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LANDSCAPE CONSERVATION AND ECONOMIC INTERDEPENDENCE: A CASE-STUDY OF WELSH NATIONAL PARKS AND THE REGIONAL ECONOMY

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Abstract

Conservation of the cherished landscapes of National Parks in Britain takes place around the communities which inhabit them. Economic activities of their populations are subject to both constraints and opportunities which the statutory protection provides, with much of the development of economies displaced into their hinterlands. Analysis of spatial relationships between the three National Parks of Wales and the rest of the Wales economy has been explored using a multi-regional input-output model, based on a gravity modelling approach. This allows inter-regional feedback effects to be monitored and the structural characteristics of interdependence to be explored. Collectively, National Parks make a considerable contribution to the economy of Wales, in terms of incomes and employment, especially in economic sectors which either use the environment (such as agriculture) or depend on its quality for their existence (such as tourism). Comparison between each Park identifies differences in economic structure and performance, and allows the development of policy recommendations as a result.

Introduction

National Parks in Great Britain are significantly different in structure and function to the generally understood international definitions (IUCN Protected Area Management Category V: an area managed mainly for landscape conservation and recreation) in that they contain the living and working activities of significant communities. Specific historic patterns of human interaction with the environment are an important element of the character and attractiveness of National Parks, and their establishment has sought to defend cherished landscapes against the risks of agrarian change (especially as most are in upland areas) and increasing residential and leisure pressures. Their original purpose, envisioned in the report of the National Park Committee (1931: the Addison Committee) was to safeguard areas of exceptional national interest against despoliation, improve access on foot, and promote protection of wildlife. The first two objectives, contained in the founding legislation, have been clarified and extended, most recently in the Environment Act 1995, which established Authorities responsible for conservation and enhancement of the natural beauty, wildlife and cultural heritage in National Parks; and promotion of opportunities for the understanding and enjoyment of their special qualities.

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National Park Authorities are also required to foster the economic and social well-being of local communities within the National Park.

Where conflict exists between the two primary purposes, conservation takes priority; and the fact that fostering local economic vitality has been subsidiary to both has been a significant contention for businesses and residents of National Parks (Richards and Satsangim, 2004). The most important tool for achieving the objectives of landscape conservation has been the planning system, as National Park Authorities are planning authorities in their own right. They have controlled the volume, nature, and appearance of developments and as a consequence altered the structure and evolution of local economies. In consequence, entrenched discourses have evolved which contrast overall public good provision with the viability and prospects of the local inhabitants and communities who produce them. Critics of National Park policies regard them as inhibiting the scope for diversification of the rural economy and inappropriate to the employment needs of local communities.

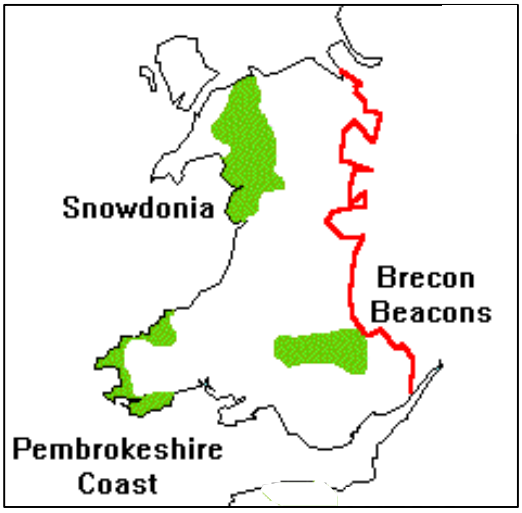
In recent years, though, a different perspective has emerged which suggests that landscape conservation of itself, both through the attraction of tourist activity and through subsequent indirect and induced multiplier impacts, is a significant contributor to local economic welfare. Vaughan *et al*. (2000) used multiplier analysis to identify the impact of tourism of Exmoor National Park, and, in demonstrating differential income and employment impacts in relation to agro-tourism and non agro-tourism spending, concluded that it was a powerful and valuable tool for analyzing the impact of tourism on a local economy. The Council for National Parks (2006) investigated the economic impact of the three Park areas of the Yorkshire and Humberside region, and concluded that although the perception of their inhabitants was unfavourable, through multiplier effects the contribution of Park-related activity to regional employment and income was significantly large; moreover, through appropriate branding and promotion, even more potential could be realised. In the United States, many studies of the economic benefits of tourism in its protected areas have come to similar conclusions by drawing on the widely available IMPLAN (1996) system, which provides micro-region estimates of economic structure (for recent examples, see Neher and Duffield, 2000; Hjerpe and Kim, 2007).

While it is of considerable importance to discover the extent to which the policy-influenced economic structures of National Parks contribute to the sustainability of their communities, few studies have investigated them in appropriate detail. Of those cited above, Vaughan *et al*. used proportionate multiplier analysis (PMA), a simplified, limited sector analysis which examines only first and second round impacts within the study area itself; the Council for National Parks uses generic multiplier estimates from English Partnerships (2004); and the IMPLAN system uses mechanically derived estimates of multipliers from scaled-down national input-output coefficients; such is the ubiquity of their use in local economic impact studies that Propst (2000) expresses serious concerns about their comprehension and interpretation.

Of particular importance in a British context is the fact that National Parks are relatively small areas which are highly specialised. This means that internal economic linkages are

weak, whereas linkages between their areas and the economy outside are much stronger. As their economic structure can be constrained by the planning powers and policy obligations of the responsible National Park Authorities, it is important to investigate linkage effects on an inter-regional as well as an intra-regional basis. Accordingly, the aim of this paper is to analyze spatial economic relationships between National Parks and the regional economy in which they are located, with a multi-regional input-output model. It uses the sub-regions of Brecon Beacons, Pembrokeshire Coast and Snowdonia National Parks in the context of the overall Wales economy, as case studies to identify inter-regional feedback effects and explore structural characteristics of interdependence.

Figure 1: Location Map of Welsh National Parks



A map showing the location of the three Parks appears in Figure 1: together, they account for 20 percent of the total land area. The Brecon Beacons National Park is an upland massif with extensive archaeological sites, contains the highest point in Southern Britain, and is easily accessible from the urban centres of South Wales and the Valleys; the Pembrokeshire Coast National Park is one of a minority in Britain which is not predominantly upland in character, but is approximately linear and encompasses spectacular coastal and estuarine scenery, much only accessible from the continuous long-distance National Trail which follows it from end to end; Snowdonia National Park is a high mountain area, extensively used for adventurous and other outdoor leisure pursuits, and accessible from West Midlands and Northwest England conurbations.

The four further sections of this paper describe the analysis method adopted, set out the empirical results of the study, comment on their interpretation, and provide a concluding discussion on policy implications and the scope for continuing research in this area.

Estimating interregional multipliers

To accurately reflect the interdependence between National Parks and the surrounding economy, the 'ideal' inter-regional input-output model first suggested by Isard (Reifler, 1973) provides an appropriate context. In essence, as well as identifying the use of inputs to produce outputs from within the region, this framework also separately identifies inputs used to produce them from all other regions described. Formally, the model is based on a system of simultaneous equations:

$$ {}_{r}X_{i} = \sum_{j=1}^{n}\sum_{s=1}^{m} {}_{rs}a_{ij\,s}X_{j} + \sum_{s=1}^{m} {}_{rs}F_{i} \qquad [1] $$

Here, X refers to total output, r and s are regions, i and j are industrial sectors, and the inter-regional input-output coefficients ${}_{rs}a_{ij}$ describe the average use of input per unit of output from the respective sector and region. However, few studies of this type have used empirically-derived regional input-output coefficients because of the cost and difficulty of accurately identifying inter-regional trade flows. Many apply adjustments of various kinds to coefficients borrowed from national input-output tables, predominantly based on location quotients, although these are disappointingly inaccurate (Round, 1983; Jensen and Hewings, 1985; and Brand 1997). The most commonly used contemporary approach is that proposed by Flegg *et al*. (1995), which adjusts a Cross-Industry Location Quotient to take into account the relative size of the regional economy:

$$FLQ_{ij} = \left(\frac{{}_{r}X_{i} / {}_{n}X_{i}}{{}_{r}X_{j} / {}_{n}X_{j}} \right) \gamma_{r}^{\beta} \qquad [2]$$

In this context, the subscript n refers to the overall national economy; the coefficient γ reflects the relative size of the national economy; in a subsequent proposal to increase its sensitivity, Flegg and Weber (1997) defined it as:

$$\gamma = \log_{2}\left(1 + \frac{\sum {}_{r}X_{j}}{\sum {}_{n}X_{j}} \right)^{\partial} \qquad [3]$$

However, there are no empirical estimates for β or δ, and a range of estimates can be evaluated for credible results; Flegg and Weber used $\beta = 4.5$ and $\delta = 0.3$ in their case study, although Tohmo (2004) has shown that a value of β of close to unity produced the best (or perhaps, least worst) estimates in comparison to a survey-derived table in the Finnish region of Keski-Pohjanmaa.

Where the FLQ is less than one, it is multiplied with the respective national input-output coefficient to produce a regional estimate; otherwise the national input-output coefficient is used. This produces an estimate of local usage of inputs by sector, with traded inputs from other sources left as a residual. Therefore, in addition to problems of inaccuracy, the approach can at best produce an estimate of a single region input-output matrix, which for reasons discussed in the introduction is of little use in the context of a small, specialized, and highly interdependent region.

A more promising prospect arises from the results of a recent survey-based input-output matrix for the Moray, Badenoch and Strathspey Enterprise Area, which offered the opportunity to compare results derived from location quotient approaches and the local sub-matrix of a gravity model based estimate of a 40-region system in Scotland (Riddington *et al*., 2006). Their estimation is based on regression equations which make trade flows of products and services between regions depend on their relative sizes as,

respectively, producers and consumers, and the cost of transport between them. Formally, for each sector,

$$\ln(X_{ij}) = \alpha + \beta^* \ln(V_i) + \gamma^* \ln(U_i) + \delta^* \ln(D_{ij}) + \varepsilon_{ij} \quad [4]$$

where X_{ij} is the trade flow between each region, V_i is the local production in the source region, U_j is the local absorption in the destination region, and D_{ij} is the distance between source and destination. Using this framework, similar results to the survey have been estimated, whereas in comparison location quotient approaches produce misleadingly inflated results. Riddington *et al*. conclude that further utilization and extension of gravity-based input-output table estimates would be worthwhile. Since their approach is fully compatible and consistent with the Scottish inter-regional input-output system (of which they form an element), it appears appropriate to adopt it for exploration of the interdependence between the sub-regions of the Welsh National Parks and the Welsh economy as a whole.

The procedure adopted to develop the inter-regional input-output transactions matrix for Wales and its National Parks involved five stages. The estimation was founded on the survey-based regional input-output matrices for Wales in 2000 (Bryan *et al*., 2004) and unpublished results of the 2001 ONS Annual Business Inquiry for electoral wards in Wales.[1] The original Wales transactions matrix describes 72 productive sectors, but due to missing sectors in some National Parks and data incompatibilities, the production structure is aggregated into 47 sectors.

The first stage involved description of local production for each of the four areas. Output per employee by productive sector was calculated from the Wales 2000 Make matrix (with the broad structure set out in Table 1), and allocated between areas on the basis of full-time equivalent employment levels. Quite significant differences exist in relative employment structures, especially in agriculture, forestry and fishing, and hotels and restaurants, and also between National Park areas themselves.

The second stage used the Wales input-output coefficients to estimate total absorption by sector in each of the four areas, on the basis of the preceding step. This required application of the contentious assumption that technical production conditions are uniform across all areas described in the aggregate Wales accounts.

Using the estimates of total production and absorption for the 44 sectors of the inter-regional input-output model, the third stage used the gravity approach to identify the extent to which local production in each area is absorbed, or leaks out into other areas or to the world outside Wales. Riddington *et al*. used three levels of estimation procedure for trade flows: a national level setting out broad trade flows between three main sectors

[1] Access to these data required a Chancellor of the Exchequer's notice; in order to protect commercial confidentiality, some details have been omitted. Employment data by ward and 4-digit SIC allowed most of the National Parks to be described, although in the few cases where the National Park boundaries bisected ward areas, the allocation of employment between them and the rest of the Wales economy was estimated.

(Scotland; the rest of the UK, RUK; and the rest of the world, ROW); a regional level with less aggregated trade flows between Scottish and English regions, and ROW; and a local level using 53 sectors and 40 areas, 11 RUK regions, *extra-regio*, and ROW. Since the trade balances between Wales, RUK and ROW are identified by the Wales input-output matrices, and the size of three of the four regions described is relatively very small, trade flows were estimated in this case on a single level describing the four Welsh regions and the RUK, representing ROW. For each sector, parameters for identifying trade flows were identified from the regression equations [5], initial estimates of trade flows X_{ij} were derived on the basis of regression parameters and distances D_{ij}, which were set for each sector on the basis of distances between the main sources and destinations in area.

Table 1: Employment by Sector, Wales and National Parks, 2001

	Brecon Beacons NP	Pembrokeshire Coast NP	Snowdonia NP	Rest of Wales
Agriculture, forestry and fishing	13.6%	7.2%	10.1%	0.8%
Mining and quarrying	0.1%	0.6%	0.2%	0.2%
Manufacturing	12.6%	9.9%	12.1%	16.2%
Energy and water	0.1%	0.4%	1.6%	0.5%
Construction	2.9%	5.4%	5.2%	4.2%
Retail, wholesale, motor trades and repairs	14.5%	16.8%	12.9%	17.3%
Hotels and restaurants	9.1%	16.6%	15.4%	6.3%
Transport, storage and communication	3.4%	6.6%	2.2%	4.6%
Finance and business activities	7.6%	6.8%	5.4%	11.4%
Public administration	4.3%	2.2%	4.6%	7.7%
Education	11.9%	12.4%	10.9%	10.5%
Health	6.6%	4.6%	9.5%	10.2%
Other industries	13.4%	10.5%	10.1%	10.0%
Source: ONS Annual Business Inquiry, 2001				

The fourth stage employed an RAS procedure to reconcile individual estimated flows between the five regions identified with the known row and column totals. The fifth stage distributes imports among sectors in the inter-regional input-output transactions matrix according to proportionate overall absorption (analogous to the supply-demand pool procedure of Schaffer and Chu, 1969). The data transformations, the estimation of trade flows between National Park areas and the rest of the Wales economy, and particularly the extent of local absorption of local production, were reviewed in key informant interviews. These were held with Park officials with responsibility for economic development, and their counterparts in local government, enterprise agencies, and local officers of the Welsh Development Agency.[2]

[2] The Welsh Development Agency was incorporated into the Assembly Government's Department for Enterprise, Innovation and Networking in 2005. In the 2007 reorganisation, the latter has become the Department for the Economy and Transport.

Table 2: Summary Inter-regional Transactions Matrix, National Parks and the rest of the UK, 2001.

		Brecon Beacons NP			Pembrokeshire Coast NP			Snowdonia NP			Rest of Wales					
		Primary Industries	Manufacturing, Construction	Utilities and Services	Primary Industries	Manufacturing, Construction	Utilities and Services	Primary Industries	Manufacturing, Construction	Utilities and Services	Primary Industries	Manufacturing, Construction	Utilities and Services	Exports	Other final demand	Gross output
Brecon Beacons NP	Primary Industries	1.28	0.22	0.17	0.07	0.01	0.01	0.10	0.23	0.00	3.03	13.45	1.78	0.39	36.13	56.88
	Manufacturing, Construction	0.09	4.72	1.42	0.01	0.09	0.09	0.28	0.68	0.00	0.15	32.66	16.98	1.26	147.50	205.93
	Utilities and Services	0.52	0.97	5.70	0.03	0.03	0.36	0.47	2.12	0.00	0.93	10.29	63.28	2.18	346.51	433.38
Pembrokeshire Coast NP	Primary Industries	0.13	0.06	0.02	0.33	0.45	0.12	0.16	0.40	0.00	2.03	9.54	1.03	21.46	42.65	78.40
	Manufacturing, Construction	0.08	0.38	0.17	0.05	1.09	1.10	0.38	2.21	0.00	0.88	22.78	13.30	48.54	78.53	169.48
	Utilities and Services	0.07	0.17	0.74	0.08	0.52	9.96	1.19	5.88	0.00	0.69	14.16	67.07	277.18	387.54	765.25
Snowdonia NP	Primary Industries	0.06	0.01	0.01	0.31	0.05	0.02	0.47	1.10	0.00	0.48	2.14	0.28	24.36	39.42	68.71
	Manufacturing, Construction	0.37	0.34	0.85	21.18	0.52	2.36	4.77	41.13	0.00	4.44	33.35	71.58	354.37	445.22	980.47
	Utilities and Services	0.04	0.11	0.49	0.23	0.11	1.26	5.38	20.49	0.00	0.24	5.16	22.68	433.83	148.52	638.53
Rest of Wales	Primary Industries	1.29	0.31	0.17	0.50	1.61	0.62	0.35	0.83	0.00	60.87	274.39	34.40	84.22	430.07	889.65
	Manufacturing, Construction	3.72	36.39	11.38	1.13	22.32	21.66	5.93	26.85	0.00	96.27	7008.81	2651.66	2121.57	8737.53	20745.24
	Utilities and Services	3.25	12.27	56.49	0.91	8.98	98.03	9.78	53.46	0.00	101.19	2151.72	10029.61	4950.61	26210.52	43686.83
	Imports	26.97	104.94	153.27	31.63	85.32	322.21	20.63	678.31	299.06	251.09	4706.06	8369.92	26.97	104.94	56.88
	Other primary inputs	18.99	45.05	202.48	21.94	48.37	307.46	18.81	146.77	339.47	367.36	6460.73	22343.25			
Total Input		56.88	205.93	433.38	78.40	169.48	765.25	68.71	980.47	638.53	889.65	20745.24	43686.83			

The main implications of the model framework and principal destinations used as proxies for transport cost were identified and substantiated in these discussions, and consequently potential *ad hoc* changes which were envisaged were not required.

Analysis of interdependence and economic linkages

The resulting inter-regional transactions matrix is summarised in aggregated from in Table 2. It suggests that the matrix structure of overall inter-regional transactions is approximately triangular, with the majority of flows across National Park boundaries and within the rest of Wales sub matrix. As a consequence, most of the multiplier impacts of activity within the National Park areas will be expressed in terms of dependent output, income and employment outside of their boundaries. From equation [1], transferred into matrix notation, final demand and production structure are related in familiar form via the Leontief inverse, or multiplier matrix,

$$\mathbf{x} = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{f} = \mathbf{B}\mathbf{f} \qquad [5]$$

so that the column elements $\{_{rs}b_{ij}\}$ where $r = s$ represent the output from sector i required to produce one unit of output in sector j, within the region (and where $i = j$ it includes the direct and any indirect requirements); where $r \neq s$, the column elements represent indirect effects which occur entirely outside the region. Consequently, the multiplier impact can be partitioned to show within area effects and effects on the aggregate regional economy. In addition, the model can be solved separately for each National Park area, treating inter-regional transactions as exogenous. In this way, three levels of interaction can be described; those entirely within each National Park area; those entirely within each National Park area, taking into account linkages which cross their boundary but then return in subsequent rounds of impact; and those which occur outside in the rest of the regional economy. Table 3 provides selected details of output multiplier relationships, partitioned on an inter-regional basis.[3]

One immediate, expected, result is the fact that internal interdependence is substantially smaller than linkages across the National Park boundaries: however, the degree to which this occurs is more surprising. On average, the proportion of indirect impact which is entirely within the respective areas is 1.5% for both the Brecon Beacons and Pembrokeshire Coast National Parks; for the Snowdonia National Park, it is somewhat larger at 9.1%. Feedback effects which pass outside the Parks and link back again are also of insignificant magnitude. The five sectors which create the largest linkages on aggregate differ slightly between the Parks, but manufacturing and the dairy and meat processing sectors appear to create relatively strong linkages. The appearance of engineering products, oil processing, and textiles in the top five output multipliers reflects the existence of significant amounts of these activities, respectively, in each of the National Parks; conversely, rubber and plastic products, vehicles, paper and paper products, engineering products, and metal products all employ relatively limited numbers

[3] Detailed multiplier estimates for all sectors are available from the author.

of workers and thus, despite high multipliers, generate relatively little impact on aggregate.

Table 3: Selected Output Multipliers

Sector	Internal multiplier	Interregional multiplier within Park	Interregional multiplier overall
Brecon Beacons National Park			
Vehicles	1.035	1.091	2.943
Dairy products	1.046	1.078	2.732
Meat processing	1.048	1.078	2.701
Metal products	1.010	1.061	2.676
Engineering products	1.030	1.072	2.546
Agriculture and fishing	1.034	1.066	2.215
Forestry	1.014	1.030	1.608
Hotels, bars and restaurants	1.014	1.043	1.886
Pembrokeshire Coast National Park			
Oil processing	1.475	1.482	2.203
Electricity	1.056	1.096	2.047
Vehicles	1.012	1.033	2.021
Paper and paper products	1.000	1.039	1.993
Metal products	1.010	1.029	1.947
Agriculture and fishing	1.004	1.038	1.662
Forestry	1.031	1.043	1.378
Hotels, bars and restaurants	1.008	1.022	1.566
Snowdonia National Park			
Meat processing	1.024	1.054	2.096
Textiles	1.025	1.028	1.563
Dairy products	1.064	1.065	1.557
Paper and paper products	1.032	1.035	1.557
Rubber and plastic products	1.023	1.027	1.553
Agriculture and fishing	1.045	1.048	1.447
Forestry	1.026	1.027	1.221
Hotels, bars and restaurants	1.033	1.033	1.325
Rest of Wales			
Oil processing	1.500	2.825	2.873
Vehicles	2.037	2.726	2.755
Meat processing	1.643	2.573	2.606
Dairy products	1.745	2.565	2.605
Electricity	1.780	2.561	2.607
Agriculture and fishing	1.434	2.073	2.097
Forestry	1.213	1.550	1.566
Hotels, bars and restaurants	1.314	1.815	1.831

Comparison of the aggregate output multipliers with the rest of Wales provides an unexpected result. Although these are generally quite a lot lower for the Pembrokeshire Coast and Snowdonia National Parks, in the Brecon Beacons they are all slightly higher. On the other hand, across the Parks, two of the industries which might be expected to act as key linkage generators, agriculture and fishing, forestry, and the hotel and catering sector (as a proxy for tourism activity) generate relatively weak impacts. Out of 47 sectors identified agriculture and fishing ranks 16th, 19th and 14th in the Brecon Beacons, Pembrokeshire Coast, and Snowdonia National Parks, respectively, in

comparison to 21st in the rest of Wales; forestry ranks 37th, 39th and 34th, compared to 42nd; and the hotel and catering sector ranks 29th, 27th and 23rd respectively, in comparison to 34th elsewhere. In terms of Hirschmanian key sector indicators (which normalise individual output multiplier as a percentage of the overall average of output multipliers), the values for agriculture and fishing are 112%, 105% and 108%, respectively (in the rest of Wales, the indicator is 102%); the hotel and catering sector performs rather less well with values of 95%, 99% and 99%, respectively (and elsewhere in Wales, 89%); forestry, for which the values are 81%, 87%, and 91% (76% in the rest of Wales) is further down the scale.

Table 4: Selected Income Multipliers

Sector	Interregional multiplier within Park	Interregional multiplier overall
Brecon Beacons National Park		
Vehicles	1.022	3.716
Dairy products	1.015	3.505
Drinks and tobacco	1.015	3.029
Agriculture and fishing	1.016	2.980
Meat processing	1.016	2.957
Forestry	1.010	1.425
Hotels, bars and restaurants	1.011	1.656
Pembrokeshire Coast National Park		
Vehicles	1.008	2.426
Meat processing	1.010	2.238
Paper and paper products	1.008	2.215
Drinks and tobacco	1.007	2.145
Agriculture and fishing	1.008	2.047
Forestry	1.016	1.271
Hotels, bars and restaurants	1.005	1.405
Snowdonia National Park		
Electricity	1.022	2.210
Dairy products	1.011	1.765
Agriculture and fishing	1.009	1.685
Vehicles	1.008	1.679
Paper and paper products	1.007	1.676
Forestry	1.006	1.159
Hotels, bars and restaurants	1.007	1.224
Rest of Wales		
Oil processing	1.425	5.881
Electricity	1.282	4.517
Gas	1.344	3.588
Vehicles	1.435	3.453
Dairy products	1.337	3.313
Agriculture and fishing	1.261	2.781
Forestry	1.159	1.397
Hotels, bars and restaurants	1.205	1.612

Selected income multipliers are shown in Table 4. The pattern they display broadly follows that of the output multipliers, in that 'out of Park' linkages are significantly greater than those generated within. In terms of income generation, agriculture and

fishing appear in the top five multipliers in the Pembrokeshire Coast and Brecon Beacons National Parks, but in forestry and the hotel and catering sector overall linkages are everywhere relatively low in the overall rankings. The Brecon Beacons National Park exhibits slightly stronger income multiplier effects on aggregate in the Wales economy than those which exist outside the Parks. On the same basis, employment multipliers, shown in Table 5, are relatively large on average, but again display approximately the same pattern as output and income multipliers.

Table 5: Selected Employment Multipliers

Sector	Interregional multiplier within Park	Interregional multiplier overall
Brecon Beacons National Park		
Dairy products	1.179	4.966
Drinks and tobacco	1.161	4.391
Metal products	1.115	4.064
Mining and quarrying	1.103	3.602
Other transport equipment	1.089	3.547
Agriculture and fishing	1.074	2.334
Forestry	1.039	1.681
Hotels, bars and restaurants	1.016	1.306
Pembrokeshire Coast National Park		
Electricity	1.159	4.885
Drinks and tobacco	1.078	2.891
Metal products	1.046	2.698
Clothing and leather products	1.056	2.565
Mining and quarrying	1.052	2.481
Agriculture and fishing	1.038	1.702
Forestry	1.044	1.404
Hotels, bars and restaurants	1.007	1.185
Snowdonia National Park		
Electricity	1.323	2.980
Dairy products	1.134	2.194
Drinks and tobacco	1.076	2.028
Clothing and leather products	1.053	1.999
Metal products	1.077	1.848
Agriculture and fishing	1.036	1.424
Forestry	1.021	1.224
Hotels, bars and restaurants	1.008	1.099
Rest of Wales		
Oil processing	13.653	13.941
Gas	10.644	10.856
Electricity	7.035	7.173
Dairy products	4.557	4.649
Drinks and tobacco	4.047	4.102
Agriculture and fishing	2.169	2.195
Forestry	1.608	1.625
Hotels, bars and restaurants	1.278	1.283

Implications of the analysis

It is particularly important to contextualise the results set out above. While the prospect of deploying inter-regional input-output models based on gravity model estimations of trade flows provides an appealing alternative to location quotient approaches, the empirical basis for adopting rests on just one example. There is some support, in this case, from triangulation of the mechanically generated estimates of trade flows with key informant interviews, but it should be acknowledged that these relate only to major and significant details in each of the three cases; while some significance should be attached to the most important coefficients, there is considerable scope for cross hauling between the (majority of) less important of the 47 sectors described. Further, the fundamental basis of all non-survey approaches is the assumption that the total input-output relations (technical coefficients) derived from the aggregate transactions matrix broadly represent the technology of production in the disaggregated sub-regions. In the National Parks, where the size of transactions flows is particularly small in relation to the overall Wales economy, this is much less likely to be the case. Alongside these specific issues, the general limitations of input-output analysis such as short-term validity should be noted; for example, significant reductions in dairy production and milk processing in Wales since 2001 probably skew all of the linkage estimates. There are also problems associated with aggregation biases and assumptions of supply elasticity.

No 'Type II' multipliers, which would account for induced as well as indirect linkages, have been calculated. Despite the fact that the fuller Social Accounting Matrix approach, identifying inter-regional transactions between productive sectors and a breakdown of households by income distribution and other institutions, can provide important additional insights (for example Roberts, 2000; Psaltopoulos *et al*., 2006), the focus here has been on production structure and interdependence. Also, in this context, accurate identification of the more detailed disaggregation required cannot be aided by gravity equation modelling.

Consequently, these estimators of linkage analysis should emphatically not be used as a means of informing policy at a detailed sectoral level, to maximise the income or employment associated with economic activity in the National Parks. Rather, subject to the preceding caveats, they provide important hints concerning the nature of the trade-off between landscape conservation and economic development; and, as convenient exemplars, albeit constrained by National Park designation, they can yield some general clarification of interdependence in small rural economies.

The fact that internal linkages between output, income, and employment in the Welsh National Parks are absolutely small, but significantly greater when their role in the overall regional economy is accounted for, vindicates the use of an inter-regional approach. Consequently, multiplier analyses (such as single region input-output models) which fail to take some kind of hierarchy of economic space into account do not provide a clear or comprehensive representation.

It is noticeable, when comparing linkages between the major employment sectors in agriculture and tourism with those outside the National Parks, that the effects of designation have adversely influenced the economic structure within them. The weaker overall linkages in two out of three of the National Parks were expected, but the slightly stronger effects in the case of the Brecon Beacons are more puzzling, and no plausible explanation is immediately apparent. Other differences in structure across the three cases are probably a reflection of different agronomic conditions, forms of tourism and leisure activities, degrees of accessibility in relation to major urban centres, and contextual factors such as the existence of oil refining activity in the Milford Haven estuary. While overall, the multiplier effects of agriculture, food processing, tourism, and to a lesser extent, forestry contribute significantly to the overall economy of Wales (Hyde and Midmore, 2006) they contribute significantly less than proportionately to their 'host' economies.

Conclusions for rural development policy

As rural areas continue to evolve from production to consumption spaces, these vignettes of economic structure in the National Parks of Wales have important implications for the pace and direction of policy reform in the European Union. Despite shifts in rhetoric, support for agriculture continues to dominate budgetary priorities, undermining the designation of the Rural Development Programme as the 'Second Pillar' of the CAP. In part, this is associated with agri-centrism within the rural policy community, in government administrations, lobby groups and among expert commentators (see Cahill and Hill, 2004; and Dwyer *et al*., 2007). One central tenet of the conventional wisdom of agri-centrism is that, despite the decline of direct economic importance of farming in the rural economy, it exerts a strong indirect employment multiplier impact; hence rationalising the focus on farm-based developments as the major element of Pillar Two policies. The evidence of this case study is that the multiplier effect is, in fact, rather weak, and that with increasing tendencies to consolidation and centralisation of food supply chains, is likely to become progressively weaker still.

Nevertheless, and especially in the context of protection of cherished landscapes, farming remains vulnerable to negative consequences of policy change, and so requires support for the provision of public goods which are essential for economic vitality in the rest of the rural community. Thus, while more resources in support of non-farm rural development would be welcome, they should not be at the expense of those parts of Pillar Two which encourage agriculture to fulfil its modern multi-functional role. The most obvious way of accommodating these concerns is to accelerate the modulation of spending from Pillar One to Pillar Two, and use the bulk of the proceeds to enhance Axes 3 and 4 of the current regulation, which are concerned with diversification of the rural economy, and integrated local action in succession to the LEADER Programme. The heterogeneity of rural areas in terms of production structure, revealed by the analysis, suggest that Axis 4 has the most potential to develop strategies for rural development which utilise local expert knowledge of economic capacity to develop new markets and exploit opportunities for diversification.

A further issue revealed by this analysis is the high level of local leakage from the hotel and catering sector in the National Park areas. Since it is more or less twice as important in terms of the relative share of employment within the Parks compared with the rest of the Welsh economy, this seems to provide a *prima facie* case for policy action, especially as the sector is characterised by numerous small and poorly coordinated businesses. However, it is important to note that hotels, restaurants and bars is only one element of the complex of tourism activities, and the Standard Industrial Classification system is a poor basis for description of it. However, recent developments in tourism satellite accounts (Bryan *et al*., 2006), when integrated with regional input-output accounts, have potential for better description and analysis of this centrally important part of the sub-regional economies of the National Parks, and could be applied at this level.

The general arguments of this analysis are necessarily tentative, because of the limited and specific nature of the evidence. In this respect, gravity modelling of trade flows might provide the basis for outlining local economic structures, if further empirical tests support the initial, and as yet sole, indication of their accuracy. Where it is used to provide predictions of trade flows internationally, it is surprisingly accurate given its lack of a firm theoretical foundation (Bergstrand, 1985). The more specific arguments also provide only limited evidence of the impact of National Park designation on economic structures and linkage patterns, since they are only based on static analysis. To gain better insights some appreciation of change over time is necessary. The easiest way to do this would be through use of comparative statics, and that would be possible since an input-output matrix exists for Wales for 1968 (Ireson and Tomkins, 1978); if the necessary data to estimate the gravity equations can be obtained, comparison between the structures over about a quarter century could provide more authoritative conclusions. These suggestions for further research would redress some of the deficiencies of the present paper. The final, and perhaps firmest, conclusion that can be reached is that the processes of economic development in rural areas are not well understood and should be a priority for further research.

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