.757	0.773	0.860	1.377	1.000

Table 2.4. CILQ matrix for Dumfries & Galloway

		Purchases By Industry										
Sales		**SIC 0**	**SIC 1**	**SIC 2**	**SIC 3**	**SIC 4**	**SIC 5**	**SIC 6**	**SIC 7**	**SIC 8**	**SIC 9**	**House**
By	**SIC 0**	0.0000	0.0001	0.0003	0.0003	0.0151	0.0009	0.0032	0.0004	0.0005	0.0005	0.002
Industry	**SIC 1**	0.0105	0.0000	0.0099	0.0109	0.0054	0.0019	0.0103	0.0036	0.0043	0.0173	0.031
	SIC 2	0.0335	0.1088	0.0000	0.0062	0.0123	0.0376	0.0123	0.0123	0.0084	0.0281	0.023
	SIC 3	0.0133	0.0068	0.0017	0.0000	0.0021	0.0093	0.0022	0.0030	0.0033	0.0039	0.003
	SIC 4	0.0544	0.0035	0.0023	0.0033	0.0000	0.0315	0.0500	0.0059	0.0236	0.0246	0.057
	SIC 5	0.0088	0.0110	0.0069	0.0004	0.0006	0.0000	0.0189	0.0015	0.0458	0.0125	0.010
	SIC 6	0.0872	0.0369	0.0125	0.0834	0.0433	0.0448	0.0000	0.0355	0.0320	0.0262	0.210
	SIC 7	0.0354	0.0026	0.0211	0.0073	0.0079	0.0054	0.0241	0.0000	0.0551	0.0135	0.052
	SIC 8	0.0499	0.0325	0.0551	0.0575	0.0363	0.0509	0.0313	0.0083	0.0000	0.0238	0.186
	SIC 9	0.0900	0.0074	0.0043	0.0044	0.0084	0.0081	0.0008	0.0143	0.0047	0.0000	0.098
	Household	0.1570	0.1454	0.1563	0.1651	0.1709	0.2675	0.3125	0.3479	0.2276	0.7206	0.000

Table 2.5. Net coefficient matrix for Dumfries & Galloway.

2.4 Income and employment multipliers

Having thus formed regional input-output coefficient matrices, they may be used to calculate the type 1 and type 2 income and employment multipliers for each SIC within the regions. The type 1 multiplier describes the direct and indirect effect an increase in output has on the economy. An increase in output in one industry will require inputs from other sectors of the economy, hence there is a knock-on effect and the type 1 multipliers describe these direct and indirect impacts. The direct and indirect increases in output will induce further multiplication of income and/or employment impacts, for example the knock-on effect of increased wages being spent in local shops, garages, household purchases etc., and the total direct, indirect and induced effects are given by the type 2 multipliers. It is the type 2 multipliers which will be used in this study, so that the overall impact of establishing an enterprise on regional income and employment can be estimated.

Calculation of these type 2 multipliers firstly involves converting the regional coefficient matrix to a Loentief inverse, which is in turn used to calculate the income and employment multipliers, described below.

2.4.1 Leontief Inverse

To understand how the Leontief Inverse is derived, it is necessary to understand briefly the mathematical structure of an input-output table. Consider an industry, *i*, then the row of the table assigned to that industry describes where the outputs of that industry go, and can be represented by the following equation:

$$X_i = \sum_{j=1}^{n} x_{i,j} + Y_i \qquad (5)$$

where X_i = total output of sector *i*

x_{ij} = output of sector *i* purchased by sector *j*

Y_i = total final demand for the output of sector *i*.

The average change in output of sector *i* that is required to produce one unit of output in sector *j* can be described by:

$$a_{i,j} = x_{i,j}/Xj \qquad (6)$$

where $a_{i,j}$ is the 'input-output' coefficient, which is assumed to be constant. This can be expressed in matrix form for all *n* sectors of the economy:

$$X = AX + Y \qquad (7)$$

This can be rearranged to give:

$$\begin{aligned} & X - AX = Y \\ \Rightarrow\ & (I - A)X = Y \text{ (where I is the Identity matrix)} \\ \Rightarrow\ & X = (I - A)^{-1}Y \\ \Rightarrow\ & X = ZY \end{aligned} \qquad (8)$$

$(I - A)^{-1}$ (or Z) is called the Leontief Inverse.

To calculate the type 2 multipliers, it is necessary to "close" the coefficient matrix, which involves including a household column, which reflects where

households purchase their good and services, and a household row, which reflects the income requirements of the industries.

Thus:

$$X = Z^*Y \tag{9}$$

where:

$$Z^* = (I - A^*)^{-1} \tag{10}$$

2.4.2 Sectoral income multipliers

The direct effect on household incomes of a change in output in sector *j*, D_j, is given by a_{Hj}, where H represents the household row of the closed matrix:

$$A = \begin{array}{c|cccccccc} & 1 & 2 & \cdots & j & \cdots & n & H \\ 1 & a_{11} & a_{12} & \cdots & a_{1j} & \cdots & a_{1n} & a_{1H} \\ 2 & a_{21} & a_{22} & \cdots & a_{2j} & \cdots & a_{2n} & a_{2H} \\ \vdots & \vdots & \vdots & & \vdots & & \vdots & \vdots \\ i & a_{i1} & a_{i2} & \cdots & a_{ij} & \cdots & a_{in} & a_{iH} \\ \vdots & \vdots & \vdots & & \vdots & & \vdots & \vdots \\ n & a_{n1} & a_{n2} & \cdots & a_{nj} & \cdots & a_{nn} & a_{nH} \\ H & a_{H1} & a_{H2} & \cdots & \mathbf{a_{Hj}} & \cdots & a_{Hn} & a_{HH} \end{array}$$

i.e. $\mathbf{D_j = a_{Hj}}$ (11)

The direct, indirect and induced effect of an increase in final demand in sector *j* on household incomes, DII_j, is given by z^*_{Hj} from the household row of the closed Z* matrix.

i.e. $\mathbf{DII_j = z^*_{Hj}}$ (12)

Thus, type 2 income multipliers can be defined as:

$$\frac{DII_j}{D_j} = \frac{z^*_{Hj}}{a_{Hj}} \quad \text{for sector } j \tag{13}$$

2.4.3 Sectoral employment multipliers

To calculate the direct, indirect and induced effects on employment, the household row is adjusted by multiplying the household rows of the closed coefficient matrix by an employment coefficient, the number of employees per unit output.

The direct effect on employment of a change in output in sector *j*, ED_j, is given by a_{Ej}:

	1	2	. . .	j	. . .	n	E
1	a_{11}	a_{12}	. . .	a_{1j}	. . .	a_{1n}	a_{1E}
2	a_{21}	a_{22}	. . .	a_{2j}	. . .	a_{2n}	a_{2E}
.	.	.		.		.	.
.	.	.		.		.	.
.	.	.		.		.	.
i	a_{i1}	a_{i2}	. . .	a_{ij}	. . .	a_{in}	a_{iE}
.	.	.		.		.	.
.	.	.		.		.	.
.	.	.		.		.	.
n	a_{n1}	a_{n2}	. . .	a_{nj}	. . .	a_{nn}	a_{nH}
E	a_{E1}	a_{E2}	. . .	$\mathbf{a_{Ej}}$	. . .	a_{En}	a_{EE}

i.e. $\mathbf{ED_j = a_{Ej}}$ (14)

The direct, indirect and induced effect of an increase in final demand in sector *j* on employment, $EDII_j$, is obtained by multiplying each z^*_{ij} from the closed inverse by a_{Ei} from the household row of the coefficient matrix:

	1	2	. . .	j	. . .	n	E
1	$z^*_{11}a_{E1}$	$z^*_{12}a_{E1}$	. . .	$z^*_{1j}a_{E1}$	. . .	$z^*_{1n}a_{E1}$	$z^*_{1E}a_{E1}$
2	$z^*_{21}a_{E2}$	$z^*_{22}a_{E2}$	. . .	$z^*_{2j}a_{E2}$	. . .	$z^*_{2n}a_{E2}$	$z^*_{2E}a_{E2}$
.	.	.		.		.	.
.	.	.		.		.	.
.	.	.		.		.	.
i	$z^*_{i1}a_{Ei}$	$z^*_{i2}a_{Ei}$	. . .	$z^*_{ij}a_{Ei}$	. . .	$z^*_{in}a_{Ei}$	$z^*_{iE}a_{Ei}$
.	.	.		.		.	.
.	.	.		.		.	.
.	.	.		.		.	.
n	$z^*_{n1}a_{En}$	$z^*_{n2}a_{En}$	. . .	$z^*_{nj}a_{En}$	. . .	$z^*_{nn}a_{En}$	$z^*_{nE}a_{En}$
E	$z^*_{E1}a_{EE}$	$z^*_{E2}a_{EE}$	. . .	$z^*_{Ej}a_{EE}$	. . .	$z^*_{En}a_{EE}$	$z^*_{EE}a_{EE}$

$$\text{i.e. } EDII_j = \sum_{i=1}^{n} z^*_{ij}a_{Ei} \qquad (15)$$

Thus, type 2 employment multipliers can be defined as:

$$\frac{EDII_j}{ED_j} = \frac{\sum_{i=1}^{n} z^*_{ij}a_{Ej}}{a_{Ej}} \text{ for sector } j \qquad (16)$$

2.4.4 Calculation of income multipliers in Dumfries & Galloway

This methodology was used to calculate the income and employment multipliers for the three regions. The calculations for Dumfries & Galloway are outlined below, and those for Grampian and Fife are contained in Appendix 3.

The first step in calculating the income multipliers was to identify the direct effect on household incomes of £1 change in output from the household row of the closed coefficient matrix above:

a_{H0}	a_{H1}	a_{H2}	a_{H3}	a_{H4}	a_{H5}	a_{H6}	a_{H7}	a_{H8}	a_{H9}
0.1570	0.1454	0.1563	0.1651	0.1709	0.2675	0.3125	0.3479	0.2276	0.7206

Table 2.6. Direct income effects in Dumfries & Galloway

Thus, for example, the direct income impact on the economy of a one unit increase in output from SIC 0 (agriculture, forestry & fishing) is 0.1570. So if output from agriculture increases by £1, this will generate an additional income of approximately 16p in the economy.

The first step in estimating the direct, indirect and induced effect is to calculate Z*, the Leontief inverse of the closed matrix:

	SIC 0	SIC 1	SIC 2	SIC 3	SIC 4	SIC 5	SIC 6	SIC 7	SIC 8	SIC 9	House
SIC 0	1.003	0.002	0.002	0.002	0.017	0.003	0.006	0.003	0.003	0.005	0.006
SIC 1	0.030	1.012	0.020	0.023	0.017	0.020	0.029	0.024	0.020	0.056	0.050
SIC 2	0.057	0.121	1.013	0.021	0.026	0.057	0.034	0.033	0.027	0.070	0.051
SIC 3	0.017	0.009	0.004	1.002	0.004	0.012	0.006	0.006	0.006	0.010	0.008
SIC 4	0.096	0.028	0.025	0.032	1.027	0.069	0.089	0.048	0.057	0.106	0.103
SIC 5	0.026	0.021	0.017	0.013	0.011	1.015	0.033	0.016	0.057	0.041	0.034
SIC 6	0.193	0.103	0.075	0.155	0.113	0.149	1.114	0.153	0.126	0.263	0.305
SIC 7	0.074	0.028	0.043	0.035	0.033	0.042	0.061	1.039	0.085	0.090	0.096
SIC 8	0.147	0.097	0.110	0.122	0.099	0.145	0.133	0.115	1.084	0.237	0.272
SIC 9	0.134	0.036	0.031	0.035	0.040	0.053	0.051	0.066	0.046	1.105	0.136
House	0.413	0.268	0.257	0.295	0.286	0.430	0.472	0.506	0.382	1.014	1.333

Table 2.7. Z* ($(I - A^*)^{-1}$) for Dumfries & Galloway

The direct, indirect and induced income effect is shown as the household row of this matrix, and the resultant type 2 income multipliers for Dumfries & Galloway are presented in Table 2.8. Thus, for example, a type 2 income multiplier for SIC 1 indicates that the overall income generated by an increase in 'energy and water' output is equal to 84% of the direct income generated. However, a high multiplier reflects strong linkages within the regional economy, but it does not mean that that industry accounts for a high proportion of the region's output. So that although 'distribution, hotels and catering' and

'other services' have the highest levels of output for Scotland as a whole, they do not have the highest estimated multipliers.

SIC 0	SIC 1	SIC 2	SIC 3	SIC 4	SIC 5	SIC 6	SIC 7	SIC 8	SIC 9
2.633	1.844	1.645	1.788	1.675	1.609	1.510	1.454	1.679	1.408

Table 2.8. Type 2 income multipliers for Dumfries & Galloway

2.4.5 Calculation of employment multipliers in Dumfries & Galloway

The direct employment impact of a change in output within sector *j* was obtained from the employment coefficient for that industry, which was derived by dividing the sector's output by the employment within that sector (Table 2.9).

SIC 0	SIC 1	SIC 2	SIC 3	SIC 4	SIC 5	SIC 6	SIC 7	SIC 8	SIC 9
2.101	0.158	0.046	0.090	0.157	0.207	0.246	0.153	0.096	0.413

Table 2.9. Direct employment effects in Dumfries & Galloway

Multiplying each element of the Z* matrix by the relevant employment coefficient (Table 2.10), and summing the columns gives the direct, indirect and induced effect, presented in Table 2.11 (to 3 sig. fig.).

	SIC 0	SIC 1	SIC 2	SIC 3	SIC 4	SIC 5	SIC 6	SIC 7	SIC 8	SIC 9
SIC 0	2.108	0.003	0.003	0.004	0.035	0.007	0.013	0.006	0.006	0.011
SIC 1	0.005	0.160	0.003	0.004	0.003	0.003	0.005	0.004	0.003	0.009
SIC 2	0.003	0.006	0.046	0.001	0.001	0.003	0.002	0.002	0.001	0.003
SIC 3	0.002	0.001	0.000	0.090	0.000	0.001	0.001	0.001	0.001	0.001
SIC 4	0.015	0.004	0.004	0.005	0.161	0.011	0.014	0.007	0.009	0.017
SIC 5	0.005	0.004	0.003	0.003	0.002	0.210	0.007	0.003	0.012	0.008
SIC 6	0.048	0.025	0.019	0.038	0.028	0.037	0.275	0.038	0.031	0.065
SIC 7	0.011	0.004	0.007	0.005	0.005	0.006	0.009	0.159	0.013	0.014
SIC 8	0.014	0.009	0.011	0.012	0.009	0.014	0.013	0.011	0.104	0.023
SIC 9	0.056	0.015	0.013	0.015	0.016	0.022	0.021	0.027	0.019	0.457

Table 2.10. Adjusted Z* for Dumfries & Galloway

SIC 0	SIC 1	SIC 2	SIC 3	SIC 4	SIC 5	SIC 6	SIC 7	SIC 8	SIC 9
2.266	0.232	0.109	0.177	0.261	0.314	0.358	0.258	0.198	0.607

Table 2.11. Direct, indirect and induced employment effects in Dumfries & Galloway

The resultant type 2 employment multipliers for Dumfries & Galloway are presented in Table 2.12. Thus, for example, a type 2 employment multiplier of 1.518 for SIC 5 (construction) shows that each job created in that industry will create a further 0.518 jobs. Again, the size of the multiplier does not reflect the importance of the industry within the economy's employment structure.

SIC 0	SIC 1	SIC 2	SIC 3	SIC 4	SIC 5	SIC 6	SIC 7	SIC 8	SIC 9
1.078	1.469	2.385	1.961	1.666	1.518	1.452	1.682	2.070	1.469

Table 2.12. Type 2 employment multipliers for Dumfries & Galloway

2.4.6 Income and employment multipliers for Grampian and Fife

Following this methodology, the type 2 income and employment multipliers for Grampian and Fife regions were calculated (Appendix 3), and are presented in Table 2.13.

Grampian region type 2 multipliers

	SIC 0	SIC 1	SIC 2	SIC 3	SIC 4	SIC 5	SIC 6	SIC 7	SIC 8	SIC 9
Income	2.717	1.507	1.761	1.824	1.978	1.724	1.555	1.486	1.720	1.443
Employment	1.081	1.290	2.573	1.974	1.816	1.587	1.458	1.706	2.099	1.493

Fife region type 2 multipliers

	SIC 0	SIC 1	SIC 2	SIC 3	SIC 4	SIC 5	SIC 6	SIC 7	SIC 8	SIC 9
Income	2.694	1.833	1.690	1.595	1.879	1.700	1.556	1.498	1.707	1.429
Employment	1.078	1.449	2.420	1.695	1.639	1.555	1.447	1.709	2.063	1.469

Table 2.13. Type 2 income and employment multipliers for Grampian and Fife

2.5 Enterprise multipliers

Having calculated the regional type 2 multipliers for the SICs, these were then used to estimate multipliers for on-farm enterprises. The first step was to measure the capital, fixed and variable costs of setting up and running an 'average' size business in the first year for the chosen enterprises. The methodology was easily adapted to measure the income and employment effects for subsequent years of trading. The fixed costs included rates, insurance, telephones, repairs, electricity, advertising etc., and the variable costs depended on the enterprise in question. The details of the estimated expenditures for each enterprise are contained in Appendix 4, but the example of establishing a caravan site in Dumfries and Galloway is presented below.

2.5.1 Multipliers for a caravan site in Dumfries & Galloway

The calculations were based on the 1999 costs of establishing a 50-pitch site for touring caravans on a farm in Dumfries & Galloway (Table 2.14), where the costs were provided by the Scottish Agricultural College (SAC) Farm Diversification Database. The size of site was based on the average size of enterprise reported by farm households who ran touring caravan sites in the Pluriactivity in Scottish Farm Household survey. This implies that the site is officially categorised as type 3, which is licensed by the local authority health department and requires local authority planning permission. This type of site can hold up to 75 units per hectare, and requires a good access road and a toilet block. The SAC diversification database contains estimates of construction costs and running costs. So, for example, the cost of the access road is placed at £2,400, which would be paid to a construction firm and is therefore allocated to SIC 5 (construction), as is the cost of the toilet block/office facilities. The costs of electricity and water are allocated to SIC 1, and any

financial costs to SIC 8. Rates (payable on a type 3 site) are assigned to SIC 9, and the remainder to manufacturing sectors (SIC 4).

Caravan Site	SIC 0	SIC 1	SIC 2-4	SIC 5	SIC 6	SIC 7	SIC 8	SIC 9
Capital costs:								
Access road				2,835				
Toilet/office/ shop				16,540				
Electricity		1,890						
Sewage/ drainage		21,260						
Fixed costs								
Interest							9,834	
Maintenance			590					
Rates								2,362
Variable costs:								
Admin.							460	
Electricity		614						
Sundries			307					
Total	0	£23,764	£897	£19,375	0	0	£10,377	£2,362

Table 2.14. Estimated expenditures for a caravan site

The model can be easily tailored to exact specifications to cater for a specific development, and the estimated expenditures for B&B, farm shop, clay pigeon shooting and livery stables are contained in Appendix 4.

From this the proportion of capital, fixed and variable costs were apportioned to each SIC, by looking at which industrial sector the expenditures were made in. This was then used to weight the regional multipliers to produce enterprise multipliers, which in turn were used to calculate the overall income and employment effects of setting up an enterprise on the regional economy. For

example, the proportional impact on each SIC of a caravan site in Dumfries and Galloway is outlined in Table 2.15, along with the proportions of expenditure going to each SIC for the other enterprises, and the enterprise multipliers were given by the equation:

caravan site income multiplier (D&G) = (0.382 * 1.844)+(0.102 * 1.703)+ (0.311 * 1.609)+ (0.167 * 1.679)+(0.038 * 1.408)

= **1.712** (17)

caravan site employment multiplier (D&G) = (0.382 * 1.469)+(0.102 * 2.004)+ (0.311 * 1.518)+ (0.167 * 2.070)+(0.038 * 1.469)

= **1.639** (18)

	Caravan Site	B&B	Farm Shop	Clay Pigeon	Livery Stable
SIC 0	0.0000	0.0000	0.3560	0.0000	0.0487
SIC 1	0.3818	0.0000	0.0567	0.0291	0.0109
SIC 2-4	0.1022	0.2811	0.2450	0.3667	0.0148
SIC 5	0.3113	0.3685	0.1207	0.5375	0.9049
SIC 6	0.0000	0.3504	0.0000	0.0000	0.0000
SIC 7	0.0000	0.0000	0.0156	0.0000	0.0000
SIC 8	0.1667	0.0000	0.1271	0.0521	0.0162
SIC 9	0.0380	0.0000	0.0788	0.0146	0.0044

Table 2.15. Proportion of expenditure of enterprises allocated to the SIC's

Following this methodology, the type 2 income and employment multipliers for each of the enterprises are given in Table 2.16.

	Dumfries & Galloway	Grampian	Fife
Income multipliers:			
caravan site	1.712	1.646	1.747
B&B	1.599	1.708	1.663
farm shop	1.999	2.076	2.050
clay pigeon shoot.	1.649	1.770	1.718
livery stables	1.663	1.771	1.749
Employment multipliers:			
caravan site	1.633	1.604	1.627
B&B	1.613	1.675	1.603
farm shop	1.531	1.566	1.515
clay pigeon shoot.	1.699	1.778	1.690
livery stables	1.511	1.574	1.543

Table 2.16. Enterprise multipliers

It can be seen that farm shops have the highest income multipliers, which is as expected since one of the highest costs is the produce for sale, which will be sourced locally, therefore incurring very few leakages from the regional economy. Clay pigeon shooting has the highest employment multiplier, indicating a slightly higher rate of employment. The multipliers for the different regions are similar, signifying that the size of the impact of establishing an enterprise will not vary much.

2.6 Conclusions

This chapter has discussed the first part of the model developed within this study i.e. the creation of enterprise income and employment multipliers for the chosen on-farm enterprises. Chapter 3 goes on to explain the method chosen to spatially distribute these impacts.

CHAPTER 3

Chapter 3 Methodological Considerations: Use of gravity models

3.1 Introduction

Although it is relatively simple to estimate the level of income derived from an on-farm enterprise, it is useful to estimate the impact this enterprise will have on the regional economy. Some rural areas are more fragile than others, depending to a greater or lesser extent on their dependency on agricultural incomes, particularly when farm incomes are falling. Inclusion of this spatial aspect of the model requires the use of spatial analysis. "Spatial interaction models are used to predict spatial choices reflected in flows of goods or people between origins and destinations, expressing trade-offs between the accessibility of alternative destination opportunities on the perceived intrinsic attractiveness of these opportunities" (Robinson, 1998).

The distance between an origin and a destination does not have a fixed effect on spatial interaction. The effect of distance depends on the type of activity and the customers. For example, in this instance, people setting up an on-farm enterprise require inputs. They may be willing to go to the nearest source, or travel further for a particular item. Therefore, distance must be combined with some notion of attractiveness. The combined effects of distance and attractiveness can be structured using a 'gravity model.' These use distance decay functions to compute interactions given the relative attractiveness of different destinations. The basic data requirements of a gravity model are a set of origins and destinations, which can be provided by a GIS as point entities, and a set of attributes related to individual locations.

"Gravity models have been used to explain various types of behaviour that occur between different entities or locations. The term 'gravity model' and its basic formulation are derived from Newtonian physics" (Desorbo *et al*, 2002), and look at how you combine basic forces of gravity with other forces, using parallels from physics and chemistry (Isard, 1960).

Isard (1960) describes the set of conditions that best describe a region when considering the use of gravity models. These include:

- absence of concentration of mass at the peripheries;
- existence within each region of a nodal centre of gravity of mass;
- coincidence of the centre of gravity of mass wit the centre of gravity of the physical area;
- regular geometric shapes for the physical area of each region;
- approximately equal areas of adjacent regions when density of mass is relatively uniform; and
- area of region varying in inverse proportion with density of mass.

According to Longley *et al* (2000) "methods of spatial analysis can be very sophisticated, but can also be very simple and intuitive.....Spatial analysis is in many ways the crux of GIS because it includes all of the transformations, manipulations and methods that can be applied to geographic data to add value to them, to support decisions and to reveal patterns and anomalies that are not immediately obvious – in other words, spatial analysis is the process by which we turn raw data into useful information".

The incorporation of a gravity model within this study is for descriptive and projective purposes, so that the model developed to describe the regional economic impact of farm household pluriactivity has a spatial dimension. This chapter reviews the use of gravity models and describes the form used in the model.

3.2 Gravity models - background

Basically, gravity models have been in existence since the days of Newtonian Physics (Robinson, 1988), when Sir Isaac Newton formulated the law of gravitation in 1687:

$$F = G(M_1 M_2)/R^2 \quad (1)$$

where:

F = magnitude of attractive force

G = gravitational constant

M_1M_2 = mass of two bodies

R = distance between them

The law explains the expected interaction between any two points, which will be positively related to their attractive characteristics (in this case mass) and negatively related to the distance between them..

3.2.1 Development of the Gravity Model

The gravity model has been used in a variety of contexts since that time. As early as 1858, Carey used it to estimate the number of trips commuters made when dealing with transportation problems. Ravenstein (1885) also applied the Newtonian model to migration, as did Lill (1891) who considered railway travel.

Use of the gravity hypothesis has also been extended outside physical science, where "since the early 40's, efforts to model the spatial interaction behaviour of human populations have been largely dominated by gravity models. The appeal of these models can be attributed both to the simplicity of their mathematical form and the intuitive nature of their underlying assumptions" (Sen & Smith, 1995). Stewart (1948) was one of the first to do this, applying it to demographic movements. However, a significant variety of disciplines have used gravity models to predict spatial choices reflecting flows of people, goods or transactions between different points. These include transportation investment decision-making (Lowry, 1964; Garin, 1966; Putman, 1983), migration models (Rogers, 1980; Rees, 1980), urban population density (Wang & Guldmann, 1996), benefits

of health care (Rushton, 1984), retail planning (Cadwallader, 1981; Wilson, 1988; Beaumont, 1991) and trade models (Kalirajan, 1999; Polak, 1996).

Huff (1963) reformulated the law into a probabilistic framework, looking at the problem from the perspective of the consumer, which is relevant to this study. He "argued that the probability that a consumer at point *i* will travel to retail centre *j* (P_{ij}) is a ratio of the utility of that centre to the consumer and the total utility of all retail centres considered by the consumer" (Robinson, 1998). Further, the "utility of a retail centre can take a gravitational form in which it increases with the size of the centre but decreases as the distance between the centre and the consumer increases" (*ibid.*):

$$P_{ij} = \frac{S_j / d_{ij}^{\beta}}{\sum_{j=1}^{k} \left(S_j / d_{ij}^{\beta} \right)} \qquad (2)$$

where:

P_{ij} = probability that a consumer will travel from point *i* to retail centre *j*

S_j = retail floor space in retail centre *j*

d_{ij} = distance from consumer *i* to retail centre *j*

β = an exponent

3.2.2 Specification of the gravity model

As stated above, a probabilistic gravity model is used in this study, because it best reflects the particular problem being examined. However other modifications and restrictions of the model were considered. Firstly, deterministic models can be effective in describing fairly predictable flow patterns of commuter traffic, but they do not reflect the complex decision process exhibited by human behaviour (Sen & Smith, 1995), which probabilistic models are capable of. Secondly, it is possible to carry out a log transformation of the equation (Ewing, 1974; Cadwallader, 1981; Robinson, 1998), which would produce a system of equations

which can be solved using linear regression. However, this is not necessary in this instance, as the model uses matrix algebra to reach a solution. Thirdly, it was assumed that a simple gravity model produces results compatible with the more complicated choice theories of spatial interaction (Howrey, 1969; Wilson, 1988). These theories introduce axioms of independence, separability and accessibility (Smith, 1975; Sen & Smith, 1995), but methods of testing these theories " are very objectionable in terms of data requirements" (Smith, 1975), where "the practical requirements for conducting meaningful direct tests of the choice theory may well be prohibitive" (*ibid.*). They are only soluble if the number of variables is relatively small, and results can be extremely sensitive to model specification, whereas gravity models are relatively soluble (Ewing, 1974). Hence, given data availability and applicability, the gravity model was chosen in this research..

3.3 Gravity model

Having calculated the overall size of the income and employment effects of establishing the selected farm-based tourism enterprises, the spatial distribution of the effects were projected by means of a Gravity Model, given by the equation:

$$P_i = \frac{\alpha_i / \left(d_i^j\right)^\beta}{\sum_{i=1}^{j} \left(\alpha_i / \left(d_i^j\right)^\beta\right)} \qquad (19)$$

where P_i = Probability of a change in expenditure being attracted to parish *i*.

α_i = Attraction Index, where the ability of a parish to attract any expenditure change is measured using weighted employment structures.

d_i^j = Straight line distances between parishes *i* and *j*.

β = an exponent.

The principle behind this model is that the likelihood of economic transactions between two places is a function of both their proximity and their difference in economic size (or attraction index); the closer together the two communities are and the greater the size difference in economic terms, the greater the flow of goods and services.

The unit of spatial analysis was the parish, as that was the smallest unit for which relevant employment data were available. The measure of economic size (or attraction) was derived by weighting the employment structure of each parish by the industrial input requirements of the different enterprises. Thus, a model was produced for each of the 5 enterprises in each region. The distances used were straight line distances between parish centroids and the choice of 2 for the exponent is explained below (3.3.1).

3.3.1 Distance decay function

Distance decay functions model behaviour in response to distance, which is directly relevant to the gravity model as it is assumed that the ability of a parish to attract expenditure generated from an enterprise is inversely related to the distance of the parish centroid from that enterprise. Figure 3.1 illustrates the impact distance has when the exponent, b, is 0.5, 1 or 2; a larger value of b implies that the probability of attraction decreases more rapidly as distance increases (Robinson, 1998).

The choice of exponent for this study was based on an examination of farm invoices in Dumfries & Galloway. The invoices of 20 farms in Dumfries & Galloway were investigated in detail to get a picture of farm business expenditure patterns. Farm business expenditure was allocated both according to SIC and whether it occurred at local (~ 15km), regional, Scottish or national levels (Mitchell & Doyle, 1993).

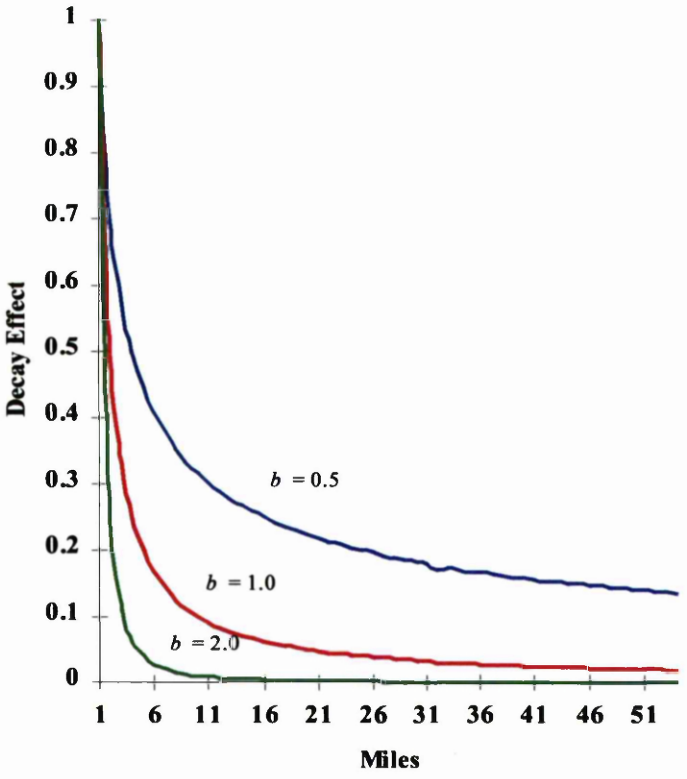


Figure 3.1. Distance decay functions

The farms selected for this exercise were chosen from those participating in the Farm Accounts Scheme, which collects detailed financial information on farm businesses on behalf of the Scottish Executive Rural Affairs Department (SERAD). The sample was stratified according to the types and numbers of participating farms in each of the four districts of Dumfries and Galloway (Table 3.1), and included total business spending over a period of twelve months. Spending was allocated according to SIC, and each invoice address was recorded.

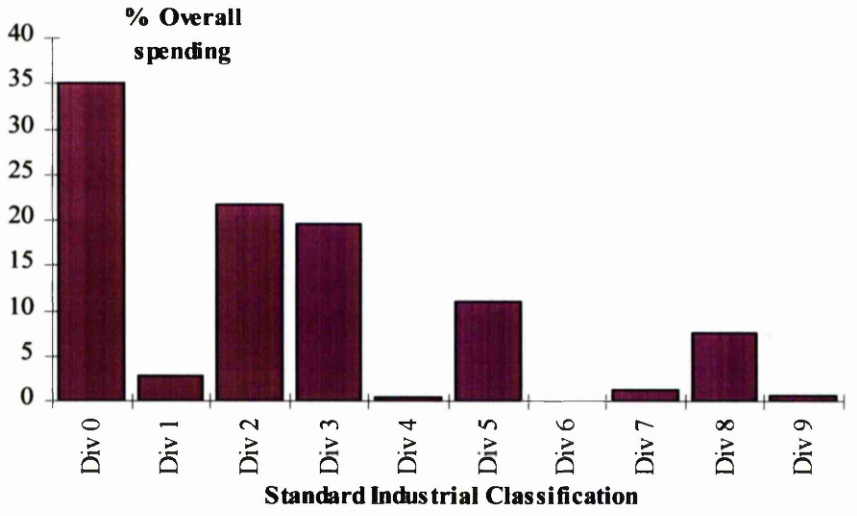
District:	*Farm Type:* LFA	Lowground cattle & sheep	Dairy	Total
Wigtown	3	0	3	6
Stewartry	2	0	1	3
Nithsdale	2	1	2	5
Annandale & Eskdale	3	2	1	6
TOTAL	10	3	7	20

source: Mitchell & Doyle, 1993

Table 3.1. Sample of farms in Dumfries & Galloway

A simple assumption was made that the expenditure 'resides' at the point of payment of the invoices, since this is likely to reflect the distance travelled by the farmer to purchase different inputs. Therefore, for national companies, an invoice generated at a local depot was taken as the point of expenditure on the basis that it employed sales, delivery, advisory and administration staff, so having some impact on the local economy. Figures 3.2 and 3.3 show the results of the analysis.

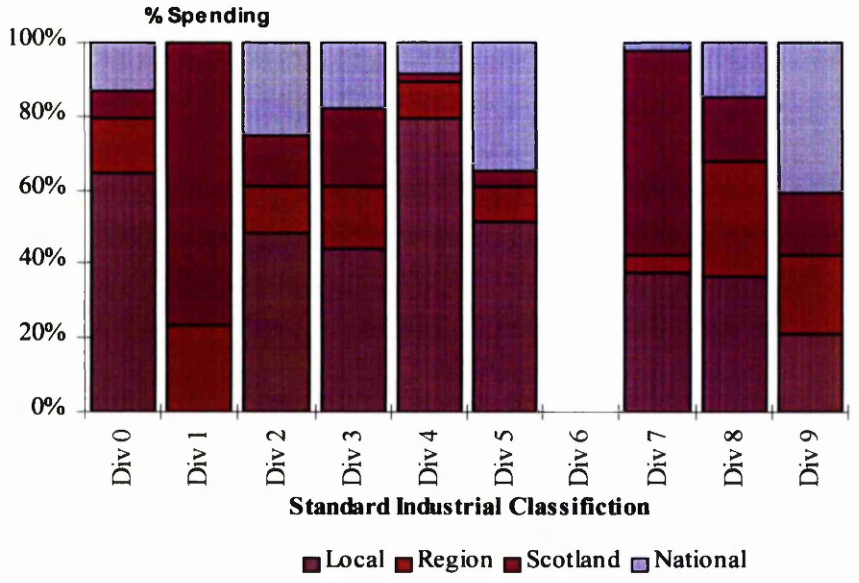
From Figure 3.2 it can be seen that the majority of farm business spending was carried out within the agriculture sector (35.06%), consisting mainly of feedstuffs, followed by SIC division 2 (21.74%), which included chemicals. Other manufacturing goods (SIC 3) came next (19.59%).



source: Mitchell & Doyle, 1993

Figure 3.2. Distribution of farm spending in Dumfries & Galloway across single digit SICs

The distance travelled to purchase products was examined to test whether the distance factor within the gravity model had been properly specified. Figure 3.3 shows whether spending within each SIC occurred i) locally (~15km), ii) regionally, iii) within the wider Scottish economy or iv) the British national economy. It can be seen that the share of local spending was largest (79.0%) within the transport and communication industry (SIC 7), but this industry accounted for only 7.52% of total spending. More significant was the fact that that local spending accounted for 64.0% of the total on the agriculture industry, which in turn accounted for 35.06% of all spending. Of the invoices examined, none related to expenditure in the hotels and catering sector (Div 6).



source: Mitchell & Doyle, 1993

Figure 3.3. Distribution of farm spending in Dumfries & Galloway - local, regional, Scottish, national.

At a regional level, shares were high within the energy and water supply (23.29%) and other services (21.12%), but again these industries were small in terms of overall spending (2.79% and 0.66% respectively). However, 16.84% of spending within the metal goods, engineering and vehicles sector occurred at the regional level, which represented almost 20% of overall expenditure. At a Scottish level, the largest share of spending was also in the energy and water industry (76.70%), and just over 20% was again assigned to metal goods, engineering and vehicles sector.

Spending in the wider British economy was largest within other services (Div. 9), but again this represented a very small amount of overall spending (0.66%). Significant expenditure outside Scotland also happened in respect of the construction industry (Div. 5), where this element accounted for 34% of a total

overall spend, but this was still less than construction expenditure at a local level.

Overall, 51.05% of total farm business expenditure occurred at a local level, 15.39% within the wider regional economy, 14.63% within the Scottish economy and 18.95% in the rest of Britain. This supported the argument that the distance decay factor for the gravity model should be in the order of two, where the importance of distance to expenditure decisions initially falls off rapidly from a high value, then stabilises.

3.3.2 Model output

The completed model produced a set of maps which spatially distributed the income and employment impacts of establishing an enterprise in a particular parish. The results (discussed in Chapter 5) were displayed using SPANS 7.1 (Tydac 1998), a Geographical Information System (GIS). The use of GIS has extended beyond geography into social sciences and offers a method of improving decision making (Longley, 1993; Clark, 1993; Campbell, 1994). According to Fotheringham (1993), combining spatial analysis techniques (gravity model) with a GIS has three benefits:

- the results of spatial analysis routines will be available to a wider audience;

- it will allow greater interaction with the data, where displaying the results of analysis can reveal interesting patterns and processes; and

- it may provide some theoretical guidance on problems in relation to zone definition, boundary problems, spatial dependency, the sensitivity of the results to the scale of analysis and the identification of the appropriate distance decay function (Fotheringham, 1993).

However, there are limitations in using a Gravity Model. "Even when apparently acceptable estimates have been produced, the lack of an explicit goodness-of-fit measure, which is also generally acceptable, has meant that it is very difficult to be sure the model is the best available. In principle, there is no reason why a model could not be developed to describe every flow correctly. However, if this is merely a saturated spatial interaction model, in the sense that it represents every flow by a corresponding parameter, then it is of little descriptive or prescriptive value" (O'Brien, 1992).

In this instance, the region is treated as an island, whereas, in reality, "changes in spatial structure outside the area in which interaction are measured can affect interaction patterns within that area" (Fotheringham, 1993). The model is also sensitive to the chosen model specifications (Thorsen & Gitleson, 1998), but the chances of this problem were reduced through an examination of farm invoices.

3.4 Conclusions

Clearly, the results of these models will have some application for those interested in rural development policies. Thus, an index of rurality (Mitchell & Doyle, 1996) can be used to classify parishes, using employment structure, population characteristics, migration, housing conditions, land use and remoteness as the main variables. This enables identification of 'fragile' or 'vulnerable' areas, making it possible to assess whether these areas will profit from an enterprise established in a particular location, or whether the benefits simply leak away to towns or cities.

This work has been carried out previously by the author and reported in Mitchell and Doyle (1996), Mitchell (1996) and Doyle and Mitchell (1994), where the spatial distribution of the impact of agricultural policies were examined. In this instance, the method has been applied to a different problem and used to spatially distribute the economic impact of on-farm pluriactivity.

CHAPTER 4

Chapter 4: Application and Results

4.1 Introduction

This chapter provides comparisons between different types of enterprises when located in a single parish, and also considers the effect of locating an enterprise in a number of different locations. Each region is discussed separately, then some overall conclusions are drawn. The implication of the results for policy makers is discussed in Chapter 8.

4.2 Regional economic impact of on-farm enterprises

The complete model described in Chapters 2 and 3 produced a set of maps which spatially distributed the economic impacts of selected on-farm enterprises. A selection of maps are presented in this chapter. Firstly, the maps distribute the income impacts according to the legend displayed. Secondly, maps are included which show which parishes account for 75% if the total income and employment impacts, which can be used to clearly show the differences in distribution of the benefits depending on where the enterprise is located within the region, and thirdly, the impacts on a small region are presented.

4.2.1 Dumfries & Galloway

The results for Dumfries & Galloway compare the impact of different enterprises when located within a single parish. Kirkmabreck lies on the south coast of the region, on the road which links the main town of Dumfries with the region's major sea-port, Stranraer. This road is also one of the major tourist routes within the region but is by-passed by visitors travelling directly from England to Glasgow or Edinburgh. Figure 4.1 presents the income impacts of establishing a livery stable in the parish.

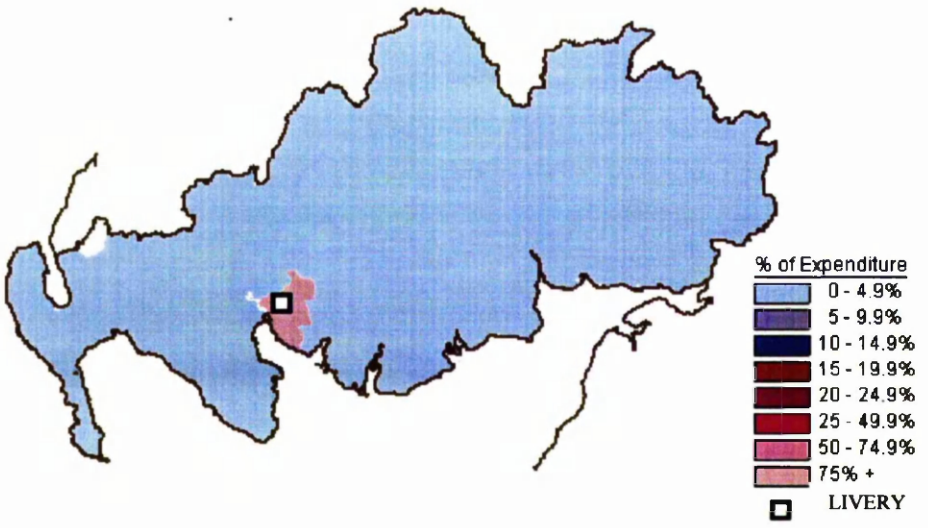


Figure 4.1. Income impacts of a livery stable placed in the parish of Kirkmabreck

It can be seen that most of the impacts, over 75%, remain within the parish of Kirkmabreck. The other parishes in the region gain very little, none of them attracting 5% of the benefits. This is probably due to the fact that the parish contains a large town, Newton Stewart, and farming areas which can supply feedstuffs, a major input to the enterprise. The remaining area includes four of the major towns in the region - Dumfries, Kirkcudbright, Castle Douglas and Annan.

Figures 4.2 displays the economic impacts of placing a caravan site within the same parish of Kirkmabreck.

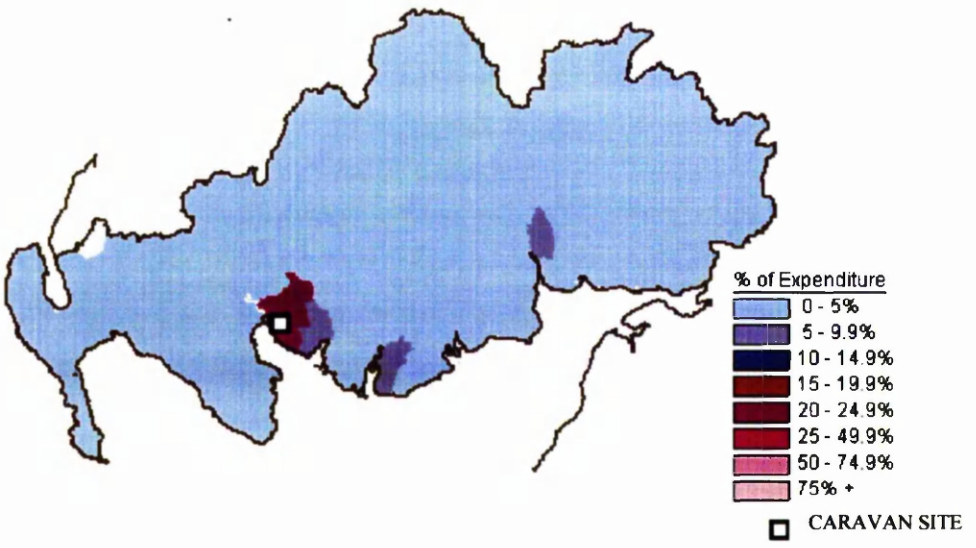


Figure 4.2. Income impacts of a caravan site placed in the parish of Kirkmabreck

Figures 4.2 shows that the impacts of a caravan site are less localised than a livery stable. The parishes benefiting from the enterprise include those which contain major towns in the region – Dumfries and Kirkcudbright. According to the theory of the gravity model, although they are a considerable distance away, they have a high attraction index and contain the industrial structure needed to supply the required inputs, so will attract some of the benefits.

Figures 4.3 describes the impact of establishing a B&B in the same parish, Kirkmabreck.

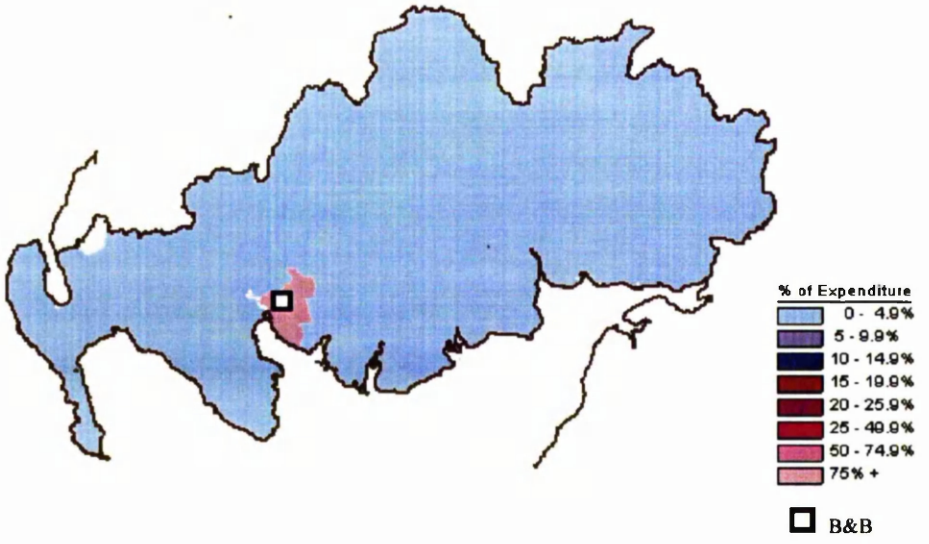


Figure 4.3 Income impacts of a B&B placed in the parish of Kirkmabreck

Figure 4.3 displays the same pattern of impact as the livery stable (Figure 4.1). A B&B generates a very small economic impact, and the parish of Kirkmabreck, which includes the town of Newton Stewart manages to keep most of it, with very small amounts leaking into neighbouring parishes. However, it should be noted, that although the impacts are local, they are small in comparison to establishing a livery stable. On the other hand, a single parish can support a number of B&B's, but there is a limit to the sustainability of livery stables.

The economic impacts of placing a farm shop within the parish is presented in Figure 4.4.

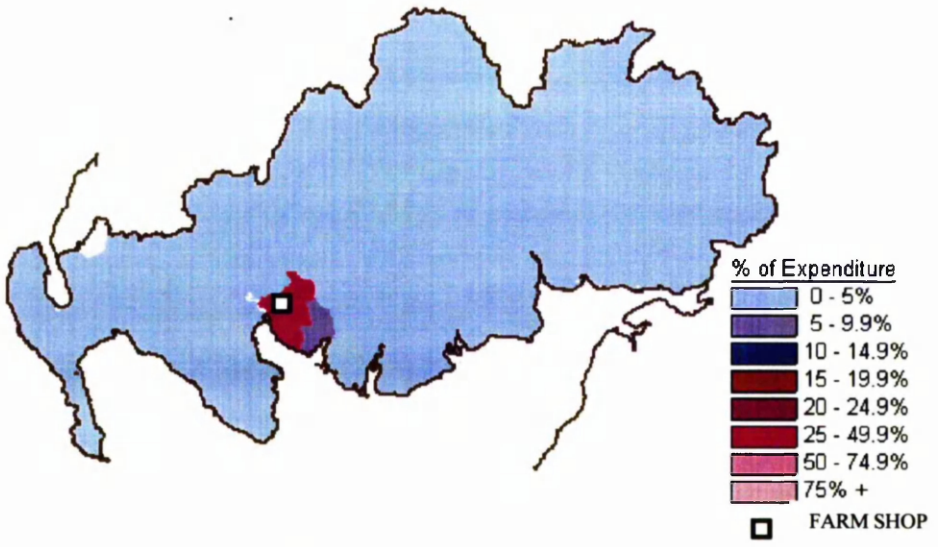


Figure 4.4. Income impacts of a farm shop placed in the parish of Kirkmabreck

Again, the impacts are very localised, with only the neighbouring parish having any measurable economic benefits (5 - 10%).

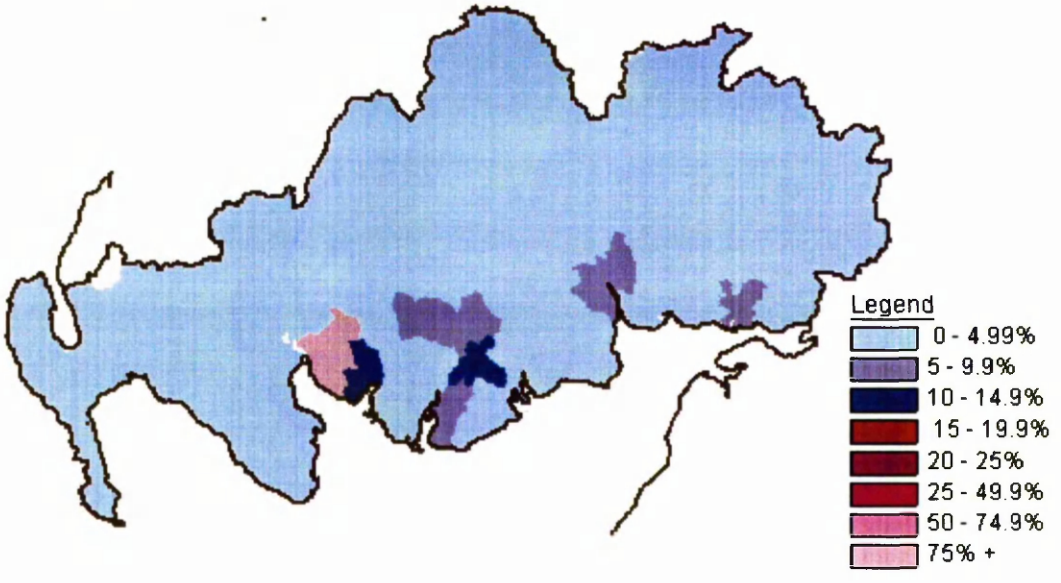


Figure 4.5. Income impacts of a clay pigeon shooting enterprise placed in the parish of Kirkmabreck

In this instance, the income impacts are more widely spread than for either of the other enterprises. This is to be expected because the amount of money involved is larger than for any of the other enterprises. By far the largest expenditures of establishing the enterprise were assigned to the manufacturing and construction industries, and it can be seen that some of the benefit leaks away to parishes containing some of the largest towns in the region.

4.2.2 Grampian Region

The results for Grampian region illustrate what happens if the same enterprise, a caravan site, is located in parishes exhibiting different geographic features, and clearly display the application of the gravity model. The dark coloured parishes are those which share 75% of the income impacts between them. For some areas, it can be seen that the impacts are very localised, whereas for others, they are widespread.

In the first example, Figure 4.6a, the site is located in the parish of Belhelvie, immediately north of the city of Aberdeen. It can be clearly seen that Belhelvie and Aberdeen are the main beneficiaries of the enterprises, with the immediately neighbouring parishes gaining most of the remaining income benefits.

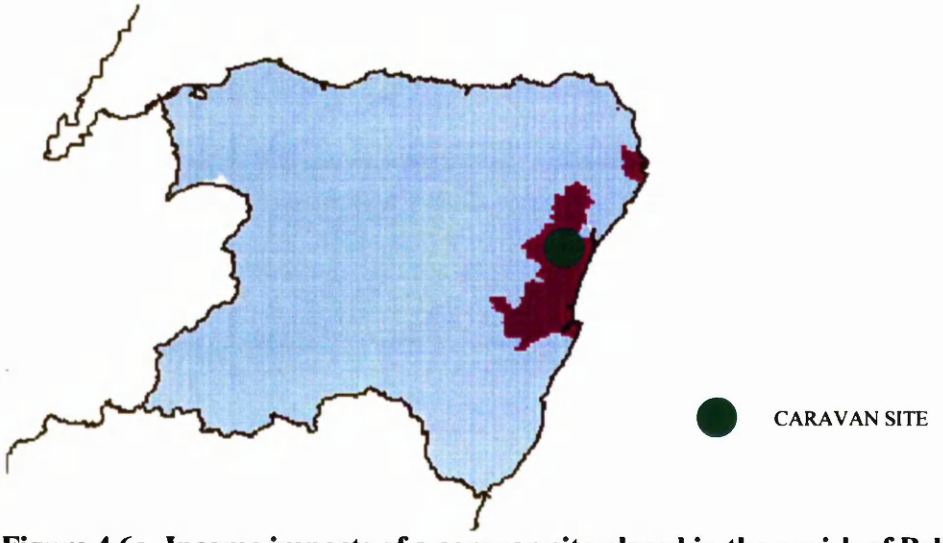


Figure 4.6a. Income impacts of a caravan site placed in the parish of Belhelvie

Moving the enterprise to Fraserburgh (Figure 4.6b), which contains a large town, also results in very localised impacts, although there is some leakage down the coast as far as Aberdeen, showing the strong attraction of a large centre of population, even though it is a large distance away.

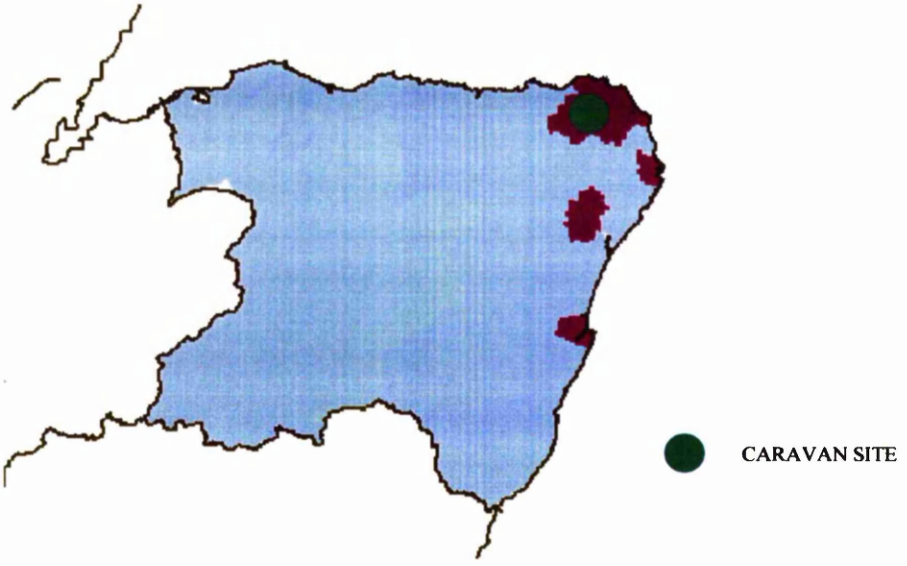


Figure 4.6b. Income impacts of a caravan site placed in the parish of Fraserburgh

In contrast, the impact of placing a caravan site in the parish of Dyke and Moy (Figure 4.6c) is very different. The parish is rural but is quite close to the town of Elgin. As a result, although the parish and the urban centres of Elgin and Aberdeen share the main benefits, there is a much wider spread of localised 'secondary' effects, reflecting the existence of a number of large villages and small towns in the area.

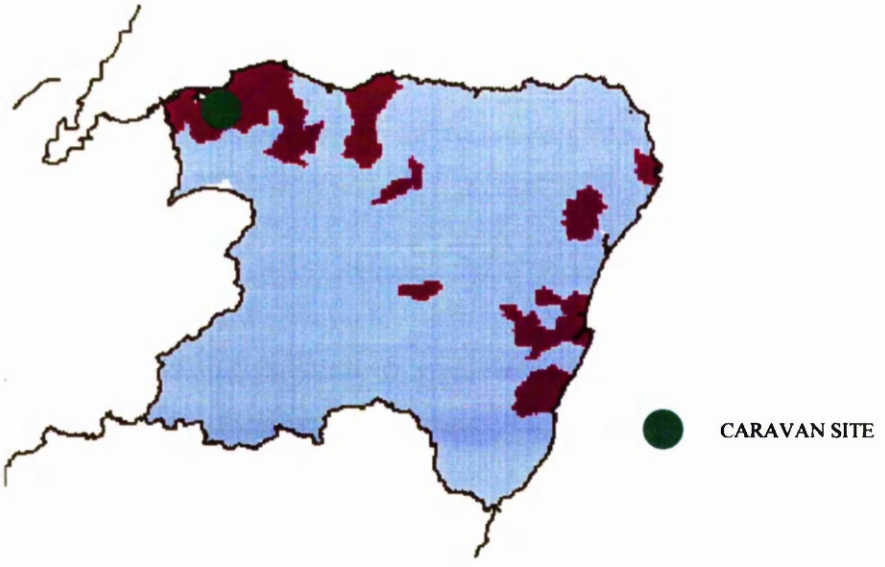


Figure 4.6c. Income impacts of a caravan site placed in the parish of Dyke and Moy

The dispersion of benefits becomes even more apparent if the caravan site is moved to more rural areas (Insch or Crathie and Braemar). Insch (Figure 4.6d) is in the heart of Grampian region, just off the main Aberdeen - Inverness road, and Crathie and Braemar (Figure 4.6e) is a very large parish in the extreme south-west of the region. In both of these instances, the income impacts are spread over a much larger number of parishes, especially when the caravan site is placed in Crathie and Braemar. This latter area is a remote rural area including the Grampian Mountains and part of the Cairngorms. There is no one centre in capable of attracting the major benefits of establishing the enterprise. So, although the rural areas gain the greatest share of the impact, the large spread means that they individually gain by a small amount compared to the major gainers in the more populated areas.

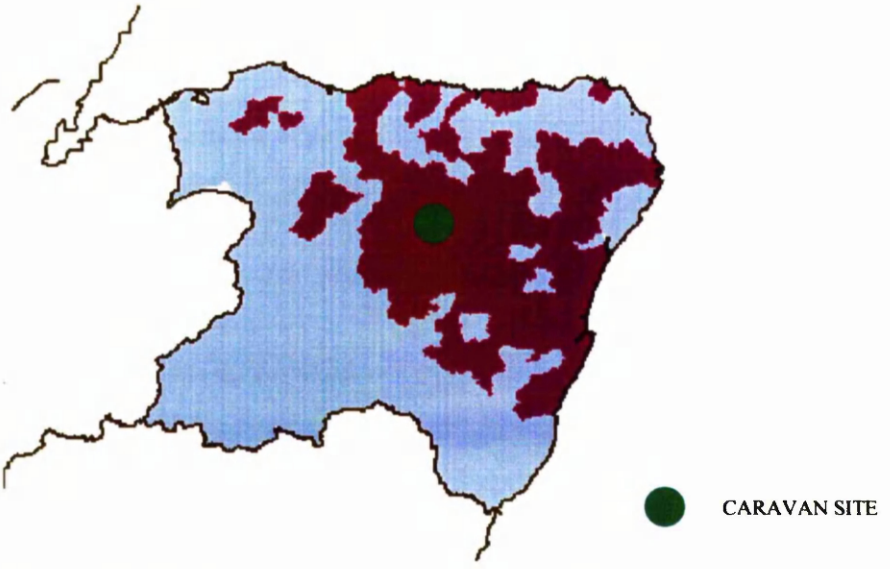


Figure 4.6d Income impacts of a caravan site placed in the parish of Insch

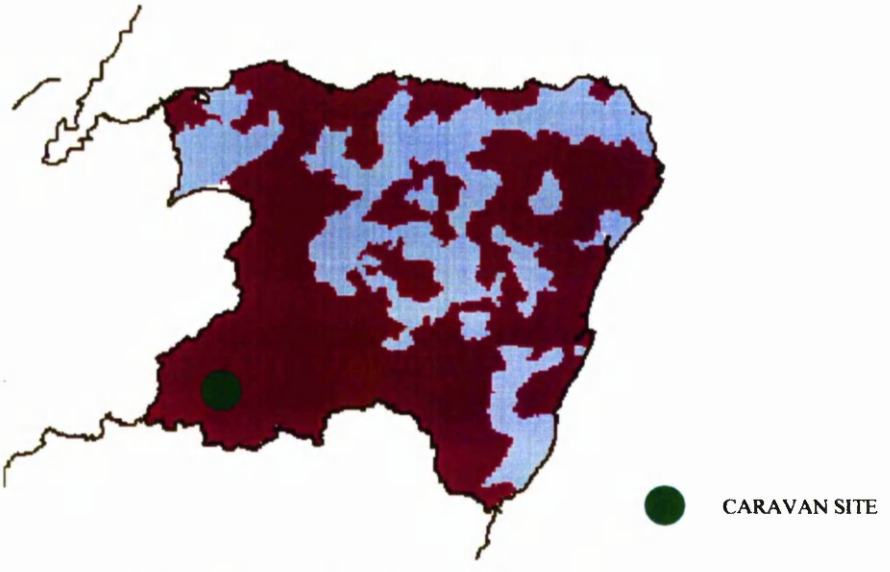


Figure 4.6e Income impacts of a caravan site placed in the parish of Crathie & Braemar

Therefore, the application of the model to Grampian region clearly illustrates that the spatial distribution of the economic impacts of farm diversification are complex and not easily predictable.

4.2.3 Fife Region

Having applied the model to a variety of enterprises in one parish and a single enterprise across a region, the figures for Fife present further illustrations of its application for a smaller region. Figures 4.7a and 4.7b show the respective income and employment impacts of setting up a livery stable in the parish of Auchtermuchty. Auchtermuchty is also a relatively rural area, but contains a large village. The fact that it does not immediately neighbour large centres of population means that it retains some of the benefits of establishing the enterprise, but a considerable amount still leaks away to the larger towns of Dunfermline and Glenrothes. The scale used to show the income and employment impacts is smaller than that used above (Figures 4.1 – 4.5), so it picks up relatively small impacts, including parishes which receive less than 1%.

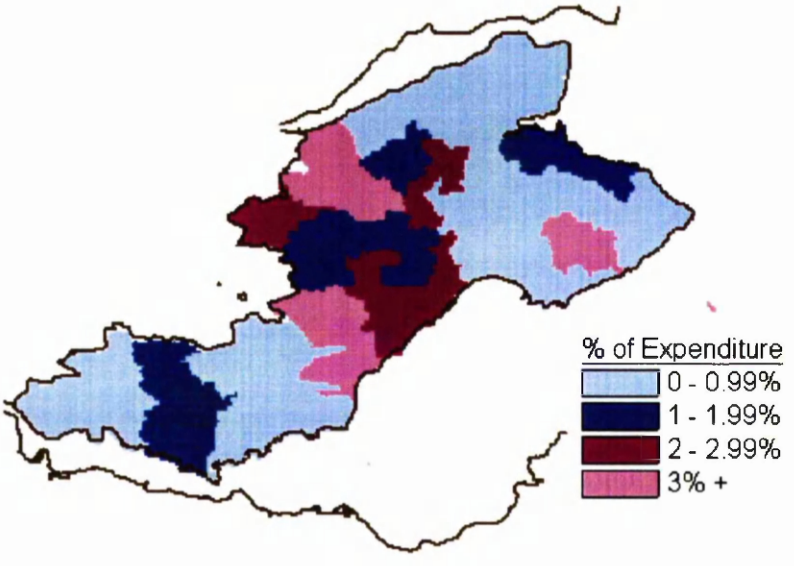


Figure 4.7a. Income impacts of a livery stable placed in the parish of Auchtermuchty

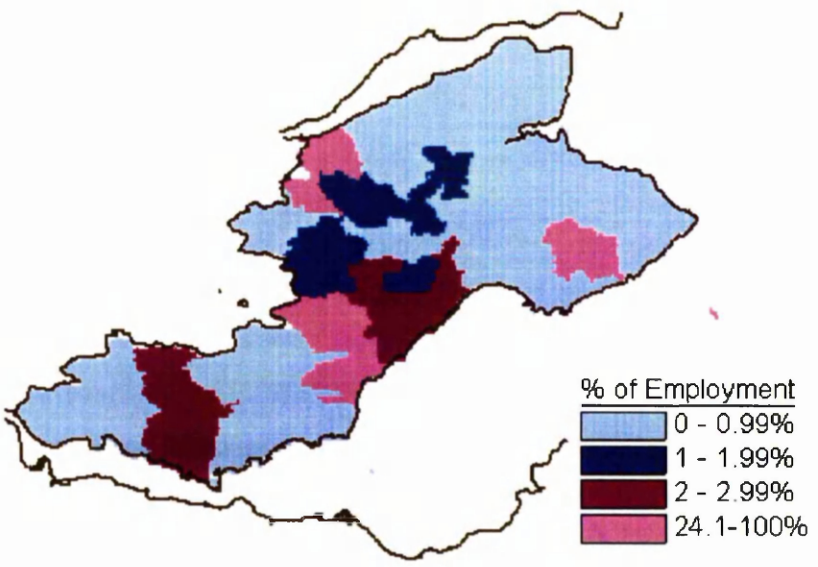


Figure 4.7b. Employment impacts of a livery stable placed in the parish of Auchtermuchty

However, the application of the model to Fife region illustrates one major problem of using a gravity model, which was discussed previously. Fife is a comparatively small region, sandwiched between the cities of Edinburgh and Dundee, which would be expected to have some impact on the economic activity within the region. However, because the model treats the region as if it were an island, this impact is ignored. Despite this, it does demonstrate that rural areas in smaller regions are less likely to gain the majority of the economic benefits of establishing an enterprise, where there are relatively large towns nearby.

4.3 Conclusion

The above figures illustrate the application of the model described in Chapters 2 and 3, showing the income and employment impacts of a farm household's decision to become pluriactive. It is important to note that these figures represent the spatial distribution of the impacts, and comparisons of the scale of impact cannot be made

unless they are viewed in conjunction with the information on the costs of the individual enterprises. Thus, Figure 4.3 (B&B) represents the distribution of a relatively small amount compared to Figure 4.5 (Clay pigeon shooting). However, understanding the spatial distribution of the economic benefits of on-farm enterprises is important from a policy perspective, which is discussed in Chapter 8.

Overall, the figures illustrate that simply locating an enterprise in a particular area does not mean that the local area will gain the greatest benefits. A significant amount will leak away if either the local area is deeply rural, or if the enterprise is cited close to a large town. However, the existence of a thriving town will have a positive knock-on effect on neighbouring parishes. As such, this model supplies a tool which will assist in examining the very complex issues of rural development and the maintenance of falling farm incomes.

CHAPTER 5

Chapter 5: Extension of Gravity model to explore impacts of RDP

5.1 Introduction

The gravity model was extended to produce a model which could be used to assess the regional economic impact of RDP grants. Instead of modelling the economic impact of a single enterprise, the extended model was capable of estimating the income and employment impacts of the RDP grants paid by SERAD within a region. These grants were paid to farm households within the Objective 5 areas (see Appendix 1) to encourage farm diversification. These areas were identified as requiring economic development, and the development of the model to incorporate multiple payments to regions produces a valuable tool for policy analysis.

Two of the regions within the study area, Dumfries & Galloway and Grampian, were eligible for RDP grants, and lists of these were provided by SERAD local project officers for the regions (personal communication). This section firstly develops the extended model, and secondly outlines its application to Dumfries & Galloway region. Chapter 6 explores the comparative income and employment impacts of farm diversification policies in Dumfries & Galloway and Grampian regions.

5.2 Extended Gravity Model

Let vector S represent the vector describing the distribution of grants across all the parishes in a region:

$$S = (s_1, s_2, s_3 \ldots\ldots, s_n) \tag{20}$$

where n denotes the number of parishes. For a particular parish (j), the extent to which grants (s_j) are retained depends on the ability of other parishes to attract it away. The proportion of grants paid to parish j (s_j) spilling over into parish k is assumed to be described by a Gravity Model, in which the likelihood

of economic transactions between them (*gravitational pull*) is greater the closer together the two centres are (*distance factor*) and the larger their difference in economic size (*attraction index*).

The distance factors (d_{jk}) for each pair of parishes were again computed from the straight line distances between the parish centres. Following the general practice (Cadwallader, 1981), the influence that one parish has on another was assumed to decrease sharply in proportion to the inverse of the square of the distance between two parishes. The distance factor for all parishes in the region could then be expressed as an n x n matrix (D):

$$D = \begin{bmatrix} d_{11} & d_{12} & .... & d_{1n} \\ d_{21} & d_{22} & .... & d_{2n} \\ .... & .... & .... & .... \\ d_{n1} & d_{n2} & .... & d_{nn} \end{bmatrix} \qquad (21)$$

where $d = 1/c^2$, and c denoted the straight line distance between parish centroids and n was the number of parishes in the region.

The most convenient way of measuring economic size was in terms of levels and patterns of employment, so that the attraction index (a_j) for parish j was equated with the employment patterns in the parish, weighted by the input requirements for the industrial sector receiving the support. Generalising the model to include all parishes, the attraction indices for each parish in the region were represented by an n x 1 vector (A):

$$A = E \times R \qquad (22)$$

where E was an n x m matrix showing the pattern of employment rates across the n parishes and m industrial sectors and R was an m x 1 vector of the input requirements of each of the different enterprises. Specifically, A was given by:

$$A = \begin{bmatrix} e_{11} & e_{12} & .... & e_{1m} \\ e_{21} & e_{22} & .... & e_{2m} \\ .... & .... & .... & .... \\ e_{n1} & e_{n2} & .... & e_{nm} \end{bmatrix} \begin{bmatrix} r_1 \\ r_2 \\ ... \\ r_m \end{bmatrix} = \begin{bmatrix} a_1 \\ a_2 \\ ... \\ a_n \end{bmatrix} \quad (23)$$

where a_j was the attraction index for parish j relative to all other parishes in the region, e_{ji} denoted the employment level in industry i in parish j and r_i represented the input requirement of the sector receiving support from sector i.

The overall gravitational pull of a parish was then a function of the distance factor and the attraction index. For all parishes in the region, the gravitational pull was expressed as an n x 1 vector (G), such that:

$$G = \begin{bmatrix} g_1 \\ g_2 \\ ... \\ g_n \end{bmatrix} = D \, x \, A \quad (24)$$

The probability of an RDP grant to a particular enterprise i being attracted to parish j (p_j) was then given by:

$$p_j = g_j / \sum_{h=1}^{h=n} g_h \quad (25)$$

The spatial distribution of RDP support across the parishes was then calculated as:

$$F = \begin{bmatrix} f_{11} & f_{12} & .... & f_{1n} \\ f_{21} & f_{22} & .... & f_{2n} \\ .... & .... & .... & .... \\ f_{n1} & f_{n2} & .... & f_{nn} \end{bmatrix} = \begin{bmatrix} p_1 \\ p_2 \\ ... \\ p_n \end{bmatrix} \begin{bmatrix} s_1 & s_2 & ... & s_n \end{bmatrix} \quad (26)$$

where F was an n x n matrix showing the support originating in parish j attracted to parish k for every combination of parishes. The overall RDP support finding its way to a particular parish (o_j) was then given by:

$$o_j = \sum_{h=1}^{h=n} f_{hj} \tag{27}$$

Using this model, the spatial distribution of the income and employment effects of the RDP was mapped using SPANS Geographical Information System (Tydac, 1999).

5.3 Application of the model to Dumfries & Galloway.

Between 1997 and 1999, there were 150 applications for RDP grants in Dumfries and Galloway, worth in terms of a total project value of just over £8 billion. Of this £6.4 billion was eligible for grants worth £2.7 billion. However, most of the grants were related to the farm business, principally the purchase of machinery. For the purpose of this study, only grants clearly applicable to on-farm non-agricultural enterprises have been included in the analysis, excluding on-farm processing and agricultural contracting enterprises. Thus, to 30 August 1999, 36 projects received grants worth £640,573.81, out of possible awards of £808,308.88; the difference is due to final claims still to be made. The SERAD agricultural parish number of the award, type of project, total project value and RDP grants are outlined in Table 5.1, while the same information for Grampian is contained in Appendix 6.

Parish	Project Description	Total Project Costs (£)	RDP Grant Awarded (£)	RDP grant claimed up to 30/08/99
299	Convert stables into holiday accommodation	£54,000.00	£25,000.00	£25,000.00
304	Erection of new buildings for retail area	£213,700.00	£25,000.00	£25,000.00
329	Upgrading to cottage (Sanquhar)	£7,785.00	£3,043.75	£3,043.75
491	Upgrade cottage into self catering unit	£12,960.00	£6,480.00	£4,677.00
492	Conversion of Old Stable to Artist's Studio	£10,800.00	£5,400.00	£5,208.00
493	Convert outbuilding into jewelry workshop	£9,650.00	£4,825.00	£3,370.54
494	Expansion of s/c holiday business	£35,000.00	£13,075.00	£12,851.92
494	Activity provision for caravan site (Gatehouse)	£50,431.00	£25,000.00	£24,367.25
495	Convert building into self catering units	£66,000.00	£25,000.00	£23,063.00
495	Expansion of visitor services/playground	£54,000.00	£25,000.00	£24,999.74
496	Convert listed bothy into self catering	£42,720.00	£20,860.00	£13,345.00
496	Self catering upgrade (Creetown)	£4,992.75	£2,296.38	£2,153.88
501	Alter building into an antique shop, tea room	£21,235.00	£10,617.50	£7,779.96
504	Bothy accommodation (Shawhead)	£38,456.00	£19,228.00	£7,372.00
508	Improve facilities/equipment for sailing centre	£45,841.10	£22,920.55	£16,432.17
512	Development of sites (22) for holiday lets	£58,223.00	£25,000.00	£13,588.82
513	Expand into computer consultancy/sales	£20,200.00	£10,350.00	£5,077.00
513	Creation of additional leisure/recreation	£222,650.00	£90,000.00	£89,161.73

Table 5.1. RDP grant for Dumfries & Galloway

Parish	Project Description	Total Project Costs (£)	RDP Grant Awarded (£)	RDP grant claimed up to 30/08/99
514	Upgrade holiday accomm for elderly/disabled	£35,814.00	£17,907.00	£17,791.00
515	Conversion for holiday accommodation	£58,646.00	£25,000.00	£501.70
515	Improvements to holiday let	£9,000.00	£4,500.00	£1,596.62
516	Construction of a nine hole par-3 golf course	£53,092.00	£25,000.00	£11,000.00
516	Equestrian centre (Twynholm)	£55,766.00	£25,000.00	£14,694.81
519	Holiday Accomm/outdoor activity provision	£54,100.00	£25,000.00	£20,209.61
853	Convert steading to a self catering cottage	£62,000.00	£25,000.00	£25,000.00
854	Expansion of self-catering business	£34,000.00	£14,500.00	£6,246.50
856	Convert buildings into self catering units	£68,000.00	£25,000.00	£25,000.00
856	7 self catering units plus conference facilities	£285,000.00	£120,000.00	£96,155.00
857	Renovate lodge houses for winter breaks	£23,029.60	£11,514.80	£6,525.18
859	Conversion of bothy into self catering accom	£43,576.00	£19,875.00	£19,085.00
860	Convert building into self catering accomm	£49,971.00	£24,985.50	£18,215.63
865	Construction of a shed to let	£120,852.00	£25,000.00	£18,750.00
866	Convert creamery into self catering flats	£78,200.00	£25,000.00	£25,000.00
867	Dog Grooming Business	£14,494.00	£6,902.00	£5,790.00
TOTAL		**£2,088,164.45**	**£808,308.88**	**£640,573.81**

Table 5.1. RDP grants for Dumfries & Galloway (cont.)

Over the years, SAC has built up a diversification database which contains information on each of the enterprises to be included in the model. This information was used to weight the regional income and employment multipliers to create enterprise multipliers for each of the enterprises receiving grants. So, for example, for self-catering accommodation, the multipliers for establishing and running the enterprise were:

self-catering income multiplier = (0.060 * 1.844)+(0.025 * 1.675)+
(0.783 * 1.609)+(0.018 * 1.454)+(0.089 * 1.679)+(0.029 * 1.408)
= **1.525**

self catering employment multiplier = (0.060 * 1.469)+(0.025 * 1.666)+
(0.783 * 1.518)+(0.018 * 1.682)+(0.089 * 2.070)+(0.029 * 1.469)
= **1.576**

These were used to calculate the overall distribution of grants across the parishes in Dumfries and Galloway, namely the vector S in the extended gravity model.

The attraction index for each parish was given by A, calculated by multiplying E, an 87 (no. of parishes) x 8 (parish employment) matrix, times R, an 8 x 1 vector of input requirements for the enterprises. Since several different types of enterprises were involved, the input requirements were weighted according to the size of grants received.

The distance between a parish and all others in the region was generated in SPANS, which can measure the straight line distance between parish centroids. SPANS uses the geographic boundary of a parish to generate a centroid, so some odd shaped parishes were assigned centroids outwith that boundary. In these cases the centroids were re-positioned manually. Figure 5.1 presents an

example of this, where the centroid was moved (from A generated by SPANS) to within the parish boundary (B).

A centroid generated B centroid placed within parish

Figure 5.1. Illustration of the requirement to move parish centroid

The distances were squared and inverted, giving D, an 87 x 87 matrix representing the distance function. In turn, the gravitational pull of a parish attracting spending from another parish was given by multiplying D by A, the 87 x 1 vector of attraction, resulting in an 87 x 1 vector, G. The overall probability of a single parish attracting some of the impact of the RDP is therefore given by one element of G divided by the summation of G. Multiplying G by S, the vector of the value of payments to each parish, produces F, the 87 x 87 matrix of the share of output change attracted to each parish. The row sums give the final total impact residing in each parish.

The models for Dumfries & Galloway and Grampian have been created in an Excel worksheet, which can easily be adapted to model different support systems. The results were then transferred to SPANS, where the parishes were classified according to the level of impact and are presented in the following chapter.

CHAPTER 6

Chapter 6: Income and employment impacts of RDP in Grampian and Dumfries & Galloway regions

6.1 Introduction

In Chapter 4, attention focused on plotting the effects of a single 'hypothetical' farm diversification activity. This chapter section looks specifically at the projected impacts of farm diversification policies on the economy and welfare of a region. As such, it considers multiple activities. To do this, the gravity model described in Chapter 3 was extended in Chapter 5 to evaluate the economic impact of a series of diversification grants being placed simultaneously in one region. Two of the study areas, Dumfries & Galloway and Grampian regions are eligible for RDP grants, and this chapter discusses the economic impact of grants received up to the end of August 1999. Firstly, maps display where the grants were paid, then the results of the gravity model were used to assess the final income and employment impacts in the two regions are presented.

6.2 Dumfries & Galloway RDP

As stated in Chapter 5, Dumfries & Galloway was awarded grants towards pluriactive enterprises totalling £808,308.88. A list of these was presented in Table 5.1, and Figure 6.1 shows which parishes received these. The largest amounts (over £100,000) were paid to two parishes, Borgue in the south and Penningham in the north. The largest payment to Borgue was to extend leisure and recreation facilities, and in Penningham, to establish self-catering and conference facilities. Two parishes, Girthon and Tongland were awarded grants worth £50,000 and several parishes fell into the lower categories, receiving less than £50,000. However, it can be seen that most of the recipients are on the west of the region, and the more remote rural areas in the north and west received very little.

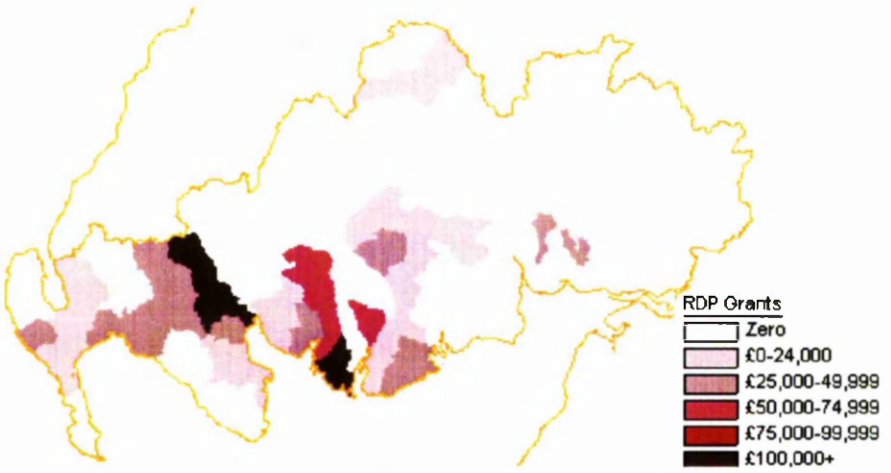


Figure 6.1. RDP grants awarded by parish in Dumfries & Galloway.

Figures 6.2a and 6.2b illustrate what happened to these payments. Rather than simply presenting the total income benefits in each parish, Figure 6.2a shows the income per head of population, which allows a more meaningful interpretation of the results. It can be seen that the benefits within each of the classifications were fairly well spread. The parishes which gained more than £20 per head of population were Whithorn, Kirkcudbright, Dunscore, Penpont, Wamphray and Tundergarth.

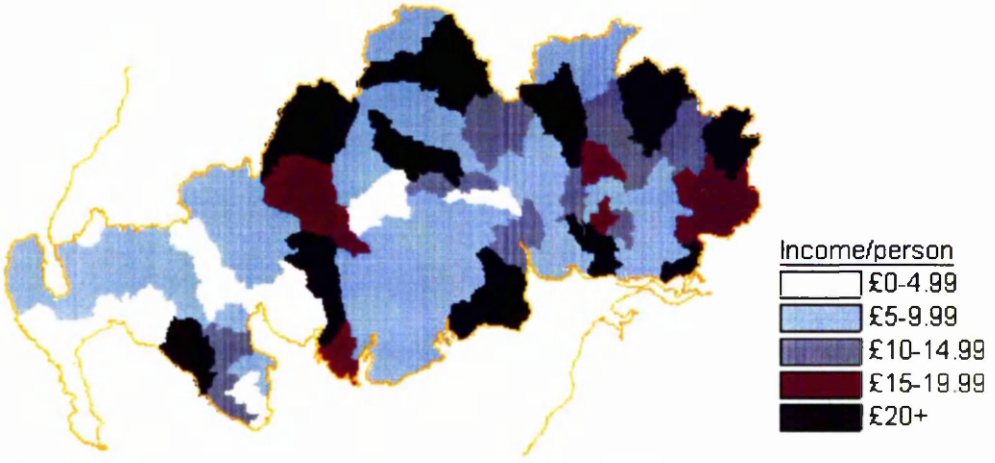


Figure 6.2a. Income impacts of RDP in Dumfries & Galloway region (£ per head of population)

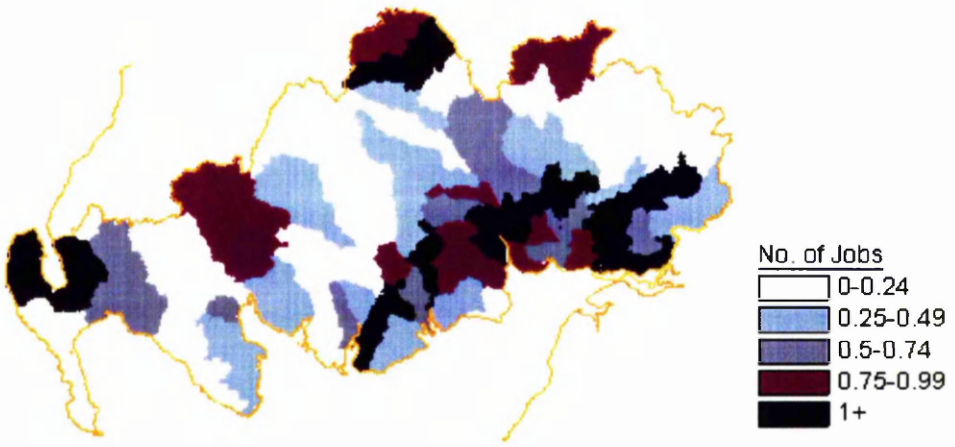


Figure 6.2b. Employment impacts of RDP in Dumfries & Galloway (number of jobs)

From figure 6.2b, it can be seen that the south-east area around Dumfries particularly benefits from any job creation due to the RDP grants. Although more areas benefited in terms of income generation, this was not translated into jobs.

6.3 Grampian RDP

Figure 6.3 shows the RDP grants paid in Grampian region, where the total payments amounted to £809,220. No parish received grants over £75,000, and four received grants in the £50,000 to £74,999 bracket - Strathdon, Tough, King Edward and Forglen. These included 5 grants for tourist accommodation, 6 for leisure & recreation and tourist facilities, 1 for kennels and 1 for rural services. Therefore, although the total awards were similar to Dumfries & Galloway, the distribution was wider.

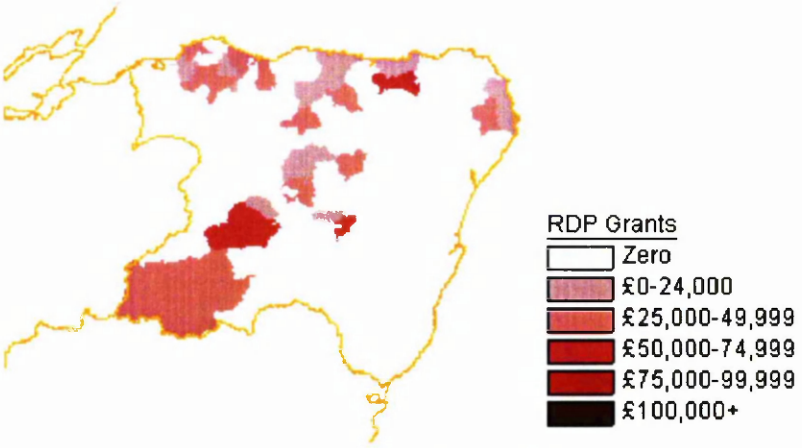


Figure 6.3. RDP grants awarded by parish in Grampian

When considering the income benefits to each parish per head of population (Figure 6.4a), it is interesting to note that these are distributed across the region, although the south-west gains very little. The two parishes which gained most contain the towns of Elgin and Inverurie, but Aberdeen city did not fall into any of the top four categories. This is probably because income per head of population was used as the measure, rather than the total amount going into an area. A number of rural areas receive £5 to £14.99 per head of population, which is a positive result for policy makers.

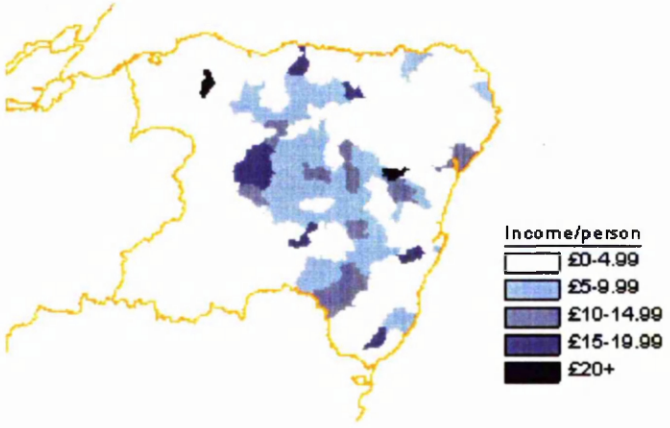


Figure 6.4a. Income impacts of RDP in Grampian region (£ per head of population)

Figure 6.4b illustrates where it is projected that jobs were created due to the RDP grants. The top classification shows areas which were predicted to gain one or more jobs, whilst the others gained less than 1. Here the impact was much more localised around Aberdeen and to a lesser extent, other coastal towns, where industrial concentration creates the necessary employment environment. Again, the south-west benefited very little.

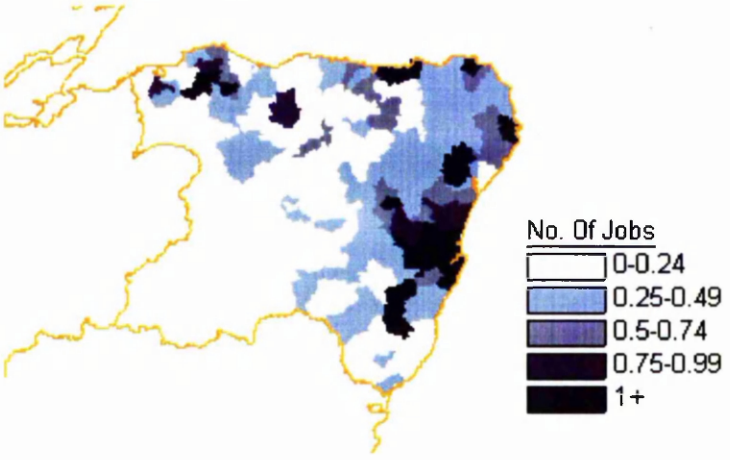


Figure 6.4b. Employment impacts of RDP in Grampian region (number of jobs)

6.4 Conclusion

The above figures demonstrate the use of the extended gravity model when applied to the RDP grants paid in Dumfries & Galloway and Grampian regions. The model was capable of spatially distributing the income and employment impacts of multiple payments across the regions, allowing policy makers the opportunity of assessing which areas benefit from these grants. In terms of income per head of population, rural areas appeared to do relatively well, but centres of population benefited from employment creation.

CHAPTER 7

Chapter 7: Developing a Framework for Identifying Areas of Potential for Pluriactivity

7.1 Introduction

This chapter outlines the methodology used to identify which areas in the three study regions have the potential for development in respect of the enterprises chosen. The methodology was developed for Dumfries & Galloway, and Fife was used to validate the model. The first step was to identify the location of existing enterprises in Dumfries & Galloway, then factor analysis was used to identify these factors which appeared to explain the existence of the enterprise. The methodology was then applied to caravan sites in Dumfries & Galloway.

7.2 Location of existing enterprises

If farm households are to be encouraged to diversify into non-agricultural enterprises it is essential for policy makers and those providing grants to be able to provide some kind of guidance as to the potential location of viable enterprises. As a first step, the location of existing enterprises - bed & breakfast, caravan site, farm shops, clay pigeon shooting and livery stables - in Dumfries & Galloway was identified, regardless of whether or not they were carried out on a farm. The data sources used to carry this out are outlined in Table 7.1.

However, there were too few clay pigeon enterprises identified to make any analysis possible, and many farm shops were not listed, relying on seasonal passing trade, so these were excluded from the analysis. Therefore the methodology was developed for three enterprises (caravan sites, B&B, and livery stables) and the six figure x-y co-ordinates of these in Dumfries & Galloway were fixed on regional maps using SPANS 7.1 (Tydac, 1999), a Geographical Information System (GIS).

Data Source	Type of Information
Your Big Sites Book	a) Club's own caravan sites; b) 1,500 certified sites authorised by the Club to take up to five caravans, with at least minimal facilities;
The Caravan Club	a) 200 Club sites; b) 3,000 small 5-van certificated locations
Caravan Sites	4,000 caravan parks, licensed by local authorities to hold six or more caravan units
Dumfries & Galloway Holiday Accom. Guide	bed & breakfasts in Dumfries & Galloway
Clay Pigeon Shooting Association	registered clay pigeon shooting enterprises
Yellow Pages	a) stables b) clay pigeon enterprises c) caravan sites d) farm shops

Table 7.1. Data sources for enterprises in Dumfries & Galloway and Fife

7.3 Identification of external variables.

Next, a list of potential characteristics, which could explain the existence of these enterprises was identified. The starting list of variables is listed in Table 7.2 and represented a variety of geographical, physical, economic and location characteristics identified at a parish level. These were the factors identified during the Pluriactivity in Scotland survey (Mitchell & Doyle, 1993) as being useful. This list was chosen because these data were readily available, and the methodology could therefore be easily translated to other areas. The parish was chosen as the unit of spatial analysis, not only because a variety of data were

available at this level, but also because, the parish was a small enough unit to give meaningful interpretation of results.

Factor	Description
MROAD	distance of the enterprise from the nearest main (class A or above) road, measured in SPANS as a straight line distance (km)
PAREMP	employment structure of the parish, using the attraction index for each enterprise developed for the gravity model
TOUROFF	number of tourist information office enquiries during 12 months at tourist information offices within 20 km radius of the enterprise (000's)
ATTNO	number of visitor attractions within 20 km radius of the enterprise
ATTATT	attendance numbers during 12 months at visitor attractions within a 20 km radius of the enterprise
NOTOWN	number of towns with a population over 1,000 within 20 km radius of the enterprise
TOWNPOP	total population of towns within 20 km radius
ITECLAS	Institute of Terrestrial Ecology (ITE) Land Classification (Table 3.3)
TOWN	distance from a town measured along a road from the enterprise to the central point of the nearest town (pop. Over 1,000) (km)
PARTYPE	dominant farm type in parish as designated by SERAD (Table 7.4)

Table 7.2. Initial factors used to identify existence of enterprise.

Table 7.3 outlines the main ITE Land Classifications (Bunce *et al*, 1981) covering Dumfries & Galloway and the geographic references of each enterprise were used to identify the class to be used in the factor analysis. Table 7.4 lists the farm types used by SERAD, and the predominant farm type of the parish in which the enterprise was located was used.

ITE Land Class	Description
7	cliffs with lowland behind
8	estuaries with arable behind
13	level, intensive arable
14	flat, arable, maybe coast
15	flat but higher than 14, not coast, intensive
16	intensive farm, arable/pasture mix, near towns
19	steeper slopes, higher altitude, forests
20	sheep, pasture
25	coast, pasture or hills, grazing, forestry
26	fertile lowland, intensive and farming
27	gentle slopes but intensive farming, pastures not arable
28	marginal, hills, sheep grazing

source: Bunce *et al*, 1981

Table 7.3. ITE Land Classification used in Dumfries & Galloway

Farm Type	Description
1	less favoured area (LFA) specialist sheep
2	LFA cattle and sheep
3	LFA specialist beef
4	LFA arable
5	lowground cattle and sheep
6	general cropping
7	dairy
8	intensive
9	small, mixed farming

Table 7.4. SERAD farm types

7.4 Factor analysis

Factor Analysis (SPSS, 1997) was then used to identify a relatively small number of factors which could represent the relationships amongst this set of interrelated variables, which greatly simplified the description and understanding of complex relationships. Factor analysis is a statistical technique which can be used to identify a relatively small number of factors that explain a much larger set of variables. This can vastly simplify the interpretation of what can be a very complex set of relationships, and the results presented in this study will allow policy makers to broadly identify areas of potential development without carrying out detailed statistical analysis. It is important to note that factor analysis does not explain a causal relationship, merely the varying degrees of association between factors and the presence of a particular enterprise.

The first step in applying the factor analysis was to identify whether the starting set of variables was correct This was carried out by examining the results of a computed correlation matrix. Variables which were not related to other variables were discarded.

An example of the application of factor analysis was the identification of the areas of Dumfries & Galloway which exhibited potential for developing caravan sites. Surprisingly, during the initial stage of the analysis, the variables relating to the distance from a main road and parish employment patterns were not strongly correlated with any other variables, having a value of less than 0.3. Therefore, these were discarded from the analysis for caravan sites, and a correlation matrix of the remaining eight variables was formed.

The next step was to evaluate whether factor analysis was itself an appropriate method to use. There is a test within SPSS to carry this out, which tests the

hypothesis that the correlation matrix is an identity matrix, where the diagonal values are equal to 1 and the off-diagonal values are zero. If the hypothesis is rejected, then factor analysis is appropriate, because there is therefore a high correlation between variables. The test statistics used to test this are i) the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy, ii) the Bartlett test of spherity and iii) the associated level of significance. The KMO should be close to 1, and in the example of caravan sites in Dumfries & Galloway a value of 0.6748 was returned. The Bartlett test of spherity was 238.90698 and the associated significance level was 0.0000. A low significance level means that the nul hypothesis of the correlation matrix being an identity could be rejected, therefore the tests proved that the use of factor analysis was appropriate.

The next step was to determine how many factors were to be used, using principal components analysis. The underlying premise was that no single variable described areas of potential, but a combination of variables could. Principal components computed linear combinations of the observed variables, which explained the largest amount of variance within the sample. When carried out in Dumfries & Galloway, the first three principal components accounted for 71.5% of total variance within the sample, and SPSS therefore extracted 3 factors for analysis.

Each variable was correlated to more than one of these factors, making interpretation difficult. Therefore the initial factor matrix was transformed into one which was more meaningful, using a method of rotation. Rotation reduces the number of variables showing relatively small correlation to the factors and increases the number of those with highly positive or highly negative correlations. SPSS gave the option of using four different rotation methods (equamax, quartimax, oblimin and varimax). In this case, the varimax method was used, which is the most common orthogonal rotation and minimised the number of variables which have a high loading in each factor. The results of

this rotation for caravan sites in Dumfries & Galloway are given in Table 7.5, which lists the factor score for each variable.

	Factor 1	Factor 2	Factor 3
TOUROFF		0.09881	0.16423
ATTNO	[illegible]	-0.05071	-0.09313
ATTATT		0.21122	0.12580
NOTOWN	0.53704		0.22037
TOWNPOP	0.43119		-.014550
ITECLAS	-0.12024		0.02268
TOWN	-0.00923	-0.29607	
PARTYPE	0.13451	-0.35703	

Table 7.5. Rotated factor score coefficient matrix.

In this instance the variables grouped into three factors - tourist activity in the area, employment opportunities and remoteness. Factor 1, tourist activity in the area, had high loading in respect of tourist information office enquiries (TOUROFF), the number of visitor attractions(ATTNO) and their attendance figures (ATTATT). In respect of Factor 2, population density, the number of towns in the vicinity (NOTOWN), their population (TOWNPOP) and the ITE land classification (ITECLAS) were the important variables, while for Factor 3, remoteness, the distance from a town (TOWN) and the farm type of the parish (PARTYPE) were the key variables.

The results were then used to identify areas of potential. Each parish was analysed, assuming that the enterprise was placed in the parish centroid. Variables were identified for each of these, their values multiplied by the absolute value of the factor scores (Table 7.5) and then added to give an overall score for each parish.

SPANS GIS was then used to produce maps, which spatially represented areas which showed potential for development in Dumfries & Galloway, and the results were validated in Fife region.

7.5 Identification of areas for potential development in Dumfries & Galloway

This section presents the results of the methodology outlined above, which used factor analysis to identify the factors that contributed to the success of an enterprise. The analysis was carried out with respect to caravan sites, livery stables and B&Bs in Dumfries & Galloway, and identified areas that showed the correct conditions for development. However, although areas of potential were identified, there is a limit to how many of these enterprises can be supported in any one area, and this limitation was not included in the analysis. Nevertheless, the results can be used to assess the viability of proposed enterprises, in conjunction with market research.

7.5.1 Caravan sites

The results of the analysis were divided into quartiles, so that the areas showing the best potential for caravan sites in Dumfries & Galloway (Figure 7.1) were those which had values within the highest 25% of the range of factor scores. It can be seen that a number of parishes fell within this quartile, and these lie within the major tourist areas of the region. Most of the major roads pass through these parishes, although the distance of a parish centroid from a main road was not included in the analysis. The north-west of the region showed the least potential.

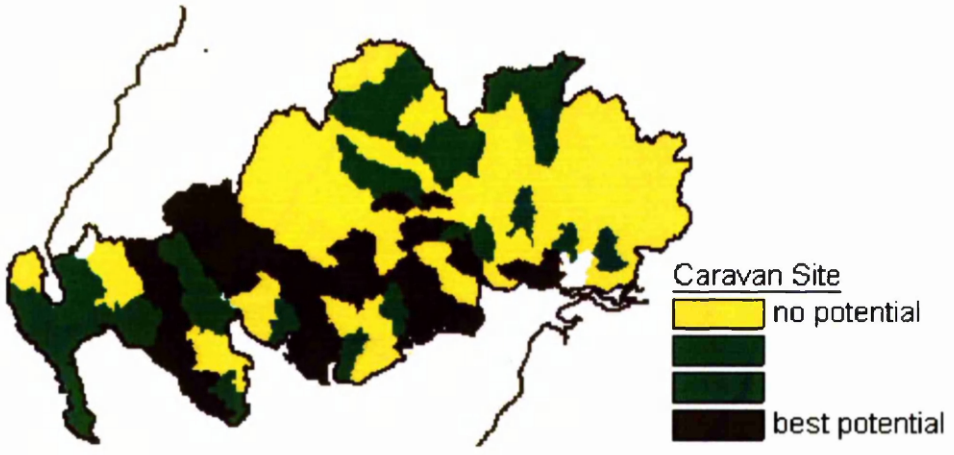


Figure 7.1. Areas exhibiting potential for the development of caravan sits

7.5.2 Livery stables

Figure 7.2 shows the areas which exhibited potential for developing livery stables. Fewer areas fell within the top 25% band of factor scores, with only seven parishes having the best potential for development. These parishes do, however, share some general characteristics. Apart from the area including Dumfries, the largest town in the region, the other parishes all contain a large village/small town, and are surrounded by rural hinterlands. This would appear to denote the correct conditions for the development of a livery stable, where, on the one hand, a centre of population creates demand, and on the other, the needs for land and feedstuffs can be met. The areas showing the second best potential for development exhibit similar characteristics, and the remoter rural areas in the north and west, containing only small villages, show the least potential.

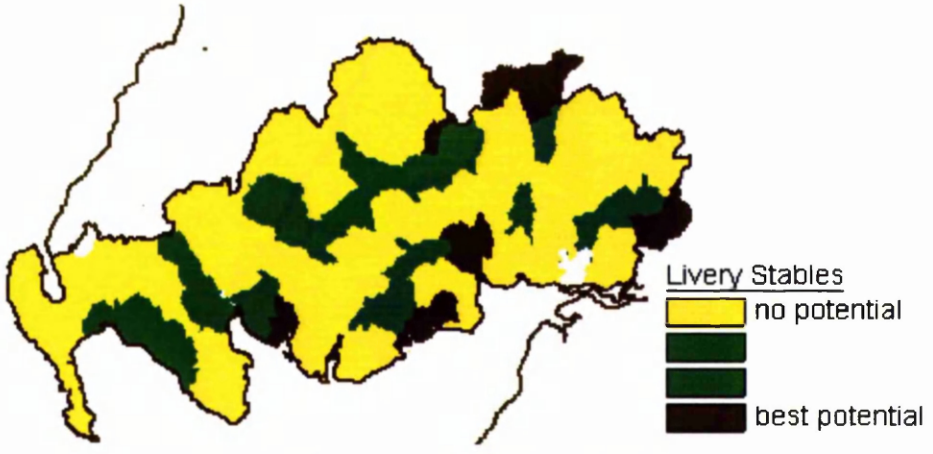


Figure 7.2. Areas exhibiting potential for the development of livery stables

7.5.3 Bed and Breakfast

The final map in this section (Figure 7.3) shows the areas which were found to have potential for running bed and breakfast enterprises. Overall, the top three quartiles formed a corridor along the south of the region, which included the main tourist areas. The exceptions were two large areas in the north, which contained the main routes for visitors travelling north from England. Since B&Bs often rely on passing trade, or on visitors to the region booking accommodation 'as they go', these results meet expectations.

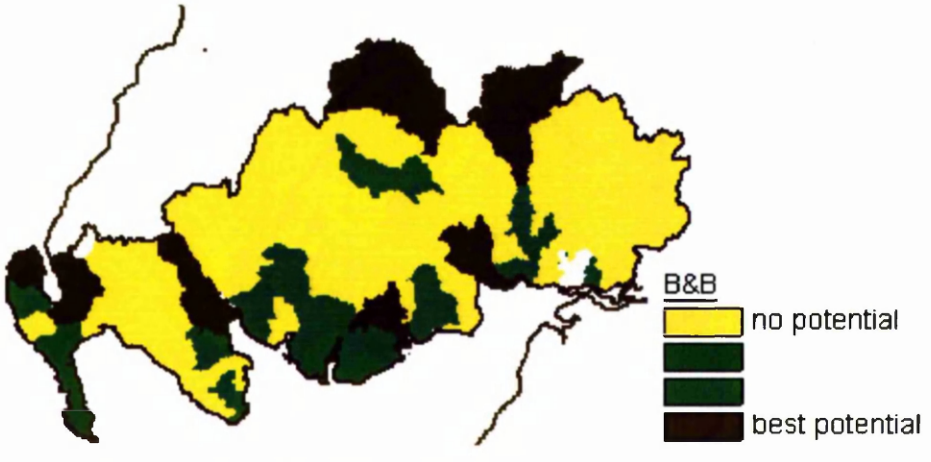


Figure 7.3 Areas exhibiting potential for the development of B&B

7.5.4 Conclusions

The analysis used to identify areas for potential development was based on data collected in relation to existing enterprises within Dumfries & Galloway. A few parishes showed potential for developing all three enterprises, but some, unfortunately, showed no potential at all. These latter areas tend to be remote rural areas, and, given the types of enterprises chosen for analysis, they should probably be discouraged from developing businesses which rely on either the tourist trade, or a neighbouring centre of population capable of providing a market.

However, the list of enterprises included in the analysis was by no means exhaustive, and there are many other types of enterprises that pluriactive households could engage in. Analysing cottage industries, or technology based developments would produce a different set of factors, thus providing possible opportunities for remoter areas.

Also, as mentioned earlier, the possibility of market saturation was not included. Clearly, before a development can proceed, a feasibility study would be required to assess whether a market exists for the product, as well as quantifying the presence, or absence, of local competition. An essentially rural region, such as Dumfries & Galloway, which has a thriving tourist industry, could sustain many more B&Bs than livery stables. Nevertheless, the results show those areas which, given the proper market research, had the best potential for a successful enterprise.

However, if the method developed is to have general applicability, it is necessary to test whether the results of the analysis can be translated to identify areas of potential development in other regions. This was tested by validating the results in Fife region.

7.6 Validation of model

The methodology for identifying areas which show development potential, which may allow farm households to successfully establish on-farm enterprises, was described above. The results produced a set of factor scores which, when applied to a list of locational, geographic and population variables, identified parishes which exhibited development potential. The analysis was based on data collected in Dumfries & Galloway.

This section tests whether the results of the analysis can be translated to other regions, using Fife to validate the model. Data describing the list of variables in Table 7.2 were collected for each parish centroid, and the factor scores were applied to identify areas which displayed potential for establishing caravan sites, livery stables and B&B enterprises.

The data sources are listed in Table 7.6. The results are presented using the same classification as that used for Dumfries & Galloway, i.e. the top classification includes those areas which obtained a total factor score in the top 25% range of scores, the second within the next 25% and so on.

Data Sources	Variable
SPANS GIS (Tydac, 1999)	MROAD - distance of an enterprise from a main road
Population Census, 1991 (OPCS, 1994)	PAREMP - parish employment
STB (1999)	TOUROFF - tourist office enquiries
STB (1998)	ATTNO - no of visitor attractions
STB (1999)	ATTATT - number of visitors
SPANS GIS (Tydac, 1999)	NOTOWN - number of towns
SPANS GIS (Tydac, 1999)	TOWNPOP - population of towns
Institute of Terrestrial Ecology (Bunce *et al*, 1981)	ITECLAS - main ITE land classification
SPANS GIS (Tydac, 1999)	TOWN - distance from a town
Pluriactivity in the Agriculture Sector in Scotland (Mitchell & Doyle, 1993)	PARTYPE - main farm type

Table 7.6. Data sources for identification of areas for potential development in Fife

7.6.2 Caravan Sites

Figure 7.4 shows which areas in Fife were expected to have the correct factors for developing a successful caravan site. The areas of best potential are coloured dark green, and the areas of least potential are coloured yellow. Against this, the pink stars are placed in parishes where actual caravan sites are to be found. Almost

58.3% of existing sites appear in areas identified as having the best potential. Two parishes containing sites were placed in the second classification, one in the third, and two in parishes showing least potential. However, some parishes contain more than one site, and overall, 71.4% of the 21 caravan sites tested in Fife region fell within the top classification.

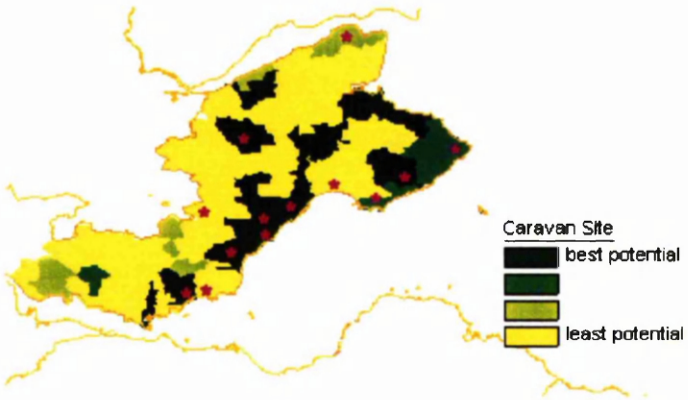


Figure 7.4 Potential for caravan sites in Fife

7.6.3 Bed & Breakfasts

Figure 7.5 repeats the exercise for B&Bs. Less parishes containing actual B&Bs fell within the top quartile of sites by potential (31%), but a further 38.5% fell into the second quartile. 0.08% of parishes containing existing B&Bs landed in the third quartile, and the remaining 30% were placed in parishes which showed least potential. However, again there were several B&B's in some parishes, and overall, 79.9% of existing B&B's landed in parishes within the 'best potential' category.

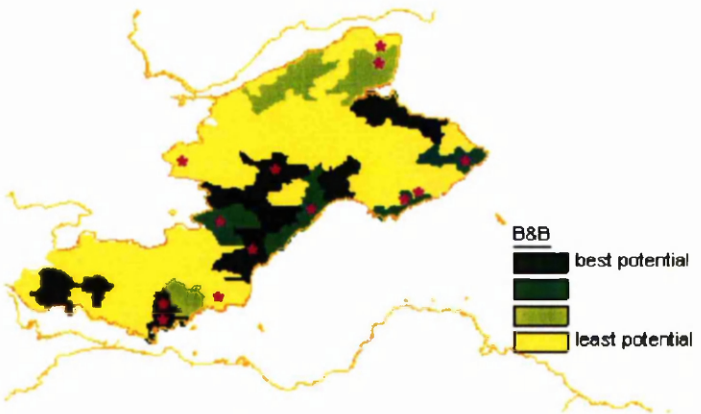


Figure 7.5 Potential for B&B enterprises in Fife

7.6.4 Livery stables

Testing the methodology for livery stables proved more difficult. Only two livery stables were identified in Fife, but both of these lie within parishes which exhibited the best potential for this enterprise. The parishes identified in Fife which appear to have potential for development have some of the same characteristics as those identified in Dumfries & Galloway, where a mixture of rural and urban areas exist.

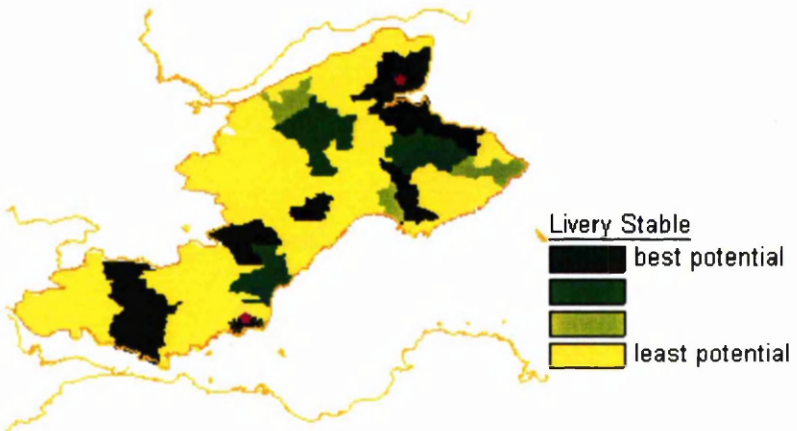


Figure 7.6 Potential for livery stables in Fife

7.6 Conclusions

The technique developed has the ability to identify areas which may have an advantage in sustaining different activities but it can also be used to detect areas

which have little or no potential as far a as farm diversification goes. The models may be extended to identify potential development "hot spots", allowing a choice of enterprises, but caution must be exercised, as market saturation may result.

Overall, the vast majority of existing caravan sites (71.4%), B&Bs (79.9%) and livery stables (100%) were placed in parishes which appeared in the top classification of areas of potential. This would suggest that the results of the factor analysis in Dumfries & Galloway, which were used to identify areas of potential development, can be translated to other regions.

CHAPTER 8

Chapter 8: Conclusions and discussion

8.1 Introduction

This chapter starts by reviewing the aims of the study outlined in Chapter1 within a policy context. It then looks at the hypotheses and finally discusses possible future developments.

8.2 Research aims

This section assesses whether the initial aims of the research were met. The aims of the study were:

i. developing a model, which combines and extends existing techniques, capable of estimating and spatially distributing the economic impacts of on-farm pluriactivity;

ii. identifying which types of activity have the greatest benefit in terms of a) local and b) regional income generation and employment, measured by size and spatial distribution;

iii. assessing the economic impact of the RDP; and

iv. identifying those areas in the regions studied, which offer the greatest and least potential for pluriactivity, as a step towards policy targeting.

8.3 Assessment of a model to describe the regional economic benefits of pluriactivity

The first aim was carried out using the methodologies described in Chapters 2 and 3. Firstly, the GRIT technique was used to develop a set of regional type 2 income

and employment multipliers which, in turn, were used to calculate enterprise multipliers. Secondly, the spatial distribution of the benefits of pluriactivity was carried out using a gravity model.

The methodology developed in this study is designed to assist applied research that will inform policy in the field of rural development. It adds significantly to existing studies and the results clearly provide information relevant to policy makers interested in an integrated approach to rural development.

As stated in Chapter 1, there is an increasing interest in farm household pluriactivity because of falling farm incomes and a growing emphasis on rural development. This is illustrated by the recent reforms of the CAP, Agenda 2000, with the focus shifting away from agricultural sector policies. However, there is evidence of uneven development in rural areas to date (Bristow, 2000; Committee for Spatial Development (CSD), 1999; Marsden, 1999; Ilbery & Bowler, 1998, SO, 1998), and there are calls for policy makers to adopt a more integrated approach. Bryden (1997) stated that there were "strong indications that there could be radical changes in EU and agricultural policies as we enter the new millennium", a sentiment which has been borne out by Agenda 2000, which is expected to undergo further reform in the coming years.

There is also a growing awareness that the impact of different regional, national and EU development policies must be evaluated and monitored (Richardson, 2000; Marsden 1999; Ilbery, 1998), particularly where the "spatial impacts of many of these policies and programmes have been overlooked in their implementation and evaluation" (Richardson, 2000).

The role of agriculture within the wider rural economy and, in turn, the relationship between rural and urban areas, are also undergoing transformation. "Social and economic changes in the countryside have brought increased pressures on rural resources and caused governments in many developed market economies to re-

evaluate their policies for the countryside" (Ilbery, 1998). Rural areas can no longer simply be dismissed as 'farming communities'. They must be seen as part of process of integrated development, where manufacturing, tourist and service industries all have their part to play.

A number of concepts may be used to further understand the changes taking place in rural society. These include firstly, changes in production and consumption patterns; secondly; commoditisation, or the development of new rural products; thirdly, the concept of sustainable rural development; and fourthly, the one-dimensional perspective.

8.3.1 Rural production and consumption

Agenda 2000 promotes increased competitiveness of European agriculture in the international arena as a result of:

- EU budgetary pressures;
- EU enlargement; and
- World trade negotiations.

The increased emergence of non-farming interests in rural areas has resulted in the decline of agriculture as the key institutional arrangement. This has led to a desire to develop new products, markets and small and medium size enterprises capable of maintaining the productivity and profitability of rural resources. Success is partly dependant on the emergence of new modes of consumption, based on niche markets and individual consumption patterns. Therefore, given that agriculture is falling in importance, farm households can redirect resources to meet new consumption demands, notably leisure, tourism and recreation. These investment decisions can be guided "both by the increasing demands for rural pursuits, experiences and values, and by the historical attractiveness and authenticity of rural

places" (Marsden *et al,* 1993). The model created in this study can go a long way towards "matching" these production and consumption patterns.

8.3.2 Commoditisation

Commoditisation describes the incorporation of new products into the market. In the context of the CAP reforms, measures to promote farm diversification and pluriactivity could provide the potential to exploit rural resources in the provision of new products. This process is not smooth or even, given different patterns in resource endowment, but the model developed has the capability of modelling the possible impacts of new commodities, both in the specific examples presented, and in extending it to include a wider set of products.

8.3.3 Sustainable rural development

A full discussion on the definition of sustainable rural development will not be entered into here, but the decline in agricultural incomes has generated considerable debate as to how the rural economy and society can be sustained.. It means that rural areas can no longer be viewed simply in terms of agriculture, but as an arena where different interests compete in attempts to exploit its potential. There is, therefore, a requirement to target payments to rural areas in ways that make best use of resources. The spatial aspects of the model, and evaluation of the RDP, can give advice on whether support payments inject money into the rural economy or merely leak away to urban areas.

8.3.4 One-dimensional perspective

To a large extent, policy has treated the problems of rural areas as one-dimensional, ignoring the spatial differences created by underlying economic and social conditions and differences in potential to support rural enterprises. These are mainly "top-down" policies, with national sectoral programmes paying lip-service to

regional development. However, effective policies must consider the rural space and the complex set of relationships that exist there. Factor analysis is a method of describing rural areas in an understandable and useful way, which has been used in this study.

8.3.5 Conclusions

Therefore, rural areas must be treated in a more holistic fashion, moving away from sectoral policies and increasing incorporating spatial dimensions in the decision making and planning processes. Pluriactivity must nit simply be seen as a method of increasing farm incomes, but a process, where spare resources in the rural economy can be used to produce marketable products whose income contributes to the viability of rural areas. All this must happen within the context of "internal", farm household, influences on pluriactivity, and "external", spatial factors, reflecting market opportunity. This study has shown that both these "internal" and "external" factors have a bearing on successful pluriactive enterprises.

It will also be necessary in future years to attend to the provision of services and infrastructures in rural areas to ensure the continued diversification of rural economies, which in turn requires new understanding about the spatial organisation of rural areas. It will be necessary to conceive of towns, villages and the surrounding countryside as single spatial units rather than as separate entities. Developing the non-farm economy must be carried out within this context, and the model developed here could be extended to advise this process.

Farm household pluriactivity has a contribution to make in these developments, providing opportunities for farm households to i) utilise spare resources, ii) become integrated in the wider economy and iii) diversify and strengthen the rural economy.

8.4 Identifying the economic impact of enterprises

The model described above was used to spatially distribute the income and employment impacts of enterprises in Dumfries & Galloway, Grampian and Fife regions. The results of this are presented in chapter 4. It can be seen from the application of the model that the spatial patterns varied according to the type of enterprise and its location. Each enterprises has different input requirements, and the purchase of these inputs will be carried out where the industrial structures support their production. Therefore, although the enterprise may earn a relatively large income for the farm household, its effects may leak away from the local area to larger centres of population. Relatively small enterprises (such as B&B) will have a relatively localised impact.

8.4.1 Economic impact of pluriactivity

Successful economic development requires strong industrial linkages within the economy, otherwise long term advantages will be limited, and any benefits will leak away. "The role that policy can play in promoting viable responses becomes crucial to the well-being of rural communities as a whole. In this context there is a clear requirement to understand the main types of economic relationships emerging in rural areas" (Marsden, 1999).

Courtney and Errington (1999) investigated the spatial integration of small towns because "there is a growing need to identify the most appropriate mechanisms through which to stimulate economic growth in rural areas". They found that "in terms of firm inputs and outputs, settlements in 'remote' rural areas may be more strongly integrated to their locality than those in 'accessible' rural areas" (Courtney & Errington, 1999), but this theory needs to be tested further. The implications of these findings could be significant to pluriactivity, where enterprises in remote areas may have stronger local economic impacts than those close to centres of population.

One way to estimate the strength of economic linkages is to use regional input-output tables and the associated multipliers. The GRIT technique was used to estimate type 2 income and employment multipliers within three regions of Scotland, and information from the SAC diversification database was used to estimate enterprise multipliers. These give some indication of the strengths of economic linkages, and therefore provide policy makers with some information on which enterprises will benefit local communities.

8.4.2 Spatial impact of pluriactivity

As stated above, the success of rural development policies has been uneven, and there is a clearly identified need to introduce spatial evaluation. This study developed a gravity model capable of i) spatially distributing the economic benefits of establishing a variety of farm enterprises, and ii) estimating the spatial income and employment impacts of the RDP grants in Dumfries & Galloway and Grampian regions.

These results could be immensely valuable to policy makers. As discussed in Chapter 1, Doyle & Mitchell (1994) developed an index of rurality and applied it to Dumfries & Galloway. Figure 8.1 shows the results of this research, where rural-urban class I is the most 'rural' area, and class VII the most 'urban'.

This type of information, in conjunction with the results of the models developed here, provides policy makers with the opportunity of targeting policies that would benefit remote rural areas.

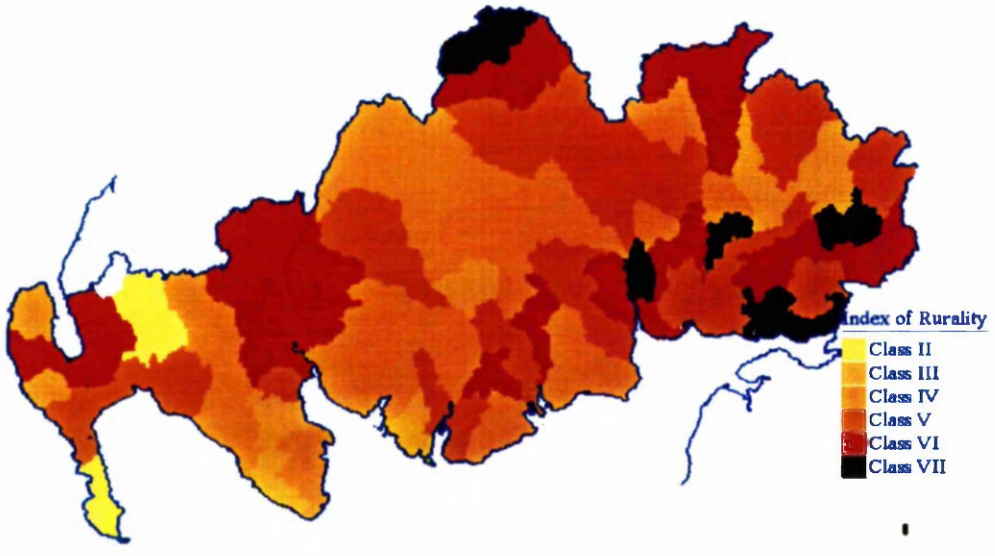


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Figure 8.1. Index of rurality applied to Dumfries & Galloway (Doyle & Mitchell, 1994)

There is a growing need to monitor rural development policies and an integrated approach to this development process includes pluriactivity, an important survival strategy for farm households. This study contributes to the information available to policy makers evaluating developments by:

i) identifying which factors contribute to the success of on-farm enterprises;
ii) measuring the strength of local economic linkages, using regional input-output tables and their associated multipliers; and
iii)providing, by means of a gravity model, a method of spatially distributing the economic impacts of on-farm pluriactivity.

One important aspect of the methods developed is that they can be widely applied across regions, making them useful from a broad policy perspective. They are not specific to distinct sociological conditions defining particular farm households or geographic locations. Therefore, the results make a valuable contribution to the debate on policy evaluation.

8.5 Economic impact of the RDP

A method was developed to extend the gravity model, which allowed the impact of numerous, simultaneous payments to be estimated. This was applied to the RDP grants in Dumfries & Galloway and Grampian, and the results were discussed in Chapter 6. These results compared the spatial distribution of the awards with the resultant income and employment impacts. It was found that the regional economy comprises a complex set of relationships, and the outcomes were influenced by the presence, or absence, of centres of population large enough to draw economic benefits away from rural areas.

Again, the results are useful from a policy perspective, especially in a climate where increased attention is being paid to evaluating and monitoring rural development policies.

8.6 Identification of areas for potential development

Having estimated the size and spatial distribution of regional income and employment generated by on-farm enterprises, the related problem of where these enterprises should be sited was discussed. Factor analysis was used (Chapter 7) to identify external factors that may contribute to the successful establishment of caravan sites, livery stables and B&Bs in Dumfries & Galloway. The results of the analysis was validated using Fife region, and it was found that there did appear to be characteristics which described areas for potential development.

The extent of the analysis was limited to three enterprises, but it was found that they rely on different factors for their success, with B&Bs and caravan sites relying on tourist activity, whereas livery stables need a rural location combined with a nearby market for their service. This type of analysis needs to be extended to include a wider range of business opportunities, but identifying which factors may contribute

to the success of some of these, such as technological developments, may prove difficult. In particular, there would be difficulties in discovering what makes businesses, which rely on a market completely outwith their location, successful. However, the methodology is especially suited to tourism and leisure & recreation related activities, which at present account for the majority of on-farm enterprises.

This type of analysis is also useful to policy makers, and, taken in conjunction with internal household characteristics, could provide advice on where and how to target diversification grants.

50 per cent of the EU population live and work in rural areas, and agriculture's role in upholding rural economies is changing. The desire to maintain farm incomes is leading many farm households to seek new sources of income from non-agricultural activities, one of which is pluriactivity. 59% of farm households in Scotland in 1991 were found to be pluriactive, with 18% having on-farm enterprises (Mitchell & Doyle, 1993). However, these statistics hide local differences in uptake and success. Gasson (1988) found that the more remote areas tended to have a higher incidence of farm-based enterprises rather than off-farm jobs, and these focused "on a narrow range of activities" (Gasson, 1988). In England, uptake of the Farm Diversification Grant Scheme in urban fringe areas favoured the development of leisure and recreation facilities, whereas the more remote areas concentrated on farm-based tourist accommodation (Ilbery & Bowler, 1998). Recent studies examined the changing role of agriculture in rural areas of Scotland (Quin & Mitchell, 2000) and found that 60.6% of alternative enterprises on farms were tourist based and 17.1% related to the leisure and recreation industry. Therefore, there appears to be spatial differences in the types of activities engaged in, which has implications for income and employment generation. " Pluriactivity in its many different forms is an adjustment strategy being adopted by many farm households in the post-productivist transition. Several factors, both internal and external to the farm, help to account for its uneven development" (Ilbery & Bowler, 1998).

This study developed a methodology which can assist policy makers to identify which areas are most suitable for development. The methodology was applied to specific enterprises, but can be extended to include others, such as food processing or technology-based developments. In terms of policy implementation, the method analysis could be reproduced for a variety of enterprises, or the factors, identified by combining a relatively large and complex set of variables, could be used to broadly identify areas of potential, looking at such properties as remoteness and tourist activity. This, combined with information on the internal factors describing pluriactive farm households, would allow policy makers to target policies or grants towards specific locations and advise farm households on suitable alternative enterprises.

8.7 Research hypotheses

The main research hypotheses of the study are examined in this section. These were:

i. the activities which farm households most frequently engage in have a small regional economic impact;

ii. the RDP does not exhibit uniform economic benefits across different regions; and;

iii. different activities are better suited to areas with particular external geographic, locational and industrial factors.

The first hypothesis was upheld. One of the enterprises most frequently engaged in by farm households was found to be B&Bs, generating a small amount of economic impact. When spatially distributed, these impacts were extremely localised because of the limited amount of inputs required to run a successful business. On the other

hand, the regional economic impact of larger, more profitable enterprises was found to be unpredictable, with results varying considerable depending on the location of the enterprise and its proximity to large centres of population.

The second hypothesis was tested by examining the economic impact of RDP grants in Dumfries & Galloway and Grampian regions. Although the initial distribution of grants was different in the two regions, the economic benefits exhibited some similarities. The income benefits were measured per head of population, and it was found that these were quite widely spread throughout the rural areas. However, the employment benefits in both regions were more concentrated around urban areas. Therefore, the second hypothesis was not upheld.

The third hypothesis was examined in Dumfries & Galloway, and the results were validated in Fife. The results upheld the hypothesis, with different factors apparently contributing to the success of various enterprises. Some areas were found to exhibit the correct conditions for developing several different enterprises, but some of the remote areas were, unfortunately, shown to have very few diversification opportunities.

8.8 Future developments

The methodology developed within this study has already had considerable application to a variety of studies, including the effectiveness of farm policies on the social and economic development in rural areas (Doyle & Mitchell, 1997), looking at the impact of different policy scenarios for rural areas (Mitchell & Doyle, 1996), the impact of replacing farm support mechanisms with natural heritage incentives, (Doyle *et al*, 1996; Topp & Mitchell, 2002) and the effect of foot and mouth on the Borders economy (Kerr & Mitchell, 2001).

However, certain developments are proposed to further develop the methodology. These include:

- Disaggregating the input-output table to consider specific developments in more detail. These would include the larger developments which justify the data collection and analysis needed to carry out this refinement.
- Revisit the gravity model to a) look at centres of population outside the regional borders and b) refine distances (parish centroid to parish centroid) to take account of actual road networks.
- The issue of supporting businesses which are likely to succeed is important. More information is needed on issues such as market saturation and/or oportunites, capital investment opportunities, business linkages and IT support. All of these can significantly affect regional variation in the level of pluriactivity.

In general, as the CAP develops and the EU expands, there will be increased demand for monitoring economic policy. The methodology developed here is a step forward in that process.

APPENDICES

Appendix 1: Description of European Union Objective areas

A 1.1 Objective areas 1987 - 1999

The European Union provides funds to geographical regions which are less developed or exhibit particular economic problems through the Structural Funds, of which there are four:

- The European Regional Development Fund (ERDF);
- The European Social Fund (ESF);
- The European Agricultural Guidance and Guarantee Fund - Guidance Section (EAGGF); and
- The Financial Instruments for Fisheries Guidance (FIFG).

Reform of the Structural Funds in 1993 brought these programmes together, accounting for approximately one third of Community spending 1994-1999 (163 billion euro), and could be used in a variety of combinations to fulfil one of six Objectives:

Objective 1: Promoting the development and adjustment of the regions whose development is lagging behind (i.e. where per capita GDP is less than, or close to, 75% of the Community average).

Objective 2: Converting the regions, frontier regions or parts of regions (including employment areas and urban communities) seriously affected by industrial decline (criteria: average unemployment rate above the Community average, industrial employment rate above the Community average, decline in industrial employment).

Objective 3: Combating long-term unemployment (above the age of 24, unemployed for more than 12 months).

Objective 4: Facilitating the occupational integration of young people (job seekers below the age of 25).

Objective 5: With a view to reforming the Common Agricultural Policy by:

5a: adapting production, processing and marketing structures in agriculture and forestry;

5b: promoting the development of rural areas (these areas were selected with reference to the following criteria: agricultural employment accounting for a high proportion of total employment; low level of agricultural income; low level of socio-economic development in terms of per capita GDP).

There was a further objective introduced with the accession of Austria, Finland, and Sweden, namely:

Objective 6: promoting the development of regions with extremely low populations.

In addition to these national initiatives, the Structural Funds were used to finance a number of Community Initiatives, which focused on more specific problems:

- INTERREG - cross border issues;
- RECHAR - aid to mining areas;
- RETEX - aid to areas dependent on textiles and clothing;
- RESIDER - aid to areas de[pendent on the steel industry;
- KONVER - aid to areas dependent on the defence industry;
- URBAN - inner city areas;
- PESCA - fishing areas;
- LEADER - to stimulate rural development;
- EMPLOYMENT - to assist disadvantaged groups gain access to employment;

- Adapt - to increase employment skills;
- SME - small and medium sized industries; and
- Peace - peace and reconciliation in Northern Ireland.

All parts of the UK were eligible under Objectives 3, 4 and 5a, but had to meet specific criteria to be eligible under Objectives 1, 2 and 5b. Figure A1.1 shows these areas for Scotland. Of relevance to this study was the Guidance section of EAGGF, which provided grants to areas falling under Objectives 1, 2, 5a, 5b and 6, mainly for:

- the improvement of marketing and processing conditions for agricultural products;
- improvements in the structure of agricultural buildings; and
- the protection of environmentally sensitive areas.

and Community Initiatives such as LEADER, aimed at developing the potential of rural areas.

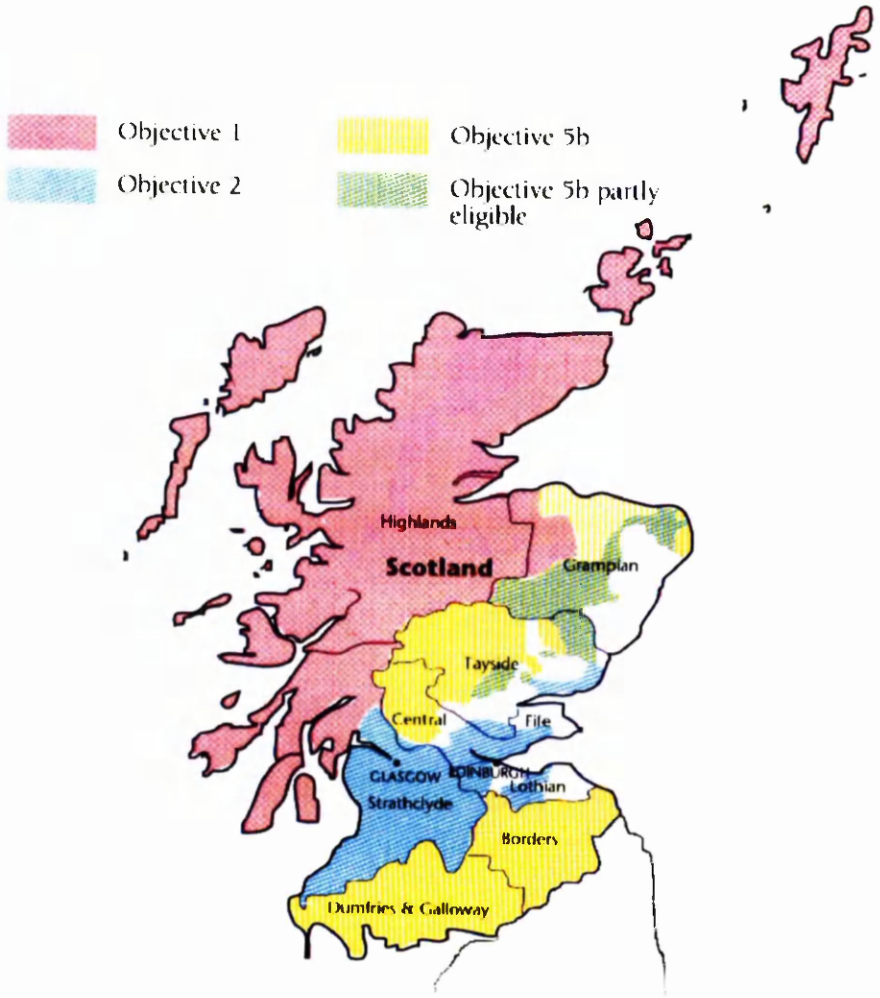

Figure A1.1 Eligible regions in Scotland under Objectives 1, 2 and 5b 1994-1999

A 1.2 Objective areas 1999 onwards

Agenda 2000 provides a framework for further reforms of the CAP and the Structural Funds for the period 2000-2006, placing emphasis on rural development. The changes were brought about because of a climate of EU enlargement, budgetary considerations (economic and monetary union) and increased competition arising from 'globalisation' of markets (commodities and labour). The Structural Funds have been significantly simplified, and three objectives have been established for the period 2000-2006:

Objective 1: Less developed regions (i.e. where per capita GDP is less than, or close to, 75% of the Union average). Additional support will be granted to regions with very high unemployment. Regions eligible under the previous Objective 1, which in future fall above the 75% threshold will receive a phasing-out mechanism. The most northerly regions with very low population densities, eligible under the previous Objective 6, will not be eligible for Objective 1.

Objective 2: For all regions confronted with major economic and social restructuring needs, including areas affected by change in the industrial, service or fisheries sectors; rural areas in serious decline because of lack of economic diversification; and urban districts in difficulty because of loss of economic activities. This Objective takes particular account of the unemployment rate; the level and rate of change of industrial employment and agricultural activity, including changes linked to fisheries; and the degree of social exclusion. Regions eligible under the previous Objective 2 and 5b, which fall outwith the new criteria, will benefit from a transitional period.

Objective 3: Applies to regions not covered by Objectives 1 and 2, assisting member states to adapt and modernise their systems in areas facing economic and social change, including policies related to lifelong education and training systems, creating active labour market policies to fight unemployment and combating social exclusion.

Table A1.1 outlines the changes in allocation of the Structural Funds between the two periods.

Structural Fund allocations 1994-1999

Objective 1	ERDF	ESF	EAGGF - Guidance	FIFG
Objective 2	ERDF	ESF		
Objective 3		ESF		
Objective 4		ESF		
Objective 5a			EAGGF - Guidance	FIFG
Objective 5b	ERDF	ESF	EAGGF - Guidance	
Objective 6	ERDF	ESF	EAGGF - Guidance	FIFG

Structural Fund allocations 2000-2006

Objective 1	ERDF	ESF	EAGGF - Guidance	FIFG
Objective 2	ERDF	ESF		
Objective 3		ESF		

source: European Commission, 1999

Table A1.1. Allocation of Structural Funds between Objective areas.

69.7% of the Structural Fund budget (195 billion euro for the period 2000-2006) will be allocated to Objective 1 regions (4.3% to areas in transition, such as the Highlands & Islands in Scotland, which has lost its Objective 1 status); 11.55% to Objective 2 regions; 12.3% to Objective 3 regions and 0.5% to FIFG to support

regions not included in Objective 1. Figure A1.2 shows the Scottish regions eligible under Objectives 1 and 2 for the period 2000-2006, included areas which will receive funding under a phasing-out scheme.

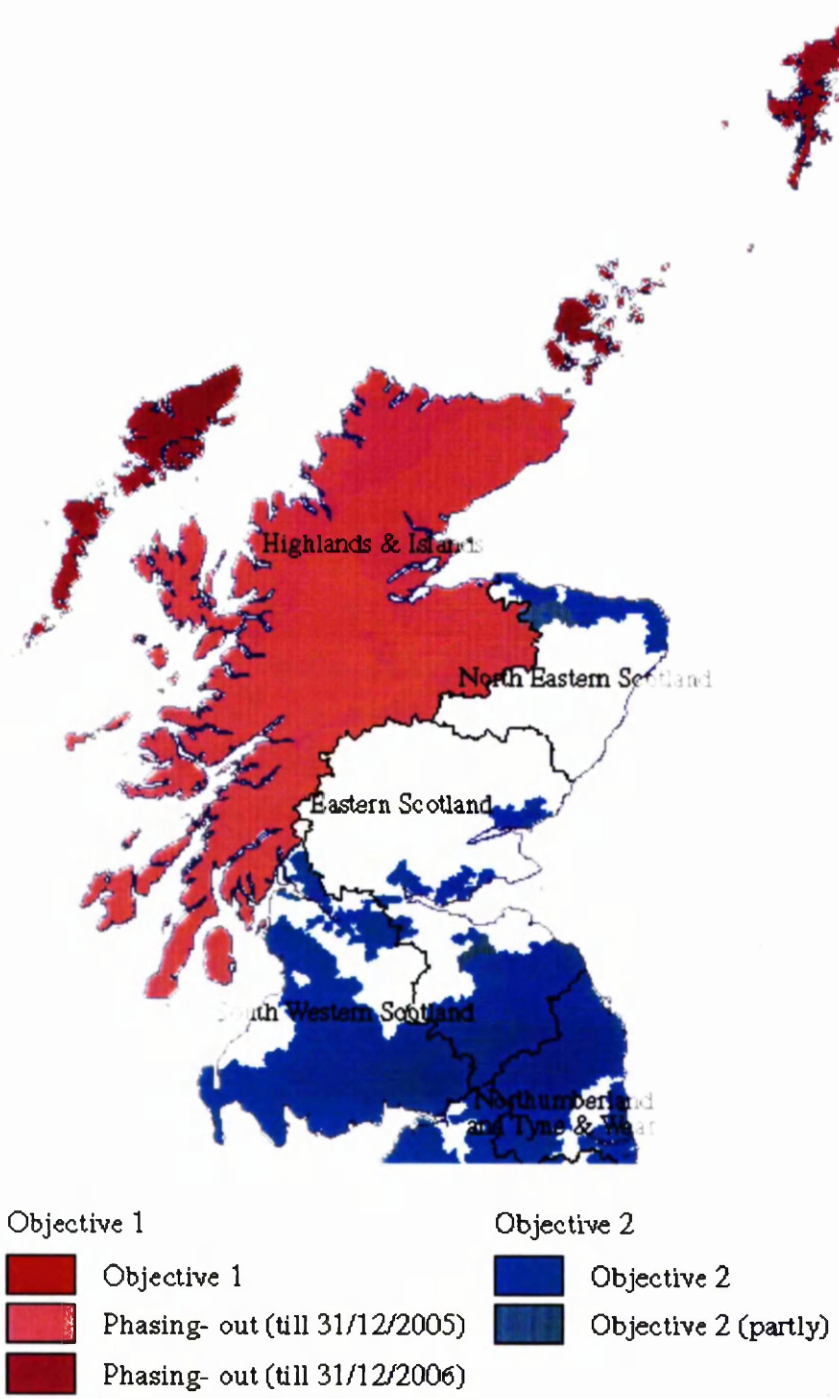

Figure A1.2 Eligible regions in Scotland under Objectives 1 and 2 2000-2006

The Community Initiatives have been reduced to four, and will receive 5.35% of the Structural Fund budget:

- INTERREG;
- URBAN;
- LEADER; and
- EQUAL, a new fund available for promoting transnational co-operation, fighting discrimination and inequality in the labour markets.

Appendix 2: CILQ and Coefficient Matrices for Grampian and Fife Regions

Grampian:

CILQS	SIC 0	SIC 1	SIC 2	SIC 3	SIC 4	SIC 5	SIC 6	SIC 7	SIC 8	SIC 9
SIC 0	1.000	0.054	0.368	0.225	0.185	0.178	0.149	0.157	0.181	0.194
SIC 1	18.508	1.000	6.812	4.160	3.415	3.299	2.758	2.903	3.358	3.593
SIC 2	2.717	0.147	1.000	0.611	0.501	0.484	0.405	0.426	0.493	0.527
SIC 3	4.449	0.240	1.637	1.000	0.821	0.793	0.663	0.698	0.807	0.864
SIC 4	5.420	0.293	1.995	1.218	1.000	0.966	0.808	0.850	0.983	1.052
SIC 5	5.611	0.303	2.065	1.261	1.035	1.000	0.836	0.880	1.018	1.089
SIC 6	6.709	0.363	2.469	1.508	1.238	1.196	1.000	1.053	1.217	1.302
SIC 7	6.374	0.344	2.346	1.433	1.176	1.136	0.950	1.000	1.157	1.237
SIC 8	5.511	0.298	2.028	1.239	1.017	0.982	0.821	0.865	1.000	1.070
SIC 9	5.151	0.278	1.896	1.158	0.950	0.918	0.768	0.808	0.935	1.000

Fife:

CILQS	SIC 0	SIC 1	SIC 2	SIC 3	SIC 4	SIC 5	SIC 6	SIC 7	SIC 8	SIC 9
SIC 0	1.000	0.057	0.066	0.036	0.060	0.061	0.065	0.091	0.083	0.059
SIC 1	17.430	1.000	1.144	0.623	1.038	1.071	1.132	1.594	1.450	1.020
SIC 2	15.239	0.874	1.000	0.544	0.908	0.936	0.990	1.394	1.268	0.892
SIC 3	27.988	1.606	1.837	1.000	1.667	1.719	1.817	2.560	2.329	1.638
SIC 4	16.786	0.963	1.101	0.600	1.000	1.031	1.090	1.536	1.397	0.983
SIC 5	16.280	0.934	1.068	0.582	0.970	1.000	1.057	1.489	1.355	0.953
SIC 6	15.399	0.883	1.011	0.550	0.917	0.946	1.000	1.409	1.281	0.901
SIC 7	10.932	0.627	0.717	0.391	0.651	0.671	0.710	1.000	0.910	0.640
SIC 8	12.018	0.690	0.789	0.429	0.716	0.738	0.780	1.099	1.000	0.704
SIC 9	17.083	0.980	1.121	0.610	1.018	1.049	1.109	1.563	1.421	1.000

Grampian: Regional coefficient matrix

		Purchases By Industry										
Sales		**SIC 0**	**SIC 1**	**SIC 2**	**SIC 3**	**SIC 4**	**SIC 5**	**SIC 6**	**SIC 7**	**SIC 8**	**SIC 9**	**Household**
By	**SIC 0**	0.0000	0.0000	0.0003	0.0001	0.0123	0.0005	0.0014	0.0002	0.0002	0.0002	0.001
Industry	**SIC 1**	0.0105	0.0000	0.0126	0.0109	0.0121	0.0030	0.0157	0.0050	0.0043	0.0203	0.034
	SIC 2	0.0335	0.0160	0.0000	0.0038	0.0109	0.0223	0.0060	0.0057	0.0041	0.0148	0.014
	SIC 3	0.0162	0.0039	0.0053	0.0000	0.0092	0.0275	0.0052	0.0069	0.0055	0.0095	0.008
	SIC 4	0.0544	0.0010	0.0023	0.0033	0.0000	0.0304	0.0404	0.0050	0.0232	0.0246	0.057
	SIC 5	0.0088	0.0033	0.0069	0.0004	0.0008	0.0000	0.0158	0.0013	0.0458	0.0125	0.010
	SIC 6	0.0872	0.0134	0.0125	0.0834	0.0641	0.0458	0.0000	0.0355	0.0320	0.0262	0.210
	SIC 7	0.0354	0.0009	0.0211	0.0073	0.0130	0.0061	0.0255	0.0000	0.0551	0.0135	0.052
	SIC 8	0.0499	0.0113	0.0819	0.0575	0.0956	0.0910	0.0457	0.0115	0.0000	0.0328	0.240
	SIC 9	0.0900	0.0021	0.0046	0.0044	0.0152	0.0098	0.0008	0.0135	0.0044	0.0000	0.098
	Household	0.1570	0.1454	0.1563	0.1651	0.1709	0.2675	0.3125	0.3479	0.2276	0.7206	0.000

Fife: Regional coefficient matrix

		Purchases By Industry										
Sales		**SIC 0**	**SIC 1**	**SIC 2**	**SIC 3**	**SIC 4**	**SIC 5**	**SIC 6**	**SIC 7**	**SIC 8**	**SIC 9**	**Household**
By	**SIC 0**	0.0000	0.0000	0.0000	0.0000	0.0040	0.0002	0.0006	0.0001	0.0001	0.0001	0.000
Industry	**SIC 1**	0.0105	0.0000	0.0126	0.0068	0.0121	0.0030	0.0157	0.0050	0.0043	0.0203	0.034
	SIC 2	0.0335	0.0951	0.0000	0.0034	0.0198	0.0430	0.0146	0.0133	0.0084	0.0251	0.023
	SIC 3	0.0162	0.0162	0.0053	0.0000	0.0112	0.0346	0.0078	0.0099	0.0068	0.0110	0.009
	SIC 4	0.0544	0.0033	0.0023	0.0020	0.0000	0.0315	0.0500	0.0059	0.0236	0.0241	0.057
	SIC 5	0.0088	0.0103	0.0069	0.0002	0.0008	0.0000	0.0189	0.0015	0.0458	0.0119	0.010
	SIC 6	0.0872	0.0326	0.0125	0.0459	0.0588	0.0433	0.0000	0.0355	0.0320	0.0237	0.210
	SIC 7	0.0354	0.0016	0.0151	0.0029	0.0085	0.0041	0.0190	0.0000	0.0501	0.0087	0.045
	SIC 8	0.0499	0.0263	0.0646	0.0247	0.0685	0.0684	0.0435	0.0133	0.0000	0.0231	0.227
	SIC 9	0.0900	0.0072	0.0046	0.0027	0.0160	0.0107	0.0010	0.0167	0.0047	0.0000	0.098
	Household	0.1570	0.1454	0.1563	0.1651	0.1709	0.2675	0.3125	0.3479	0.2276	0.7206	0.000

Appendix 3: Calculation of regional income and employment multipliers - Grampian and Fife

A3.1 Regional income and employment multipliers for Grampian region

Step 1: direct income effects

a_{H0}	a_{H1}	a_{H2}	a_{H3}	a_{H4}	a_{H5}	a_{H6}	a_{H7}	a_{H8}	a_{H9}
0.1570	0.1454	0.1563	0.1651	0.1709	0.2675	0.3125	0.3479	0.2276	0.7206

Step 2: direct, indirect and induced income effects

	SIC 0	SIC 1	SIC 2	SIC 3	SIC 4	SIC 5	SIC 6	SIC 7	SIC 8	SIC 9	House
SIC 0	1.002	0.001	0.001	0.001	0.013	0.002	0.003	0.002	0.001	0.003	0.003
SIC 1	0.034	1.010	0.025	0.026	0.029	0.026	0.038	0.028	0.023	0.067	0.059
SIC 2	0.046	0.021	1.007	0.011	0.020	0.033	0.018	0.017	0.014	0.037	0.028
SIC 3	0.026	0.007	0.010	1.005	0.016	0.036	0.014	0.015	0.013	0.026	0.019
SIC 4	0.096	0.019	0.027	0.032	1.033	0.071	0.080	0.047	0.057	0.107	0.104
SIC 5	0.027	0.010	0.019	0.013	0.016	1.019	0.032	0.017	0.058	0.043	0.037
SIC 6	0.199	0.066	0.082	0.157	0.150	0.162	1.120	0.158	0.130	0.273	0.316
SIC 7	0.077	0.019	0.047	0.036	0.047	0.050	0.067	1.042	0.087	0.097	0.104
SIC 8	0.184	0.073	0.159	0.144	0.194	0.225	0.183	0.154	1.115	0.319	0.364
SIC 9	0.136	0.025	0.034	0.036	0.052	0.059	0.052	0.067	0.046	1.108	0.140
House	0.426	0.219	0.275	0.301	0.338	0.461	0.486	0.517	0.391	1.040	1.363

Step 3: type 2 income multipliers

	SIC 0	SIC 1	SIC 2	SIC 3	SIC 4	SIC 5	SIC 6	SIC 7	SIC 8	SIC 9
Income	2.717	1.507	1.761	1.824	1.978	1.724	1.555	1.486	1.720	1.443

Step 4: direct employment effects

SIC 0	SIC 1	SIC 2	SIC 3	SIC 4	SIC 5	SIC 6	SIC 7	SIC 8	SIC 9
2.101	0.158	0.046	0.090	0.157	0.207	0.246	0.153	0.096	0.413

Step5: direct, indirect and induced employment effects

	SIC 0	SIC 1	SIC 2	SIC 3	SIC 4	SIC 5	SIC 6	SIC 7	SIC 8	SIC 9
SIC 0	2.106	0.001	0.002	0.002	0.028	0.004	0.007	0.003	0.003	0.006
SIC 1	0.005	0.160	0.004	0.004	0.005	0.004	0.006	0.004	0.004	0.011
SIC 2	0.002	0.001	0.046	0.001	0.001	0.002	0.001	0.001	0.001	0.002
SIC 3	0.002	0.001	0.001	0.091	0.001	0.003	0.001	0.001	0.001	0.002
SIC 4	0.015	0.003	0.004	0.005	0.162	0.011	0.013	0.007	0.009	0.017
SIC 5	0.006	0.002	0.004	0.003	0.003	0.211	0.007	0.004	0.012	0.009
SIC 6	0.049	0.016	0.020	0.039	0.037	0.040	0.276	0.039	0.032	0.067
SIC 7	0.012	0.003	0.007	0.006	0.007	0.008	0.010	0.160	0.013	0.015
SIC 8	0.018	0.007	0.015	0.014	0.019	0.022	0.018	0.015	0.107	0.030
SIC 9	0.056	0.010	0.014	0.015	0.022	0.024	0.022	0.028	0.019	0.458

	SIC 0	SIC 1	SIC 2	SIC 3	SIC 4	SIC 5	SIC 6	SIC 7	SIC 8	SIC 9
col. sum	2.271	0.204	0.118	0.178	0.285	0.329	0.359	0.262	0.201	0.617

Step 6: type 2 employment multipliers

	SIC 0	SIC 1	SIC 2	SIC 3	SIC 4	SIC 5	SIC 6	SIC 7	SIC 8	SIC 9
Employ.	1.081	1.290	2.573	1.974	1.816	1.587	1.458	1.706	2.099	1.493

A3.2 Regional income and employment multipliers for Fife region

Step 1: direct income effects

a_{H0}	a_{H1}	a_{H2}	a_{H3}	a_{H4}	a_{H5}	a_{H6}	a_{H7}	a_{H8}	a_{H9}
0.1570	0.1454	0.1563	0.1651	0.1709	0.2675	0.3125	0.3479	0.2276	0.7206

Step 2: direct, indirect and induced income effects

	SIC 0	SIC 1	SIC 2	SIC 3	SIC 4	SIC 5	SIC 6	SIC 7	SIC 8	SIC 9	House
SIC 0	1.001	0.000	0.000	0.000	0.004	0.001	0.001	0.001	0.001	0.001	0.001
SIC 1	0.034	1.014	0.025	0.019	0.028	0.025	0.038	0.029	0.023	0.066	0.058
SIC 2	0.059	0.108	1.013	0.016	0.037	0.064	0.038	0.036	0.028	0.070	0.053
SIC 3	0.028	0.022	0.011	1.005	0.019	0.044	0.018	0.020	0.016	0.030	0.023
SIC 4	0.097	0.028	0.026	0.026	1.031	0.072	0.091	0.050	0.058	0.108	0.106
SIC 5	0.027	0.021	0.018	0.010	0.015	1.018	0.035	0.018	0.058	0.043	0.037
SIC 6	0.197	0.099	0.078	0.109	0.139	0.156	1.120	0.158	0.128	0.267	0.313
SIC 7	0.070	0.023	0.036	0.022	0.035	0.040	0.054	1.036	0.077	0.078	0.087
SIC 8	0.172	0.103	0.134	0.094	0.156	0.192	0.173	0.149	1.107	0.289	0.340
SIC 9	0.136	0.036	0.033	0.030	0.051	0.059	0.053	0.071	0.047	1.107	0.140
House	0.423	0.266	0.264	0.263	0.321	0.455	0.486	0.521	0.388	1.029	1.355

Step 3: type 2 income multipliers

	SIC 0	SIC 1	SIC 2	SIC 3	SIC 4	SIC 5	SIC 6	SIC 7	SIC 8	SIC 9
Income	2.694	1.833	1.690	1.595	1.879	1.700	1.556	1.498	1.707	1.429

Step 4: direct employment effects

SIC 0	SIC 1	SIC 2	SIC 3	SIC 4	SIC 5	SIC 6	SIC 7	SIC 8	SIC 9
2.101	0.158	0.046	0.090	0.157	0.207	0.246	0.153	0.096	0.413

Step5: direct, indirect and induced employment effects

	SIC 0	SIC 1	SIC 2	SIC 3	SIC 4	SIC 5	SIC 6	SIC 7	SIC 8	SIC 9
SIC 0	2.103	0.001	0.001	0.001	0.009	0.002	0.003	0.001	0.001	0.002
SIC 1	0.005	0.160	0.004	0.003	0.004	0.004	0.006	0.005	0.004	0.010
SIC 2	0.003	0.005	0.046	0.001	0.002	0.003	0.002	0.002	0.001	0.003
SIC 3	0.002	0.002	0.001	0.091	0.002	0.004	0.002	0.002	0.001	0.003
SIC 4	0.015	0.004	0.004	0.004	0.162	0.011	0.014	0.008	0.009	0.017
SIC 5	0.006	0.004	0.004	0.002	0.003	0.211	0.007	0.004	0.012	0.009
SIC 6	0.049	0.024	0.019	0.027	0.034	0.038	0.276	0.039	0.032	0.066
SIC 7	0.011	0.004	0.006	0.003	0.005	0.006	0.008	0.159	0.012	0.012
SIC 8	0.016	0.010	0.013	0.009	0.015	0.018	0.017	0.014	0.106	0.028
SIC 9	0.056	0.015	0.014	0.013	0.021	0.024	0.022	0.029	0.019	0.458

	SIC 0	SIC 1	SIC 2	SIC 3	SIC 4	SIC 5	SIC 6	SIC 7	SIC 8	SIC 9
col. sum	2.266	0.229	0.111	0.153	0.257	0.322	0.356	0.262	0.197	0.607

Step 6: type 2 employment multipliers

	SIC 0	SIC 1	SIC 2	SIC 3	SIC 4	SIC 5	SIC 6	SIC 7	SIC 8	SIC 9
Employ.	1.078	1.449	2.420	1.695	1.639	1.555	1.447	1.709	2.063	1.469

Appendix 4: Estimated expenditures for on-farm enterprises

This appendix estimates expenditures required to establish an on-farm enterprise, and run it for a year. Figures are based on 1999 prices (£), based on data collected during the Pluriactivity in the Agriculture Sector in Scotland project, the Scottish Tourist Board and the Scottish Agricultural College Farm Diversification database. The size of each enterprise was taken as an average of the size of enterprises engaged in by farm households in the pluriactivity study, and the costs from the SAC farm database.

The first step was to measure the capital, fixed and variable costs of setting up and running an 'average' size business in the first year for the chosen enterprises, but can be adapted to measure the income and employment effects for subsequent years of trading. The fixed costs included rates, insurance, telephones, repairs, electricity, advertising etc., and the variable costs depend on the enterprise in question. It is then assumed that these costs represent changes in output of these sectors, which in turn will require inputs from other sectors. These changes in output will lead to changes in income and employment in the regional economies, and it is these which are modelled. Income derived from the enterprises is not included in the model, as there is an assumption made of long-run competition, where average costs equal average revenue.

These estimates were then used to distribute spending proportionately to the different SICs (Table 2.12). Tables A1.1 to A1.4 outline the costs of running B&B, a farm shop, clay pigeon shooting and livery stables for the first year.

A4.1 Bed and Breakfast

Bed & Breakfast	SIC 0	SIC 1	SIC 2-4	SIC 5	SIC 6	SIC 7	SIC 8	SIC 9
(6 adults, 16 weeks, 53% occupancy[1])								
Capital costs:								
Construction[2]				1,180				
Furnishing			900					
Variable costs:								
Food/cleaning					1,122			
Total	0	0	£900	£1,180	£1,122	0	0	0

Table A4.1. Expenditure to establish on-farm bed & breakfast enterprise.

Notes 1: The size of operation was based on the average size of B&B found in the pluriactivity survey, and the occupancy rates were from the Scottish Tourist board estimates of average occupancy for Scotland. It is assumed that the household members supply all labour.

2. Capital costs include the provision of extra toilet facilities.

A4.2 Farm shop

Farm Shop[1]	SIC 0	SIC 1	SIC 2-4	SIC 5	SIC 6	SIC 7	SIC 8	SIC 9
Capital costs:								
Construction				9,800				
Electricity		803						
Equipment			4,760					
Security								482
Fixed costs:								
Rates								5,914
Insurance							5,906	
Heat/light		3,800						
Vehicles			9,900					
Telephone						1,270		
Repairs/ maintenance			3,460					
Advertising							1,418	
Legal fees/ accounting							2,244	
Hire purchase							750	
Variable costs:								
Cost of sales	28,900							
Seals/ wrapping			1,772					
Total	£28,900	£4,603	£19,892	£9,800	0	£1,270	£10,318	£6,396

Table A4.2 Expenditure to establish farm shop.

Note 1: It is assumed that the farm shop is a converted farm building where the cost of produce includes home grown and/or purchased products. Costs are based on 200 opening days per year.

A4.3 Clay pigeon shooting

Clay Pigeon Shooting	SIC 0	SIC 1	SIC 2-4	SIC 5	SIC 6	SIC 7	SIC 8	SIC 9
(40 corporate days, 48 hours tuition, 10 days open shooting[1])								
Capital costs:								
Parking area				904				
Electricity		5,906						
Club house				108,070				
Equipment			24,924					
Guns			7,085					
Fixed costs:								
Rates								2,953
Administration							1,890	
Advertising							3,780	
Maintenance			2,365					
Bank charges							4,875	
Variable costs:								
Materials			22,680					
Total	0	£5,906	£57,054	£108,974	0	0	£10,563	£2,953

Table A4.3 Expenditure to establish an on-farm clay pigeon shooting enterprise.

Note 1: The size of enterprise is based on that used in the SAC diversification database, since respondents in the pluriactivity study were not asked for this information. It will require 2-4 hectares of level land, and includes a club house, though this is optional, as less elaborate shelter may be considered adequate.

A4.4 Livery stables

Livery Stables[1]	SIC 0	SIC 1	SIC 2-4	SIC 5	SIC 6	SIC 7	SIC 8	SIC 9
Capital costs:								
Wire/posts/ construction				35,031				
Fixed costs:								
Fuel/ transport			3,657					
Repairs/ maintenance				3,445				
Insurance							1,346	
Capital repayment/ interest							5,557	
Electricity		1,078						
Rates								500
Admin.			1,228					
Variable costs:								
Feed	8,562							
Bedding	3,048							
Advertising								1,390
Forage	9,072							
Other		3,572						
Total	£20,682	£4,650	£4,885	£38,476	0	0	£6,903	£1,890

Table A4.4 Expenditure to establish on-farm livery stables.

Note 1: The size of enterprise is based on the SAC diversification database, where it is assumed that existing farm buildings can be converted to provide stabling, and that secure fencing must be provided. It is based on full livery for 10 horses.

Appendix 5: RDP grants in Grampian region

Project	Parish Number	Parish Name	Project Sector	RDP Grant Committed (£)
Hotel & Sport Facilities	596	Urquhart	Tourist Facilities	25,000
B & B	227	Gamrie	Tourist Accommodation	7,074
Farm Accommodation	21	Strathdon	Tourist Accommodation	24,997
Chapel/Retreat	228	Rathven	Tourist Facilities	15,141
S/C Accommodation	594	Bellie	Tourist Accommodation	15,366
S/C Accommodation	72	Cairnie	Tourist Accommodation	23,020
Fishing Pond	59	Culsalmond	Leis, Rec and Sport Facilities	25,000
S/C Accommodation	78	Rhynie	Tourist Accommodation	16,461
S/C Accommodatio	14	Auchindoir & Kearn	Tourist Accommodation	5,667
S/C Accommodatio	81	King Edward	Tourist Accommodation	21,886
Ostrich Catering	596	Urquhart	Catering Facilities	7,904
Caravan Park	81	King Edward	Tourist Facilities	2,742
Bakery	231	Fordyce	Catering Facilities	8,732
S/C Accommodatio	16	Glenbuchat	Tourist Accommodation	14,185
Breeding Kennels	35	St Fergus	Rural Services - Kennels	4,073
S/C Accommodatio	227	Gamrie	Tourist Accommodation	15,181
Modelling Paste	28	Longside	Rural Services - Crafts	20,103
Boarding Kennels	22	Tough	Rural Services - Kennels	25,000
S/C Accommodatio	220	Forglen	Tourist Accommodation	17,999
S/C Accommodatio	42	Crathie & Braemar	Tourist Accommodation	25,000
S/C Accommodatio	61	Insch	Tourist Accommodation	25,000
Woodturning	239	Grange	Rural Services - Crafts	7,884
Birds of Prey Centre	72	Cairnie	Tourist Facilities	25,000
Bothy & Pheasant Shoots	81	King Edward	Leisure, Rec. & Sporting Facilities	9,425
Art Centre	21	Strathdon	Leisure, Rec. & Tourism Facilities	25,000
Accommodation & Crafts	223	Ordiquhill	Tourist Accommodation	25,000
Ostrich Catering	596	Urquhart	Catering Facilities	7,127

Holiday Cottages	81	King Edward	Tourist Accommodation	8,737
Community Pond	32	Peterhead	Leisure, Rec. & Sporting Facilities	14,814
Chalet	592	Elgin	Tourist Accommodation	19,065
Garden Centre	220	Forglen	Leisure, Rec. & Sporting Facilities	25,000
Indoor Riding School	26	Crimmond	Leisure, Rec. & Sporting Facilities	24,989
Caravan Park	81	King Edward	Tourist Facilities	11,094
Bunkhouse	594	Bellie	Tourist Accommodation	25,000
Hunter Chase XC Course	21	Strathdon	Leisure, Rec. & Sporting Facilities	10,610
Crafts & Tearoom	14	Auchindoir & Kearn	Tourist Facilities	24,000
Car Driving School	13	Alford	Rural Services - Rural Business	5,210
OrganicHerbs	75	Gartly	Alternative Agriculture Production	4,130
Golf Club Facilities	590	Alves	Leisure, Rec. & Sporting Facilities	20,787
Farm Visitor Centre	588	Duffus	Leisure, Rec. & Sporting Facilities	25,000
S/C Accommodation	22	Tough	Tourist Accommodation	25,000
Riding Centre	593	St Andrew	Leisure,Rec. & Sporting Facilities	20,143
Waste Plastic Collection	220	Forglen	Rural Services	25,000
Cottage & Sporting Enterprises	224	Alvah	Leisure,Rec. & Sporting Facilities	13,245
Gliding Club	591	Birnie	Leisure,Rec. & Sporting Facilities	25,000
Garden Veg Growing & Storage	592	Elgin	Alternative Agricultural Production	14,908
Boarding Kennels	28	Longside	Rural Services - Kennels	22,525
TOTAL GRANT				**£809,220**

REFERENCES

Appleton, Z. (1994). European rural development policy 1994-1999: proceedings of *'Rural Realities - Trend and Choices', the 35th EAAE Seminar*, Aberdeen, Scotland, June 27-29, 1994, edited by A. Copus and P.J. Marr. Aberdeen: University of Aberdeen, p. 471-478.

Arkleton Trust (1985). *Part-time farming in the rural development of industrialised countries*. Langholm: Arkleton Trust.

Arkleton Research (1988). *Rural change in Europe: structural policies and multiple job holding in the rural development process*. Frankfurt: Institut Für Ländliche Strukturforschung.

Arkleton Trust (1992). *Rural change in Europe: Research programme on farm structures and pluriactivity. Draft Final Report.* Langholm: Arkleton Trust.

Austin, E.J., Deary, I.J., Gibson, G.J., McGregor, M.J. and Dent, J.B. (1996). attitudes and values of Scottish framers: "yeoman" and "entrepreneur" as factors, not distinct types. *Rural Sociology,* 61(3), p. 464-474.

Austin, E.J., Gibson, G.J., Deary, I.J. and Dent, J.B. (1998). Models of off-farm pluriactivity in Scotland, *unpublished paper.*

Bailey, A. (1994) Dangers of using Leontief input–output for predicting change: the case of producing commodities with more than one input. Paper Presented to *One-Day Workshop Held by Agricultural Economics Society on Multi-Sectoral Modelling in Agriculture,* University of Reading, February 1994.

Bautista, R.M. (2001). Agriculture-based development: a SAM perspective on Central Vietnam. *Developing Economics*, 39(1), p. 112-132.

Beaumont, J.R. (1991). Spatial decision support systems: some comments with regard to their use in market analysis. *Environment and Planning A,* 23, p. 311-317.

Bristow, G. (2000). Structure, strategy and space: issues of progressing integrated rural devlopment in Wales. *European Urban and Regional Studies*, 7(1), p. 19-33.

Brun, A.H. and Fuller, A.M. (1991). *Farm pluriactivity in Western Europe.* Oxford: Arkleton Trust (Research) Ltd..

Bryden, J. (1993). *Rural Scotland and the European Community: pounds, policies and prospects.* A summary report prepared for Rural Forum Scotland. Langholm: Arkleton Trust.

Bryden, J., Bell, C., Gilliat, J., Hawkins, E. and MacKinnon, N. (1993). *Rural change in Europe: farm structures and pluriactivity.* Final Research Report to the EC. Luxembourg: CEC.

Bryden, J., Bell, C., Gilliatt, J., Hawkins, E. and MacKinnon, N. (1992). *Farm Household adjustment in Western Europe 1987-91.* Final report on the Research Programme on Farm Structures and Pluriactivity. Nethy Bridge: Arkleton Trust.

Bryden, J. (1997). Future prospects for rural areas in Europe. Paper presented at the *Objective 5b Local Authority Partnership Annual Conference, 10-11 July 1997.* Powys, Wales.

Bunce, R.G.H, Barr, C.J. and Whittacker, H.A. (1981). Land classes in Great Britain: preliminary descriptors for users of the Merlewood method of land classification. *ITE Research and development paper no. 86.* Merlewood: ITE.

Cadwallader, M. (1981). A cognitive gravity model of consumer spatial behaviour. *Journal of Regional Science*, 15, p. 279-284.

Champion, A.G. and Watkins, C. (Eds.) (1991). *People in the countryside - studies of social change in Britain.* London: Paul Chapman Publications Limited.

Cloke, P.J. (1977). An index of rurality in England and Wales. *Regional Studies*, 11, p. 31-46.

Cloke, P.J. and Edwards, G. (1986). Rurality in England and Wales 1981: a replication of the 1971 index. *Regional Studies,* 20, p. 289-306.

CEC (1985). *Perspectives for the Common Agricultural Policy: The Green Paper of the Commission.* Brussels/Luxembourg: CEC.

CEC (1988). *The future of rural society.* Commission communication transmitted to the Council and to the European Parliament on 29th July 1988 [COM(88) 371 final]. Luxembourg: European Communities.

Courtney, P. and Errington, A. (1999). Spatial patterns of economic activity: the role of small towns in the rural economy and some implications for planning and development policy. Paper presented at *RICS Research Conference, ROOTS '99.* RICS Research.

CSD (1999). *European spatial developemnt perspective: towards balanced and sustainable developemnt of the territory of the EU.* Final discussion at the meeting of Ministers responsible for regional/spatial planning of the EU, Potsdam. Luxembourg: European Communities.

Dalton, G.E. and Groves, C.R. (1990). *The role of support agencies in farm diversification in Scotland.* A study for SAC and SDA. Aberdeen: Aberdeen University.

Dalton, G.E. and Wilson, C.J. (1989). *Farm Diversification in Scotland.* Edinburgh: SAC Economic Report No. 12.

Davies, L., Mack, N. and Mitchell, M. (1995). Sustainability, equality and pluriactivity: the suitability of the farm household as a vehicle for rural development. *Progress in Rural Policy and Planning,* 5, p. 89-97. Chichester: Wiley.

Davies, L., Mitchell, M. and Mack, N. (1994). Pluriactivity, rural development and the farming community. Paper presented at the *Institute of British Geographers Conference,* Wageningen, January 1994.

Dent, J.B., Doyle, C.J., Dalton, G.E., Heal, J.W.O. and Crabtree, J.R. (1993). *Pluriactivity in the agricultural sector in Scotland.* Report prepared for the Economic and Social Research Programme on Agriculture and the Environment. Edinburgh: Edinburgh University.

Desarbo, W.S. (2002). A gravity based multidimensional scaling model for deriving spatial structures underlying consumer preference/choice judgements. *Journal of Consumer Research*, 29(1), p. 91-100.

Doyle, C.J., Ashworth, S.W., Mitchell, M. and Topp, K. (1996). "Socio-Economic Impact of Replacing Agricultural Commodity Support with Natural Heritage Incentives" *Report prepared for Scottish Natural Heritage.*

Doyle, C. & Mitchell, M. (1994). *Effectiveness of farm policies on social and economic development in rural areas in Scotland.* Report prepared for Scottish Office Agriculture and Fisheries Department, May 1994, p. 52-60.

Doyle, C., Mitchell, M. and Topp, K. (1997). Effectiveness of farm policies on social and economic development in rural areas. *European Review of Agricultural Economics* 24, p. 530-546.

Edmond, H. and Crabtree, B. (1993). *Modelling locational access to markets for pluriactivity: a study of the Grampian Region of Scotland.* Report prepared for the Economic and Social Science Research Programme on Agriculture and the Environment. Edinburgh: The University of Edinburgh.

Eikland, S. and Lie, I. (1999). Pluriactivity in rural Norway. *Journal of Rural Studies,* 15, p. 405-415.

Erlander, S. and Stewart, N.F. (1990). *The gravity model in transportation analysis: theory & extensions.* Utrecht: VSP. p. 203-213.

Errington, A. (1989). Estimating enterprise input-output coefficients from regional farm data. *Journal of Agricultural Economics,* 40(1), p. 52-56.

Errington, A. (undated). Input-output relationships and the rural economy. *Unpublished paper.*

Errington, A.J., Harrison-Mayfield, L.E. and Jones, P. (1996). *Modelling the employment effects of changing agricultural policy.* CAS Paper 33. Reading: University of Reading.

European Commission (1999). *Reform of the Structural Funds 2000-2006: comparative analysis.* Brussels: European Commission.

Ewing, G.O. (1974). Gravity and linear regression models of spatial interaction: a cautionary note. *Economic Geography*, 50, p. 83-98.

Farm Development Review, August 1991, vol. 5, no. 10, p.2-5.

Flegg, A.T., Webber, C.D. and Elliott, M.V. (1995). On the appropriate use of location quotients in generating regional input-output tables. *Regional Studies*, 29(6), p. 547-561.

Fletcher, J.E. (1989). Input-output analysis and tourism impact studies. *Annals of Tourism Research*, 16(4), p. 514-529.

Fotheringham, A.S. and O'Kelly, M.E. (1988). *Spatial interaction models: formulations and applications*. Dordrect: Kluwer.

Garin, R.A. (1966). A matrix formulation of the Lowry model for intra-metropolitan activity location. *Journal of American Planners*, 32, p. 361-364.

Gasson, R. (1973). Goals and values of farmers. *Journal of Agricultural Economics,* 24, p. 521-43.

Gasson, R. (1974). Socio-economic status and orientation to work: the case of farmers. *Sociologia Ruralis*, 14, p. 127-41.

Gasson, R., Crow, G., Errington, A., Hutson, J., Marsden, T. and Winter, D.M. (1988). The farm as a family business: a review. *Journal of Agricultural Economics,* 39(1), p. 1-42.

Gould, B.W. and Kulshreshtha, S.N. (1985). An input-output analysis of the impacts of increased export demand for Saskatchewan products. *Canadian Journal of Agricultural Economics,* 33, p. 127-149.

Harrison, L. (1992). *Agriculture's role in rural employment: a study of the relationship between agriculture and other rural employment in England and Wales.* Unpublished PhD Thesis, Reading: University of Reading.

Harrison-Mayfield, L. (1996). Agriculture's links with the rural economy: an input-output approach. In Midmore, P. and Harrison-Mayfield, L. (eds.) *Rural economic modelling: an input-output approach*, Oxford: CAB International, p. 19-34.

Haynes, K.E. and Fotheringham, A.S. (1984). *Gravity and spatial interaction models*. Beverly Hills: Sage.

Heathfield, D.F. and Wibe, S. (1987). *An introduction to cost and production functions*. Basingstoke: Macmillan.

Hewings, G.J.D and Jensen, R.C. (1988). Emerging challenges in regional input-output analysis. *Annals of Regional Science*, 22, p. 43-53.

Hodge, I. and Monk, S. (1992). *In search of a rural economy: patterns and differentiation in non-metropolitan England.* Department of Land Economy, Monograph 20, Cambridge: Cambridge University.

House of Commons (1999a). *CAP reform: rural development.* Second report by the Select Committee on Agriculture.

House of Commons (1999b). *Third Report by the Select Committee on Agriculture.*

Howrey, E.P. (1969). On the choice of forecasting models for air travel. *Journal of Regional Science*, 9(2), p. 215-224.

Hubbard, L.J. (1982). *New jobs in West Durham.* Department of Agricultural Economics, Monograph 9, Newcastle: University of Newcastle-upon-Tyne.

Huff, D.L. (1963). A probabilistic analysis of shopping centre trade areas. *Land Economics*, 39, p. 81-89.

Ilbery, B. (1998). Dimensions of rural change. In Ilbery, B. (ed.) *The geography of rural change.* Harlow: Longman. p. 1-10.

Ilbery, B. and Bowler, I. (1998). Farm agricultural productivism to post-productivism. In Ilbery, B. (ed.) *The geography of rural change.* Harlow: Longman. p. 57-84.

Ilbery, B., Healey, M., Higginbottom, J. and Noon, D. (1996). Agricultural adjustment and business diversification by farm households. *Geography*, 81(4), p. 301-310.

Isard, W. (1960). *Parallels for regional science: an introduction to regional science. London*: John Wiley and sons Ltd.

Isard, W. (1971). *Ecologic and economic analysis for regional planning.* New York: The Free Press.

Isard, W. (1999). Regional science: parallels from physics and chemistry. *Papers in Regional Science*, 78(1), p. 5-20.

Isard, EW., Saltzman, S. and Yaman, A. (1997). Trade and conflict: a gravity model reformulation. In Chatterji, M. and Yang, K. (eds.) *Regional science in developing countries*. London: MacMillan.

Jensen, R.C. (1976). An inter-industry study of the central Queensland economy. *Economic Record,* 52, p. 315-338.

Jensen, R.C. (1990). Construction and use of regional input-output models: progress and prospects. *International Regional Science Review*, 13, p. 9-25.

Jensen R. C., Mandeville, T. D. and Karunaratne, N. D. (1979). *Regional economic planning: generation of regional input–output analysis*, London: Croom Helm.

Johns, P. M. and Leat, P. M. K. (1986) *An Approach to Regional Economic Modelling: The Case of Grampian*, Economic Report No. 144, Aberdeen: North of Scotland College of Agriculture.

Kalirajan, K. (1999). Stochastic varying coefficients gravity model: an application in trade analysis. *Journal of Applied Statistics*, 26(2), p. 185-193.

Katz, J.L. and Burford, R.L. (1985) Shortcut formulas for output, income and employment multipliers. *Annals of Regional Science*, 19(2), p. 61-76.

Keeble, D. (1992). *Business success in the countryside: the performance of rural enterprise.* London: HMSO.

Kerr, G. & Mitchell, M. (2001). *Effect of the Foot and Mouth Crisis on the BordersAgricultural Economy*. Report prepared for Borders Regional Council. Penicuik: SAC Rural Business Unit.

Kilkenny, M. (1999). Inter-regional fiscal accounting. *Growth and Change*, 30(4), p. 567-589.

Lager, C. and Schöpp, W. (1985) Estimation of input – output coefficients using neo-classical production theory. In: Proceedings of the *Fifth IIASA Task Force Meeting on Input – Output Modelling,* Smyshlyaev, A. (ed.). International Institute for Applied Systems Analysis, Laxenburg, Austria, p. 151-161.

Leat, P. (1990). The future of rural society. Proceedings of *A one day conference*, Aberdeen School of Agriculture 17th November 1989. Aberdeen: University of Aberdeen.

Leat, P.M.K., Chalmers, N. and Brown, D.A. (1989) An analysis of agricultural adjustment in Grampian using an input-output model of the agriculture and food complex. *Scottish Agricultural Economics Review*, 4, Edinburgh: SAC.

Leat, P. and Chalmers, N. (1991). Analysing agricultural adjustment in Grampian using an input-output model of the agricultural food complex. In Midmore, P. (ed.) *Input-output models in the agricultural sector*, Aldershot: Avebury, p. 57-71.

Leontief, W. (1986). *Input-output economics*, 2nd edition. Oxford: Oxford University Press.

Leontief, W. (1951) Input-output economics. In: Leontief, W. (ed.) *Input-Output Economics (1966)*, Oxford University Press, New York, p. 13-29.

Lill, E. (1891). *Das Reisegesetz und Seine Anwendung auf den Eisenbahnverkehr*. Wein.

Longley, P.A., Goodchild, M.F., Maguire, D.J. and Rhind, D.W. (2000). *Information systems and science*. Chichester: John Wiley and Sons Ltd.

Lowry, I.S. (1964). *A model of metropolis. RM-4035-RC*. Santa Monica: The Rand Corporation.

Macfarlane, D. (1995). Tourism multipliers – the way forward. *Tourism and Leisure Towards the Millennium*, 2, p. 187-192.

MAFF (2000). *Towards sustainable agriculture: a pilot set of indicators*. London: MAFF.

MAFF (1999). *Towards a New Direction for UK Agriculture.* Consultation Document and Economic Note, January 1999. London: MAFF.

Marsden, T. (1999). Rural futures: the consumption countryside and its regulation. *Sociologia Ruralis*, 39(4), p. 501-520.

Marsh, J.S. (1997). *A review of agriculture, horticulture and forestry in the UK economy*. London: DTI.

Mathur, P.N. (1970). Introduction. In Carter, A.P and Bródy, A. (eds.) *Application of input-output analysis*. Amsterdam London: North Holland, p. 1-14.

McCann, P. and Dewhurst, J.H.L. (1998). Regional size, industrial location and input-output expenditure coefficients. *Regional Studies*, 32(5), p. 435-444.

McDonald, S. (1996). Structural changes in final demands and productivity growth. In Midmore, P and Harrison-Mayfield, L. (eds.) *Rural economic modelling: an input-output approach*, Oxford: CAB International, p. 69-84.

McInerney, J., Turner, M., and Hollingham, M.A. (1989). *Diversification in the use of farm resources*. Exeter: University of Exeter, Agricultural Economics Unit.

McInerney, J. and Turner, M. (1991). *Patterns, performance and prospects in farm diversification.* Exeter: University of Exeter, Agricultural Economics Unit.

McNicoll, I.H. (1985). Input-output and local authority planning: Shetland experience. In McGilvray, J.W. (ed.) *Applications of regional input-output analysis*, Fraser of Allander Institute Research Monograph 11, p. 57-66.

Medcalf, R., Midmore, P. and Harrison-Mayfield, L. (1995). *Regional input-output analysis and agriculture.* Aberystwyth Rural Economy Research Papers No. 95-03. Aberystwyth: University of Wales.

Midmore, P. (1998). Rural policy reform and local development programmes: appropriate evaluation procedures. *Journal of Agricultural Economics*, 49(3), p. 409-426.

Midmore, P. (1996). Future directions for multi-sectoral modelling and rural economics. In Midmore, P and Harrison-Mayfield, L. (eds.) *Rural economic modelling: an input-output approach*, Oxford: CAB International, p. 99-108.

Midmore, P. (1993). Input-output forecasting of regional agricultural policy impacts. *Journal of Agricultural Economics*, 44(2), p. 284-300.

Midmore, P. (1991a). Input-output in agriculture: a review. In Midmore, P. (ed.) *Input-output models in the agricultural sector.* Aldershot: Avebury, p. 5-20.

Midmore, P. (1991b). Agricultural policy impact and input-output multipliers: a critique. Paper presented at the *Operational Research Society Agriculture and Related Industries Group Meeting*, The Open University, 22nd May 1991.

Midmore, P. (1990). Estimating input-output coefficients from regional farm data – a comment. *Journal of Agricultural Economics*, 41(1), p. 108-111.

Miernyk, W.H. (1987). Regional input-output analysis: a comparison of five 'ready-made' model systems. *Review of Regional Studies,* 17(2), p. 17.

Mitchell, M. (1996). Measuring the regional economic impact of pluriactivity on Scottish farms. In Midmore, P. and Harrison-Mayfield, L. (eds.) *Rural economic modelling: an input-output approach.* Oxford: CAB International, p. 35-44.

Mitchell, M. (1994). Non-agricultural land use among farm households in Scotland. In Fresco, L.O., Stroosnijder, L., Bouma, J. and Van Keulen, H. (eds.) *The future of the land.* Chichester: Wiley, p. 345-350,

Mitchell, M. and Doyle, C.J. (1993). *Pluriactivity on Scottish farms: regional socio-economic impacts and prediction of potential.* Report prepared for the Economic and Social Science Research Programme on Agriculture and the Environment. Edinburgh: The University of Edinburgh.

Mitchell, M. and Doyle, C.J. (1996). Spatial distribution of the impact of agricultural policy reforms on rural areas. *Scottish Geographical Magazine,* 112, p. 76-82.

Morimoto, Y. (1970). On aggregation problems in input-output analysis. *Review of Economic Studies*, 37, p. 119-126.

Moss, J.E. (1992). The role of pluriactive family farms in Northern Ireland's Rural Economy, *Unpublished paper.*

NFU (1999). *A "Barometer" of the rural economy: report of the second rural summit.* London: NFU Public Affairs, May 1999.

Nitsch, V. (2000). National borders and international trade: evidence from the European Union. *Canadian Journal of Economics*, 33(4), p. 1091-1105.

O'Brien, L. (1992). *Introducing qualitative geography: measurement, methods and generalised models.* London: Routledge.

OECD (1978). *Part-time farming in OECD countries: general report.* Paris: OECD

OECD (1992). *Rural indicators: progress report.* Paris: OECD.

OECD (1994). *Creating rural indicators for shaping territorial policy.* Paris: OECD.

OECD (1996a). *Territorial indicators of employment: focusing on rural development.* Paris: OECD.

OECD (1996b). *Better policies for rural development.* Paris: OECD.

Office of Population Census Statistics (1994). *Economic activity in Great Britain - Census 1991.* London: OPCS.

ONS (1999). *Annual abstract of statistics 1999 edition*, 135, London: Stationery Office.

Ozaki, I. (1970). Economies of scale and input-output coefficients. In Carter, A.P. and Bródy, A. (eds.) *Application of input-output analysis.* Amsterdam London: North Holland, p. 280-302.

Perderson, O. G. (1986). *Landbruget i Amterne - en Input-Output Analyse.* Statens Jordbrugsøkonomiske Institut, Rapport 27, Copenhagen.

Polak, J.J. (1996). *Is APEC a natural regional trading bloc? A critique of the 'Gravity Model' of international trade.* Oxford: Blackwell. p.522-543.

Pradhan, B.K., Sahoo, A. and Saluja, M.R. (1999). A social accounting matrix for India, 1994-1995. *Economic and Political Weekly*, 34(48), p. 3378-3394.

Putman, S.H. (1983). *Integrated urban models*. London: Pion.

Quin, F. and Mitchell, M. (2000). *A review of the level of pluriactivity in Scottish farming: a summary of existing data for Scotland.* AA201 Report prepared for SERAD. Edinburgh: SERAD.

Randall, J.N. (1985). Economic trends and support to economic activity in rural Scotland. *Scottish Economic Bulletin,* 31. Edinburgh: Scottish Office.

Ravenstein, E.G. (1885). The laws of migration. *Journal of the Statistical Society,* 48, p. 167-227.

Rees, P.H. (1980). Multistate demographic accounts: measurement and estimation procedures. *Environment and Planning A*, 12, p. 499-531.

Richardson, H.W. (1972). *Input-output and regional analysis*. Trowbridge: Redwood Press Limited.

Richardson, T. (2000). Discourses of rurality in EU spatial policy: the European spatial perspective. *Sociologia Ruralis*, 40(1), p. 53-71.

Roberts, D. (1998). Rural-urban interdependencies: analysis using an inter-regional SAM model. *European Review of Agricultural Economics*, 25, p. 506-527.

Roberts, D. (1995). UK agriculture in the wider economy: the importance of net SAM linkage effects. *European Review of Agricultural Economics*, 22(4), p. 495-511.

Roberts, D. (1991). A comparison of input-output and social accounting methods for analysis in agricultural economics. . In Midmore, P. (ed.) *Input-output models in the agricultural sector*. Aldershot: Avebury, p. 311-48.

Roberts, D. and Russell, N. (1996). Income distribution and the structure of production: insights from a SAM-based model of UK agriculture. In Midmore, P and Harrison-Mayfield, L. (eds.) *Rural economic modelling: an input-output approach*, Oxford: CAB International, p. 53-68.

Robinson, G.M. (1998). *Methods & techniques in human geography*. Chichester: Wiley. p.222-229.

Robson, N., Gasson, R. and Hill, B. (1987). Part time farming: implications for farm family income. *Journal of Agricultural Economics*, 38(2), p. 167-191.

Rogers, A. (1980). Introduction to multistate mathematical demography. *Environment and Planning A*, 12, p. 489-498.

Roland-Holst, D.W. and Ferran, S. (1995). Modelling prices in a SAM structure. *The Review of Economics and Statistics*, 77(2), p. 361-371.

Roland-Holst, D.W. and Sancho, F. (1995). Modelling prices in a SAM structure. *Review of Economics and Statistics*, 77(2), p. 361-371.

Rural Forum (1991). Tenants and trees. Issue 29, Winter 1991. Perth: Rural Forum.

Rural Forum (1997). A focus on people living and working in the Scottish countryside. *Rural Forum* Issue 45, Winter 1997. Perth: Rural Forum.

Rushton, G. (1984). Use of location-allocation models for improving the geographical accessibility of rural services in developing countries. *International Regional Science Review*, 9, p. 217-240.

Scottish Office (1992). *Scottish rural life: a socio-economic profile of rural Scotland.* Edinburgh: Scottish Office.

Scottish Office (1998a). *Towards a development strategy for rural Scotland.* Edinburgh: Scottish Office.

Scottish Office (1998b). *Input-output tables and multipliers for Scotland 1995.* Edinburgh: Government Statistical Service.

Sen, A. and Smith, T.E. (1995). *Gravity models of spatial interaction behaviour.* Berlin Heidelberg: Springer-Verlag.

Sevaldson, P. (1970). The stability of input-output coefficients. In Carter, A.P. and Brody, A. (eds.) *Application of input-output analysis*. Amsterdam London: North Holland, p. 207-237.

Shucksmith, M. (1993). Farm household behaviour and the transition to post-productivism. *Journal of Agricultural Economics*, 44, p. 466-478.

Shucksmith, M. (1999). Structural changes in British agriculture beyond 2000. Paper presented at *RICS Research Conference, ROOTS '99*. RISC Research.

Slee, R.W. (1990). Agency roles and the development of farm diversification in the UK. Paper presented at the *XIV European Congress of Rural Sociology*, Giessen.

Smith, T.E. (1975). A choice theory of spatial interaction. *Regional Science and Urban Economics,* 5, p. 137-176.

SOAEFD (1998). *Objective 5b: rural diversification programme - explanatory leaflet.* Edinburgh: SOAEFD.

SOAEFD (1999). *Farm incomes in Scotland 1997/98.* Edinburgh: SOAEFD.

SPSS Inc. (1990). *SPSS/PC+ Advanced Statistics 4.0.* Chicago, Illinois: SPSS INC.

Stanley, T.J. and Sewell, M.A. (1976). Image inputs to a probabilistic model: predicting retail potential. *Journal of Marketing,* 40, p. 48-53.

STB (1998). *What to see and do in the kingdom of Fife and St. Andrews.* Edinburgh: STB.

STB (1999). *Tourist office enquiries and visitors to attractions.* Personal communication.

Stewart, J.Q. (1948). Demographic gravitation: evidence and application. *Sociometry,* 11, p. 1-58.

Thorsen, I. and Gitlesen, J.P. (1998). Empirical evaluation of alternative model specifications to predict commuting flows. *Journal of Regional Science,* 38(2), p. 273-292.

Topp, C.F.E., Mitchell, M. (2001) Forecasting the environmental and socio-economic consequences of changes in the common agricultural policy. *Agricultural Systems,* in press.

Topp, K. and Mitchell, M. (eds.) (1997). *The impact of CAP reforms on the peripheral regions of the Community.* Final report the European Union, Contract No. AAIR - CT93 0883. Auchincruive: Universities of Limerick, Galway, Evora and SAC.

Tracy, M. (1994). The spirit of Stresa. *European Review of Agricultural Economics,* 21(3/4), p 357-374.

Tydac (1999). *SPANS 7.1.* Ontario: Inter-Tydac Technologies.

Vaccara, B.N. (1970). Changes over time in input-output coefficients for the United States. In Carter, A.P. and Bródy, A. (eds.) *Application of input-output analysis*. Amsterdam London: North Holland, p. 238-260.

Wagner, J.E. (1997). Estimating the economic impacts of tourism. *Annals of Tourism Research,* 24(3), p. 592-608.

Wang, F. and Guldmann, J-M. (1996). Simulating urban population density with a gravity-based model. *Socio-Economic Planning Science,* 30(4), p. 245-256.

Waters, E.C., Weber, B.A. and Holland, D.W. (1999). The role of agriculture in Oregon's mixed economy: findings from a social accounting matrix. *Journal of Agricultural and Resource Economics,* 24(1), p. 266-280.

Wheelock, J. and Oughton, E. (1994). *The household as a focus for comparative research.* Working Paper 4. Newcastle upon Tyne: Centre for Rural Economy Publications, University of Newcastle upon Tyne.

Whitby, M.C. (1985). Job creation costs and benefits: a rural to urban spectrum. *Journal of Agricultural Economics,* 37(1), p. 77-106.

Wilson, A.G. (1988). Store and shopping centre location and size. In Wrigley, N. (ed.) *Store choice, store location and market analysis*. London: Routledge. p. 160-186.

Wilson, C.J. (1990). Incomes from farm diversification in Scotland. *Scottish Agricultural College Economic Report* 25. Edinburgh: SAC.

Xie, J. (2000). An environmentally extended social accounting matrix – conceptual framework and application to environmental policy analysis in China. *Environmental and Resource Economics*, 16(4), p. 391-406.