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Assessment of Local Key Sectors in a Triple-Layer Spatial System

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Assessment of Local Key Sectors in a Triple-Layer Spatial System:

Microsimulation and Input-Output Models as Tools for Multi-Level Policy Analysis

Eveline van Leeuwen, Yoshifumi Ishikawa and Peter Nijkamp*

Abstract

This article addresses the differentiated impacts of various sectors and branches in a multi-layer regional system. As a case-study the Cairngorms National Park (CNP) in Scotland is used. In this area, policy makers —at different administrative levels— strongly emphasize the need for new sustainable economic development. We use a novel combination of stakeholder analysis with household questionnaires and interregional input-output analysis to define the most important local key-sectors as carriers for local sustainability. The methodological vehicle employed is based on microsimulation. This paper demonstrates how, even for small areas such as the CNP in Scotland, survey information combined with secondary data and existing input-output tables can be integrated into a useful policy tool.

Keywords

Input-output analysis, microsimulation, key-sectors, Scotland, multi-regional

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1. Sustainable Local Development in Rough Seas

The space-economy is a dynamic and spatially-functionally interconnected system of regions. Despite the current rhetoric on 'the death of distance' or 'the flat world', spatial systems show a high degree of disparity and heterogeneity in terms of many economic indicators: employment, consumption patterns, industrial structure, and entrepreneurship. Such systems may also exhibit complex spatial dynamics as a result of interactive forces among distinct agents in a space-economy. Regions are the home of various economic agents, and upscaling of a given region (through spatial aggregation of economic functions and interlinkages) to a higher-order region also implies that socio-economic structures and performances will alter. Regions are by no means stable economic entities, and their relative performance level is critically dependent on the degree and nature of spatial aggregation and representation. Each geographical scale level displays differences in various economic functionalities. And therefore, a multi-level space-economy exhibits a high degree of socio-economic heterogeneity, in which various regions exert centripetal and centrifugal forces on others. Clearly, the spatial socio-economic landscape is permanently in motion and does not show a uniform stable profile. Regions in a spatial system are also influenced by other forces such as trade, migration, transformation and the environment. Consequently, regions are no islands of economic tranquility, but offer varying performance pictures depending inter alia on the geographic aggregation level and structure.

The present paper aims to map out the complexities involved when a multi-layer system of regions is considered, that displays socio-economic heterogeneity at various scale levels. An innovative mix of micro- and macro-information is used, allowing to take into account both detailed local processes and redistributive macro-processes. It seeks to trace the various socio-economic implications of interlinked regions by focussing on a triple-layer input-output connectivity structure. A main instrument to be used is micro-simulation analysis. This results in two interesting outcomes: the determination of local and national key-sectors based on output and multiplier effects; and deeper provision of insights into one key sector, the retail sector.

The actual case study addresses the Cairngorms National Park in Scotland and its linkages to various surrounding areas. In this context, an integration of micro-simulation methods and multi-layer input-output methods will be developed. This approach is able to show quite some variability in spatial-economic profiles at different spatial scales. The policy conclusions from these experiments will be presented at the end.

The structure of our study is as follows. In Section 2, all modeling aspects will be described, including a picture of the research area Cairngorms National Park, the design of the microsimulation process, and the development of a triple-layer input-output model. Section 3 will focus on the key-sectors as most important micro-macro sectors, while in Section 4 the importance of household consumption and possible policy measures is assessed. Finally, Section 5 draws some relevant conclusions.

2. Spatial Impact Analysis with Stakeholder Behaviour, Microsimulation and Input-Output Modeling

2.1 Sustainable economic development in the Cairngorms National Park

The Cairngorms National Park (CNP) is the largest national park in the UK and was created as a result of the National Park (Scotland) Act in 2003. It covers approximately 3,800 km2 and is home to approximately 16,000 human residents as well as significant protected habitats and species. National Parks in Scotland are explicitly required to achieve 'sustainable development', as illustrated by the four statutory duties set out in the Park Act (CNP, 2010a):

1. to conserve and enhance the natural and cultural heritage of the area;
2. to promote sustainable use of the natural resources of the area;
3. to promote understanding and enjoyment of the special qualities of the area by the public;
4. to promote sustainable economic and social development of the area's communities.

The CNP boundary deliberately includes settlements, as the National Park is an example of a living protected landscape that is shaped by ongoing human activities. The CNP is one of the most sparsely populated parts of the United Kingdom. The age profile indicates that there are less children, less people of a working age and more retired people (aged 65 years or more) than the overall Scottish average. This profile has been stable from 2001-2007.

The mean house price in the Park in 2007 was £178,541. In 1998, the mean house prices were lower than the Scottish average, but in 2007 they were 20% higher than the Scottish average. This suggests a rise in demand in –or a higher appreciation for– homes in this ecological area. The population has been growing steadily since 2003. However, it is important to recognize that the communities within the Park are heterogeneous, consisting of long-term rural residents whose families have lived in the area for generations as well as recent economic or amenity immigrants attracted by the special qualities of the Park. There are differences by gender, age, class, occupation and land tenure as well as important differences in terms of preferences and attitudes to land use, environmental protection and economic development.

The percentage of total population who are income –or employment– deprived is half that of the Scottish average. There are also lower than average rates for depression, alcohol abuse and drugs abuse reported (CNP, 2010b).

The CNP is an interesting case-study, since the goals of the local authorities are: Conserving and Enhancing the Park; Living and Working in the Park; and Enjoying and Understanding the Park. These goals can clearly reinforce but also contradict each other. Therefore, a deeper insight into the ties of the local economy is important to local and national policy makers. Consequently, there is a need for a more thorough investigation of the behavior of residents and the related socio-economic profiles and interlinkages. To this end, we will combine in our applied work input-output analysis and microsimulation methods.

2.2 Simulating individual households: microsimulation as a hybrid context

Regional input-output analysis has become a common tool for local and regional planning. In order to derive regional input-output data, many researchers use a hybrid approach with a combination of superior data (or partial surveys) and non-survey techniques (including RAS techniques). Hybrid approaches were initially developed in response to dissatisfaction with the cost of survey models and the limited accuracy of non-survey models. This approach has become so popular and highly valued, because it offers appropriate empirical results without the need for prohibitively expensive pure surveys.

According to West (1990), hybrid methods can be subdivided into `bottom-up` methods –such as the DEBRIOT procedure outlined by Boomsma and Oosterhaven (1992), which uses only information from the respective regions concerned – and `top-down` methods, which use a national input-output table as a point of departure. An example of the latter approach is the GRIT (Generation of Regional Input-Output Tables) technique pioneered by West (1980), which is known as a top-down method.

A new and complementary bottom-up method is the use of microsimulation models (MSM). Simulation as a method of problem-solving becomes attractive when conventional analytical, numerical or physical experimental methods become too time-consuming, expensive, difficult, hazardous and/or irreversible or even impossible as real-world experiments for solving a problem (Merz 1991). MSM is a technique that aims at modelling and replicating the likely characteristics or behavior of individual persons, households, or individual firms. In simulation modelling, the analyst is interested in information relating to the joint distribution of attributes over a population (Clarke and Holm 1987). In these models, agents represent members of a population for the purpose of studying how individual (i.e. micro-)behaviour generates aggregate (i.e. macro-)regularities from a bottom-up approach (see e.g. Epstein 1999).

A particular advantage of MSM relates to data linkage (coupling). Often, at a low geographical level, the data availability is relatively poor. Provided that there is a link through at least one common attribute, MSM can include different data sets (for example, questionnaire results and census data at different geographical levels) in the same simulation exercise. This allows the models to be driven by new variables such as household income and expenditure.

For MSM to be a useful tool in constructing input-output tables, a static, deterministic approach would be most appropriate. This means that when a (rich) database of micro-units is created, the adjustment of the structure is reached exclusively by re-weighting the available information due to exogenously given aggregate data (constraint variables). After reweighting a sample, one micro unit will then represent another number (given by the new weights) of respective units in the whole population. By using several constraint variables simultaneously, the simulated population with its characteristics remains very heterogeneous and is close to the actual situation.

However, the selection of the constraint variables is an important choice that should be made using insights from the literature and from the specific area under study. When using information on (the location of) household expenditures, for example, not only the number of households and their size should be taken into account, but also the household's income group, whether they own a car, and whether and where they have a job (see van Leeuwen and Rietveld, 2011). When taking all these characteristics into account, the expenditures over different sectors and in different locations can be quite well simulated.

2.3 Simulating the Cairngorms households

As mentioned earlier, the main aim of this research is to get a detailed picture of the population of the CNP, specifically related to their spatial retail behavior. Our two main data sources are results from a questionnaire, held in early 2010 in the context of the EU-FP7 project SMILE[1], and a dataset obtained from ADMAR, a company that collects marketing lists and enhance datasets. Those two datasets provide both very detailed micro-level information. Within the questionnaire, the focus was on where people buy different types of products and services, as well as on the location of their work. The ADMAR dataset contains more information about internet use, gas and electricity use, the kind of dwelling people are living in, etc. Besides the already mentioned complementary information, the two datasets also have similarities through which they can be linked; these are household size, household age, length of residence, tenure and household income.

To simulate the households under consideration, we used a novel combination of matching and MSM techniques to get the most extensive picture (see van Leeuwen 2013 for a detailed description of this approach and Figure 1, for the steps to be taken). Based on insights from the literature and from the questionnaire, constraint variables for the matching and MSM procedures were next selected. Furthermore, statistics on the current situation of the CNP were collected from various sources, such as reports from local authorities. The matching procedures resulted in a new and more heterogeneous dataset, the questionnaire/ADMAR micro-population, as described in van Leeuwen (2013). This was used as an input for the final microsimulation.

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[1] The EU-FP7 project SMILE (Project no.217213) aimed to analyse the trade-offs and synergies that exist between the different objectives related to sustainable development.

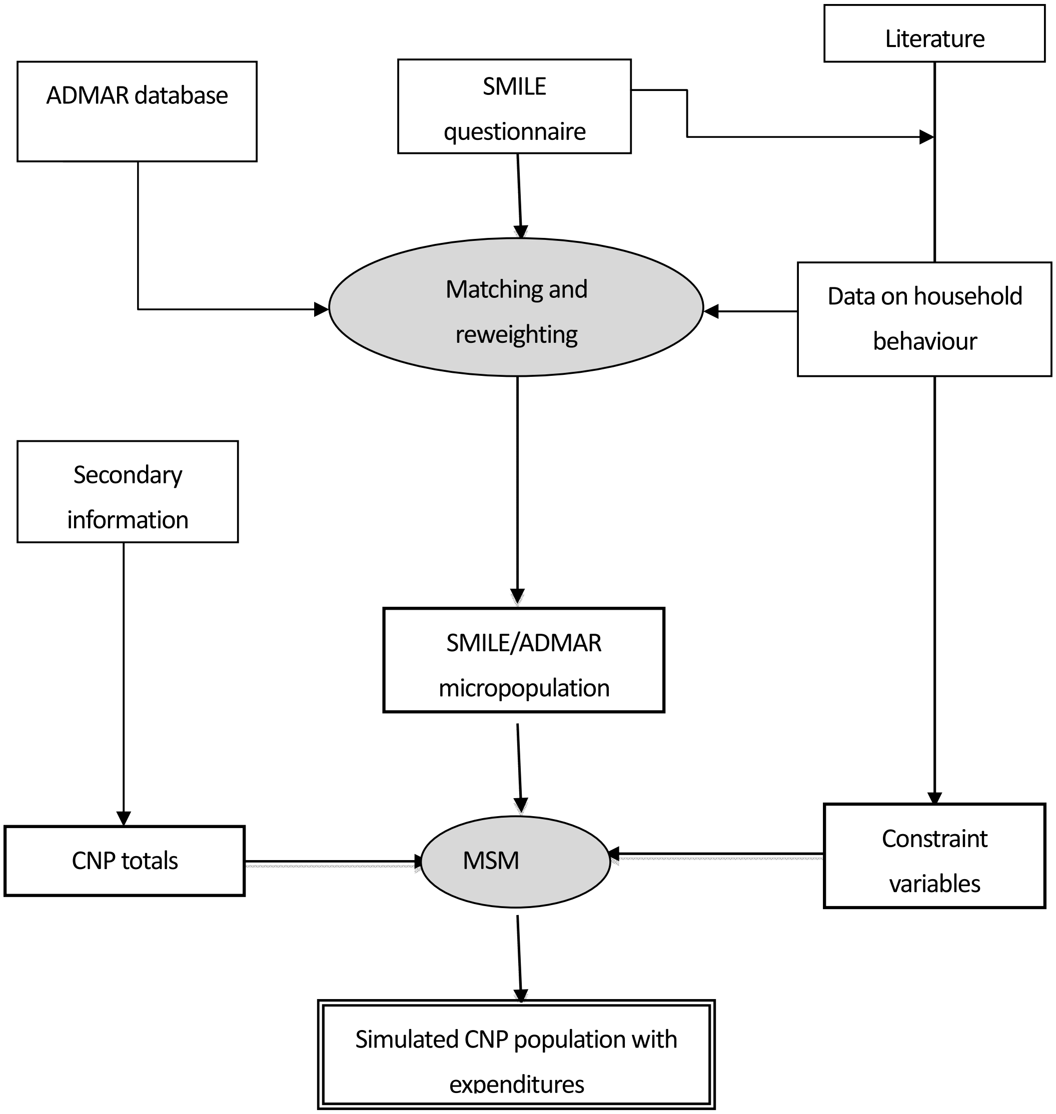


Figure 1: Flowchart of the microsimulation procedure. Source: Van Leeuwen (2013)

The detailed questionnaire which was returned by approximately 100 households was combined with a larger and extensive database ADMAR. This was done by a grouped multivariate matching procedure. This matched dataset was then used as an input for the MSM. A static deterministic approach resulted next in a good picture of the Cairngorm residents with information about Internet use, electricity use, spending on goods and services, and the location of this spending.

Clearly, this approach has some disadvantages. For instance, some of the results are based on a relatively small sample (100 of the 8000 households)[2], but overall there are many more advantages. First of all, the optimal matching procedure (instead of exact matching) resulted in a more heterogeneous population in terms of age, income, size and commuting. Secondly, it allowed the inclusion of additional variables.

The result of our MSM approach provides a detailed picture of the Cairngorms population regarding Internet accessibility, energy use, spending on several services and products, and the location of these expenditures. It appears that almost half of the CNP households has internet access. Furthermore, they appear to spend per month on average £ 87 on electricity, around £650 on products, and £350 on services in total. More than 38% of those expenditures are made in the Park. This is quite a high share and very useful information for our 'three level' input-output model to be designed in Section 2.4.

2.4 A triple-layer input-output model

In order to understand and map out the relationship between small regions –such as the Cairngorms– its surrounding regions and a country as a whole, and to analyze the economic effects of a policy on all three regions in such a multi-layer system, it is useful to employ an interregional input-output model. However, such triple-layer interregional input-output tables with a granular spatial subdivision are usually not available. The aim of this study is now to construct a three-region interregional input-output table in a triple-layer system of regions comprising the Cairngorms National Park, the surrounding regions, and the rest of the country.

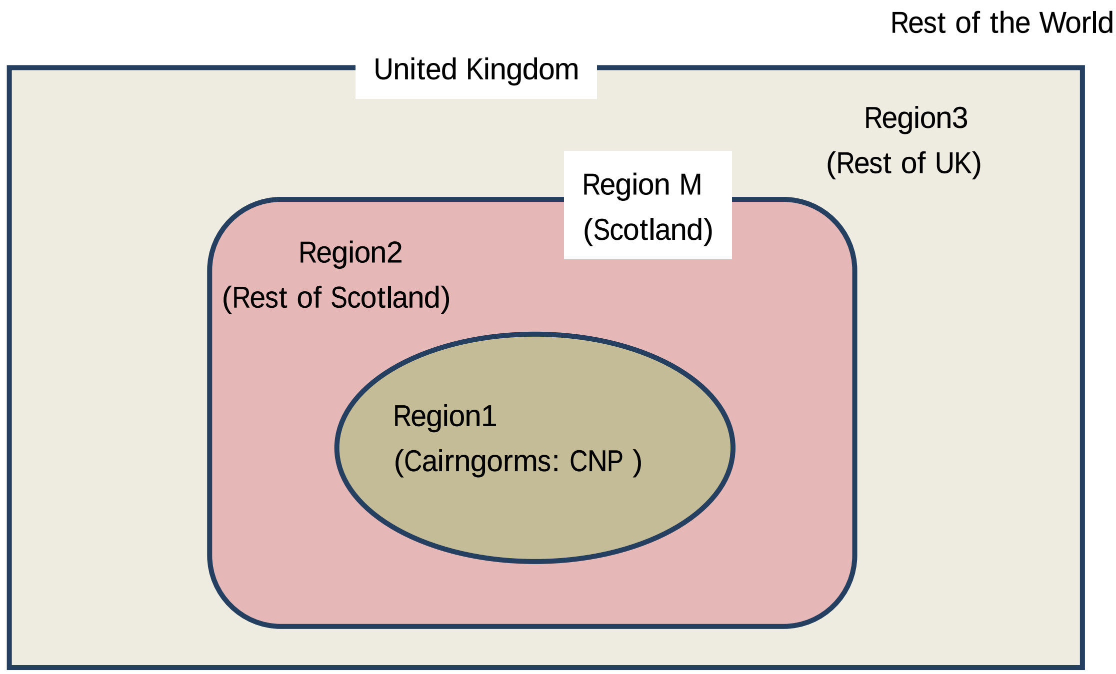
Such a regional input-output table in an open spatial system could in principle be constructed by a survey method. But it is not realistic to conduct a full survey for the region concerned, due to the high costs and efforts involved. On the other hand, in practice non-survey approaches are also applied when compiling regional input-output tables. However, as some studies have shown (see Harrigan et al. 1980; Morrison and Smith 1974; Round 1978), the latter approach suffers from accuracy problems. Consequently, survey and non-survey methods are nowadays no longer considered as the most cost-effective means of constructing sufficiently accurate regional input-output tables. The hybrid approach is a popular method, which was developed to overcome the weaknesses inherent in survey and non-survey approaches. Currently, this approach is the most popular one and highly valued, because it tends to offer satisfactory empirical results. In the hybrid approach, a generally significant sector is identified, while superior data are collected for this key sector through a questionnaire survey or expert opinion. However, even if it is possible to conduct a survey for a key sector in a region, it is difficult to

[2] For example, through the above described two-step procedure, it might happen that one household gets a disproportionally high weight.

have a sufficiently large sample. Therefore, we have applied a new hybrid approach which combines microsimulation based on survey data with existing input-output tables in order to construct a three-region interregional input-output table centring around the Cairngorms region in Scotland. Because microsimulation has the ability of complementing sample data (synthetic micro-data), we employed an MSM to obtain reasonably precise information for this small region at relatively low cost.

The region of interest to be analysed is divided into the following three regions, as shown in Figure 1. First, the small region is defined as Region 1. The middle region surrounding Region 1 is defined as Region 2, and the largest area other than Region 1 and Region 2 is called Region 3. The whole middle region, consisting of Region 1 and Region 2, is called Region M. In this study, Region 1, Region 2 and Region 3 denote the Cairngorms, Scotland and the United Kingdom, respectively. By defining regional divisions, it is possible to analyze the inter-industry structure at small, middle and whole country level. Furthermore, it enables us to estimate the interregional trade comparatively easily by using existing input-output tables and the inclusive relation of regions. For example, because Region 1 and Region 2 are included in Region M, it can be assumed that the percentage of import from Region 3 in total import and the import coefficient of each region are equivalent to those of Region M. If the input-output for Region M is available –by assuming that import is proportional to the total intra-regional demand– the percentage of regional import from Region 3 to Region M and the import coefficient of Region M are calculated. In this study, because input-output tables for the UK and Scotland have already been constructed, it is possible to calculate most transactions among regions by using information from existing input-output tables. However, it is impossible to estimate interregional trade for only Region 1 (small region) using the existing tables. Therefore, we estimated interregional trade coefficients for endogenous sectors using location techniques, and for final demand we used trade data based on microsimulation.

Figure 3 shows a set of procedures for developing a hybrid three-region interregional input-output (IO) table. In the first phase, an input-output table for Region M (large region) and a national table are prepared. Because each input-output table differs in sector classification, the sectors of both input-output tables are aggregated and then the year of the input-output table is adjusted. Next, a questionnaire survey is conducted for the small region, and micro-data per household are generated by microsimulation. By using these results and the input-output tables, all necessary coefficients such as trade coefficients for compiling the three-region interregional input-output table can be estimated. In phase 5, the three-region interregional input-output table is compiled. However, because the interregional input-output table is compiled in this step using coefficients in columns, the totals of the columns do not correspond with the totals of the rows. Therefore, lastly, the input-output is adjusted using an RAS method.



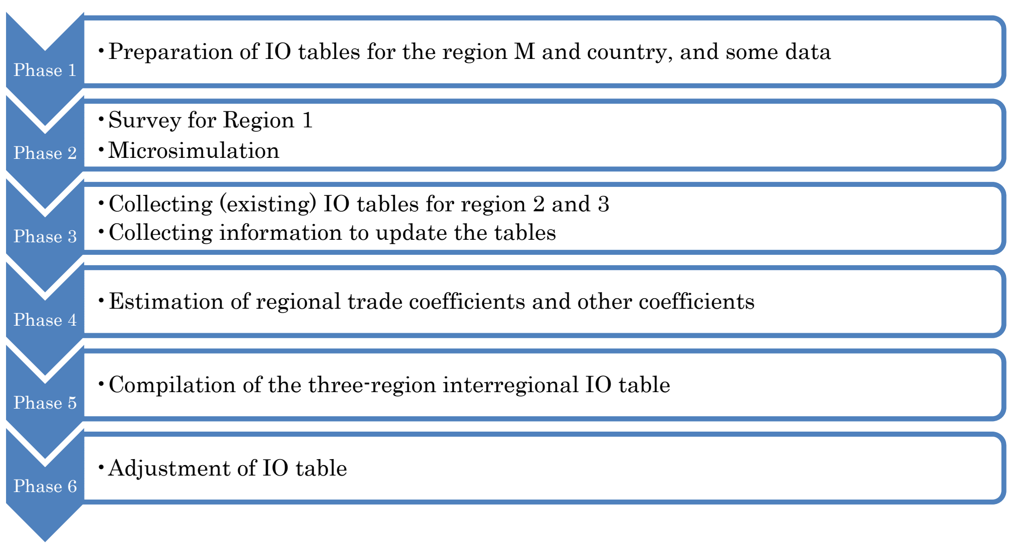


Figure 3. Procedure for constructing a three-region interregional input-output table

The actual procedure for constructing the three-region interregional table is as follows. Firstly, in order to construct the table, it is necessary to prepare input-output tables for the UK and Scotland. The latest available symmetric input-output table for the UK by the UK Statistical Office is for the year 1992. In the UK, use tables and supply tables are available for every year. So it is possible to compile a symmetric table using these tables and additional statistical data. However, because the UK symmetric input-output table for the year 2004 by Grant Allan et al. (2004) is available, we used this table in this case study. Regarding the Scotland table, symmetric input-output tables are available for every year, while the latest table is available for 2004. Because we are interested in the year 2007, the most recent year for which most information is available, we updated the UK and Scotland tables using an RAS method with output by sectors for the year 2007. In the UK, the supply table and the use table for the year 2007 are available. So we used these tables to update the data. In addition, the sector classification of the UK table is different from that of the Scotland table. Therefore, the sectors of the UK table were aggregated into 108 sectors. After this, we calculated technical input coefficients, import coefficients and regional import coefficients for 108 sectors in UK and Scotland. In this case study, we compiled the input-output table using 108 sectors and then aggregated these into 42 sectors. When estimating trade coefficients on intermediate demand for Region 1, we applied a location quotient method to estimate regional trade coefficients and applied the MSM to obtain household consumption.

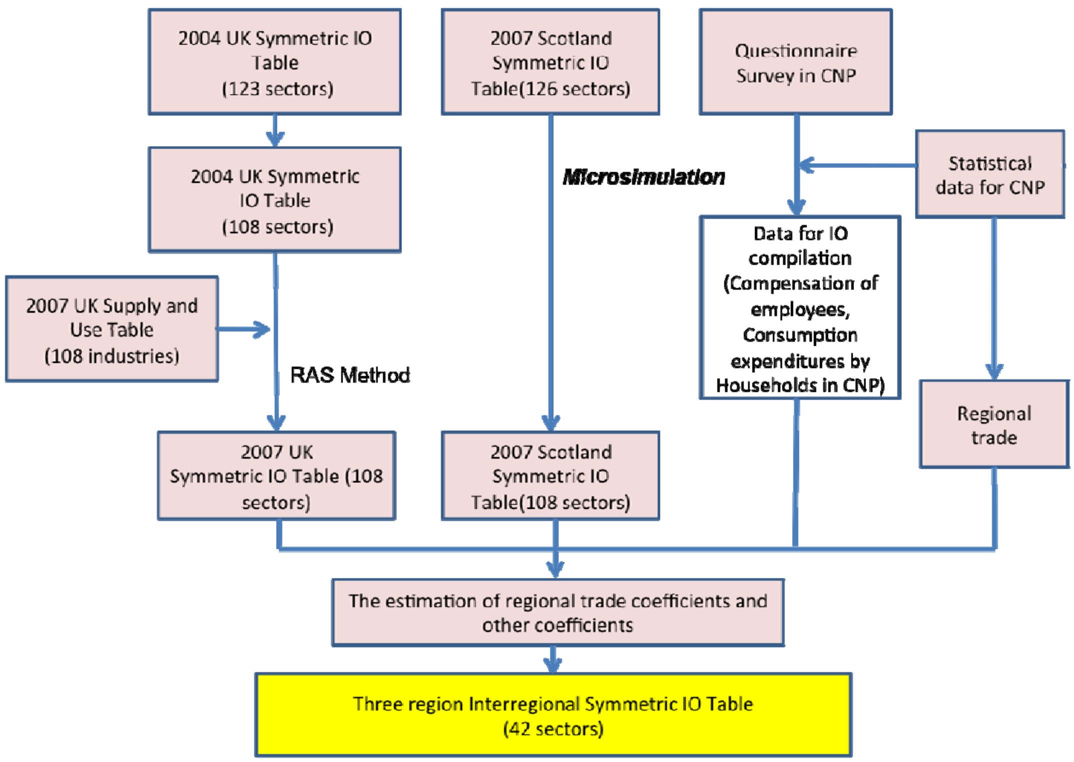


Figure 4. Actual procedure for compiling a three-region interregional IO table in this case study

3. Micro-Macro Results: Local Multipliers

3.1 Main sectors in the local economy

As explained in the previous Section, we constructed a three-region interregional input-output table for the Cairngorms, the rest of Scotland and the rest of the UK. In the analysis of the regional structure to be conducted using the IO framework in this study, the first step is to take a broad view of the scale of production by industry in each region.

The following tables present the top-10 ranking of the outputs in the UK, Scotland and the Cairngorms. In the UK, production from construction amounted to 211 billion pounds, the biggest output, followed by banking and finance with 196 billion, human health and veterinary activities with 171 billion and real estate activities restaurants with 158 billion pounds. As the table for the UK shows, there are some key sectors in the tertiary industries. The same tendency is seen in Scotland. For example, tertiary sectors such as construction, human health and veterinary activities, banking and finance and public administration rank highly. Among other key sectors are coke, petroleum, chemical products, electricity and gas. In contrast, in the Cairngorms, the proportion of hotels and reservations is extremely high compared to the other sectors at 23 percent. 1.4 million tourists visit the Cairngorms national park each year. Hotels and restaurants are the key sector in the Cairngorms in terms of output.

Table 1. The top-10 ranking of outputs in Scotland and their location quotients (LQ) (unit: million £)

Rank	Code	Description	Output	Proportion	LQ
1	18	Construction	19,183	9.5%	1.1
2	37	Human health and veterinary activities	16,870	8.3%	1.2
3	26	Bank and finance	14,605	7.2%	0.9
4	35	Public administration	13,916	6.9%	1.3
5	9	Coke, Petroleum, chemical products	10,174	5.0%	1.3
6	27	Real-estate activities with own property, letting of own property, except dwellings,	9,933	4.9%	0.8
7	36	Education	8,230	4.1%	1.0
8	16	Electricity, gas	8,194	4.1%	1.5
9	21	Retail distribution	8,164	4.0%	0.9
10	5	Food, drink and Tobacco	7,577	3.7%	1.4

Table 2. The top-10 ranking of outputs in the Cairngorms (unit: million £)

rank	code	description	output	proportion	LQ
1	22	Hotel and restaurants	119	23.2%	8.4
2	21	Retail distribution	87	16.9%	4.2

3	31	Legal activities	59	11.5%	5.6
4	20	Wholesale	58	11.4%	3.9
5	18	Construction	34	6.6%	0.7
6	40	Recreational, cultural and sporting activities	25	4.9%	1.6
7	27	Real estate activities with own property, letting of own property, except dwellings.	25	4.8%	1.0
8	5	Food, drink and Tobacco	15	2.9%	0.8
9	1	Agriculture	14	2.6%	2.2
10	37	Human health and veterinary activities	11	2.1%	0.2

In addition, we calculated the location quotients (LQ) for the largest sectors, to see how Scotland differs from the UK and the CNP from Scotland. The LQ compares the regional share of economic activity in a particular industry with the national share of economic activity in that industry. The result reveals the degree of regional specialization in each industry. If the LQ for a particular industry is greater than one, it reveals greater specialization of the industry in the local economy than in the national economy. It appears that the sectors with the largest LQ in Scotland are not always the largest sectors in terms of output: the primary industries such as fishing, forestry, wood and agriculture are key sectors in Scotland in terms of location quotient. In the Cairngorms, the four largest sectors, are also the ones with the highest LQ. This means that in terms of both output and specialization the sectors hotels and restaurants; retail distribution, legal activities and wholesale are the CNP key-sectors.

Figure 5 shows the direct input percentage per region by the demand for each industry in Scotland (a) and the Cairngorms (b), that is to say, the self-sufficiency rate. The self-sufficiency rate of the Cairngorms region is the lowest of the three regions, followed by the rest of Scotland, and the rest of the UK. The Cairngorms is a small region, and imports significant amounts of goods from the surrounding region. The scale of the economy in the rest of UK is large compared to Scotland, and the input from the Cairngorms and Scotland is small. In the Cairngorms, the sufficiency rates of agriculture, forestry, food drink and tabacco, wood and wood products and construction are particularly high. In the rest of Scotland, the self-sufficiency rates for electricity and gas, and construction are high.

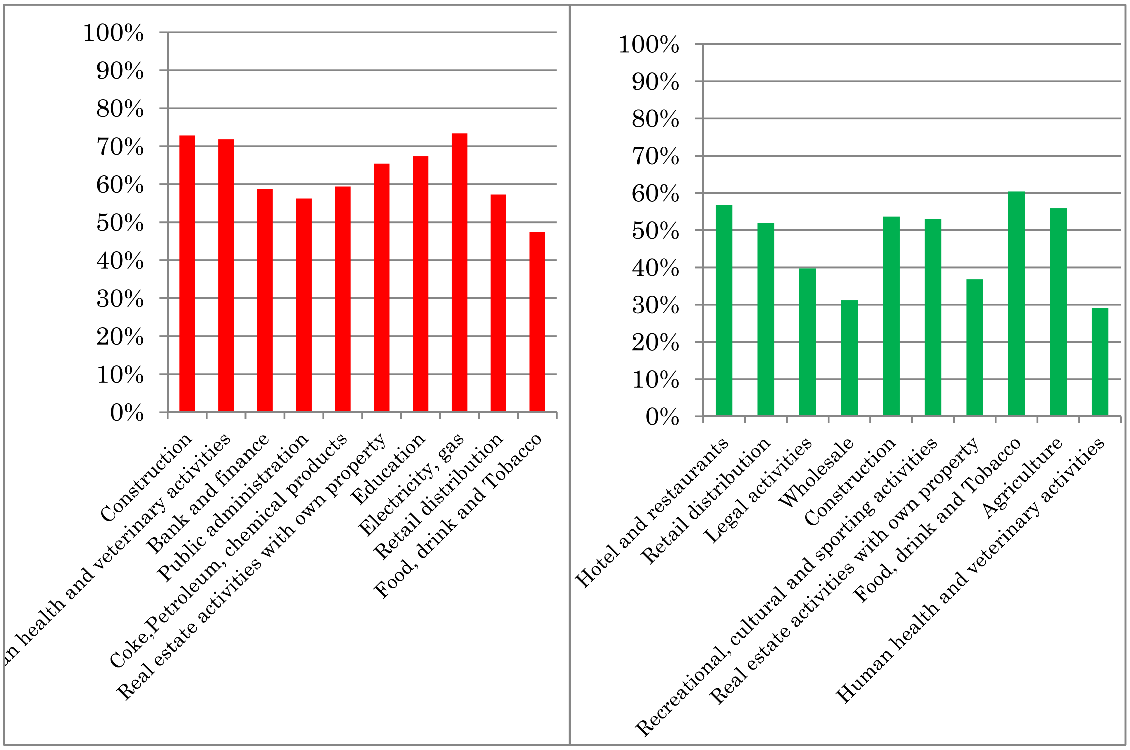


Figure 5 a, b. Self-sufficiency rate of the ten largest sectors in Scotland (left) and the Cairngorms (right)

3.2 Local multipliers and key sectors

Using the three-region input-output tables, interesting multipliers can be derived for the UK, Scottish and Cairngorms economy. Here we will manly focus on the Cairngorms, our region of interest. The interregional input coefficients are derived using the Leontief inverse from the three-region interregional input-output compiled in this study. One of the interesting aspects of this three-layered approach is that the total multiplier effect can be decomposed based on the three regions. Table 3 shows the top-10 Park output multipliers, and the multipliers for the rest of the largest sectors as shown in Table 2. It appears that most of the larger sectors do not have the largest multipliers. In other words, investing in those larger sectors will result in less additional (multiplier) effects in the total economy (Park, Scotland and the UK). The largest multipliers are related to the Electricity and gas sector (2.52), the Coke, petroleum and chemical products sector (2.37) and Forestry (2.37).

However, when we take a closer look at where these effects will trickle down, most of it will end up in Scotland and the UK, not in the Park itself. Only in the forestry sector, the local economy benefits most of the multiplier effect.

Table 3: The top-10 Park output multipliers, and the multipliers for the rest of the largest sectors

	Total multiplier	Effect in Park	Effect in Scotland	Effect in UK
Electricity, gas	2.52	1.12	0.92	0.48
Coke, petroleum, chemical products	2.37	1.17	0.72	0.48
Forestry	2.24	1.74	0.30	0.21
Construction	2.12	1.46	0.41	0.24
Wood and wood products	2.11	1.51	0.35	0.25
Ancillary Transport services	2.11	1.23	0.58	0.30
Pulp and paper, printing and publishing	2.09	1.30	0.47	0.32
Textiles, wearing apparel and leather products	2.09	1.23	0.51	0.34
Other manufacturing	2.02	1.30	0.42	0.30
Mining	2.02	1.27	0.45	0.30
Food, drink and tobacco	2.01	1.50	0.30	0.21
Recreational, cultural and sporting activities	2.00	1.44	0.37	0.19
Agriculture	1.81	1.36	0.27	0.18
Wholesale	1.70	1.16	0.33	0.21
Human health and veterinary activities	1.69	1.16	0.38	0.16
Hotel and restaurants	1.61	1.29	0.20	0.12
Retail distribution	1.56	1.23	0.21	0.12
Legal activities	1.51	1.16	0.22	0.12
Real estate activities with own property	1.43	1.13	0.18	0.13

An interesting next step is to combine the multiplier effects in the Park with the actual size of the sectors to point out actual key-sectors for future investments. Figure 6 shows the size of the multiplier effect in the Park together with the size of the sector in terms of share of output. It appears that sectors with the highest multipliers are in general relatively small, such as Forestry, Wood and wood products and the food, drinks and tobacco sectors. The three largest sectors – hotels and restaurants, retail distribution and human health and veterinary activities sector – have much lower multiplier effects. An explanation for this could be a stronger competition and scale effects.

However, on the basis of this figure, we can conclude that key-sectors for the local economy are two smaller sectors with high multipliers, recreational, cultural and sports activities, as well as construction, and the two largest sectors with a medium-sized multiplier, viz. the retail and hotel and restaurant sector.

Sectors that from a regional development policy perspective could be further stimulated are the forestry and the wood and wood products sector. These two sectors can reinforce each other, while the local economy will benefit significantly from an increased production level, when the same production structure is kept

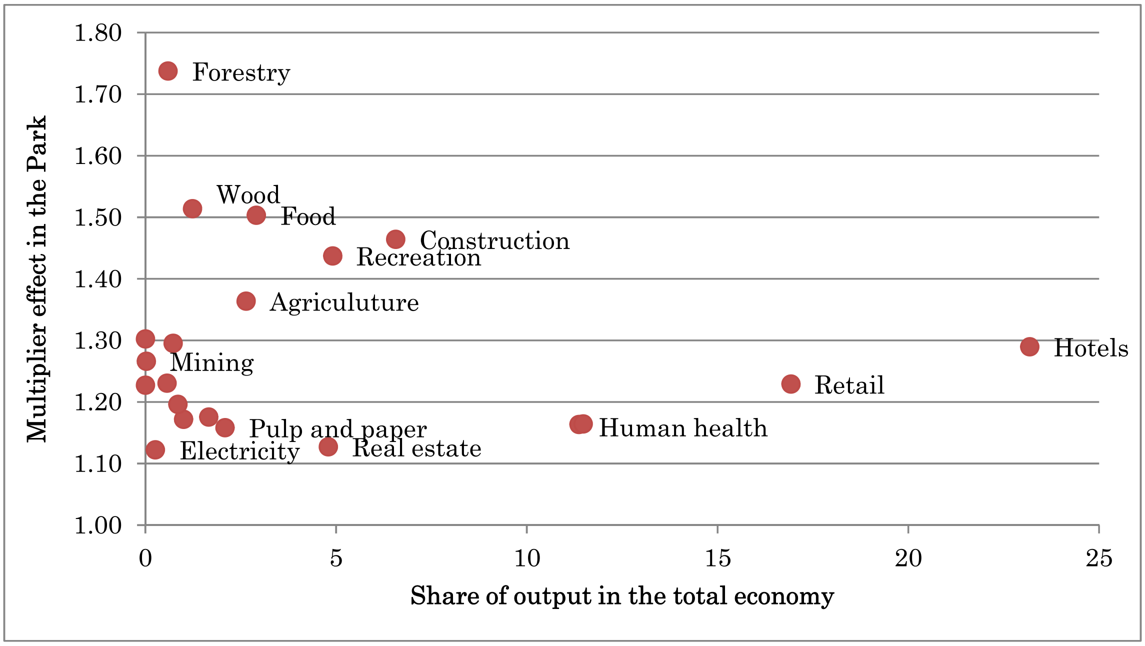


Figure 6: Scatter plot of the multiplier effect in CNP and the size of the sector.

4. Household Consumption

Since the retail sector is one of the key sectors in the CNP, another way to stimulate the local economy is through stimulating household consumption. In this section we focus on household preferences and expenditure patterns.

4.1 Household preferences

In the questionnaire, we asked the respondents about the biggest advantages of the CNP; they were allowed to select the two most important ones. Figure 1 shows that both the landscape and recreation possibilities are seen as the biggest advantages of the park. In particular households that (recently) moved to the park indicate the attractiveness of these park characteristics. Another important advantage of the park is the presence of family. Not surprisingly, this is in particular important for households that always lived in the area. The least important advantage of the park is being able to reach a job outside the park.

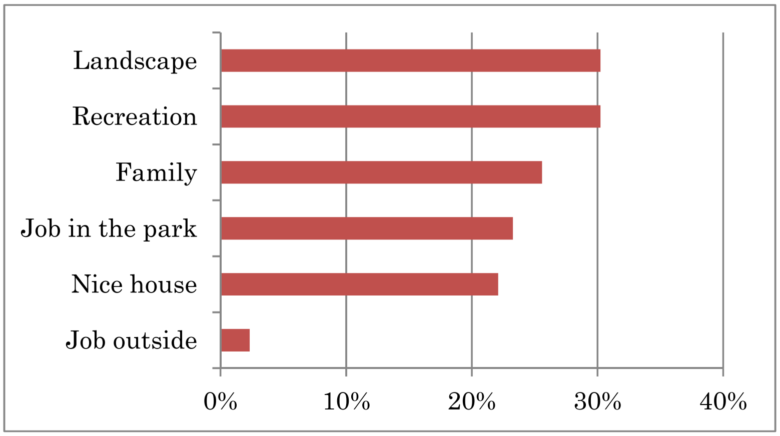


Figure 7: The biggest advantages of the CNP (share of respondents, N=86)

When asking people about the biggest advantages of living in the CNP, 23 percent filled in 'a job'. Most of those households have a job in the Park, a quarter in the adjoining areas and the rest further away. In addition, we also asked the most important reason to move to the CNP; 41 percent mentioned that a job was the most important reason to move to the Park. Most of them (60 %) have a job in the park, 30 percent a job in adjacent areas. This indicates that for the residents of the CNP, the local job market is quite important.

The jobs in the park are mostly in the public sector (30 %) and in tourism (23 %). Employees with a job in the adjoining areas most often work in the public sector. This holds for 60 percent of them.

By performing a cluster analysis based on share of products bought in the park and share of products bought in the adjacent areas, three different types of households can distinguished. The first and biggest cluster can be indicated as the 'average' households. When comparing their characteristics with those of the total group, the biggest differences appear in how they appreciate the park, with a relative low value for the availability of a job in the park and a slightly higher appreciation of the houses. Furthermore, they buy in general a little more than a quarter of their products in the park and the same share in the rest of Scotland. In addition, they buy quite a lot through the Internet and in the rest of the UK.

The second cluster is the most interesting one for policy makers in the CNP: since this clusters includes those households that do most of their expenditures in the park (86 %). They often have been living in the park for a long time, on average 40 years old, and they generally have a middle income (the 5^{th} decile). They appreciate the park for the jobs and because their family always lived there. Furthermore, they generally do not have a job in the adjacent areas.

Table 4: Hierarchical Custer analysis based on share of expenditures in areas adjacent to the CNP

Characteristics	Cluster 1	Cluster 2	Cluster 3	All
# households	37	21	21	79
HH size	2,1	2,2	**2,7**	2,3
HH age	57	59	**46**	55
Children under 8	,08	,10	**,29**	,14
Years living in CNP	27	**40**	**13**	27
HH income	7,1	**5,1**	7,1	6,6
The biggest advantage:				
Job in park	,13	**,32**	,24	,21
Job outside the park	,03	,00	,05	,03
Nice house	**,28**	**,00**	,19	,18
Family always lived here	,28	**,47**	**,14**	,29
Recreation possibilities	,25	,32	,33	,29
Landscape	,56	,42	,43	,49
Job in Park	,43	,52	,52	,48
Job adjacent	,35	**,05**	**,48**	,30
Job far	,08	,05	,10	,08
Expenditures CNP	29%	**86%**	14%	40%
Expenditures ROS	37%	12%	**80%**	42%
Expenditures RUK	**15%**	2%	3%	8%
Expenditures ROW	**19%**	0%	3%	10%

The long period of residence is perhaps not something that can be affected by policymakers. But this analysis suggests that it might be a good idea to facilitate people who have family in the park, or who grew up in the CNP to be able to buy a house as well. One of the problems of the Park is the rising prices of houses, and the difficulty for local people to buy one. But this study shows that people who have a history in the CNP and/or who work there, have stronger ties and are more likely to spend their money in the Park as well.

4.2 Macro effects of consumption

Table 4 shows expenditures by households in the Cairngorms and the economic (multiplier) effects on each region. The total expenditures by households in the Cairngorms is estimated to be 124 million pounds per year, of which 55 million pounds is spent in the park itself, which accounts for 47%. Households consume many goods and services from outside the Cairngorms, especially from the rest of Scotland, where their value is estimated to be 49 million pounds.

Next, we estimated the economic effects of household consumption in the Cairngorms on each region. As shown in Table 4, household consumption by residents of the Cairngorms has a large impact on the rest of Scotland. It is estimated that household consumption in the Cairngorms generated approximately 227 million pounds in total.

Table 5. Economic effects of expenditure by households in the CNP (unit: million £)

	Consumption		Economic Effects	
CNP	55	47%	73	32%
Rest of Scotland	49	42%	98	43%
Rest of UK	12	10%	56	25%
Total	116		227	

Figure 8 shows how the effects of household expenditures are distributed over different sectors. This figure is a result from the expenditures obtained from our MSM, and from information about inputs for different goods and services. Through the microsimulation, we know which products the CNP population buys and where they get it from. This combined with the interregional multipliers results in the total economic effects and the effects on the different sectors in CNP, the rest of Scotland and the rest of the UK.

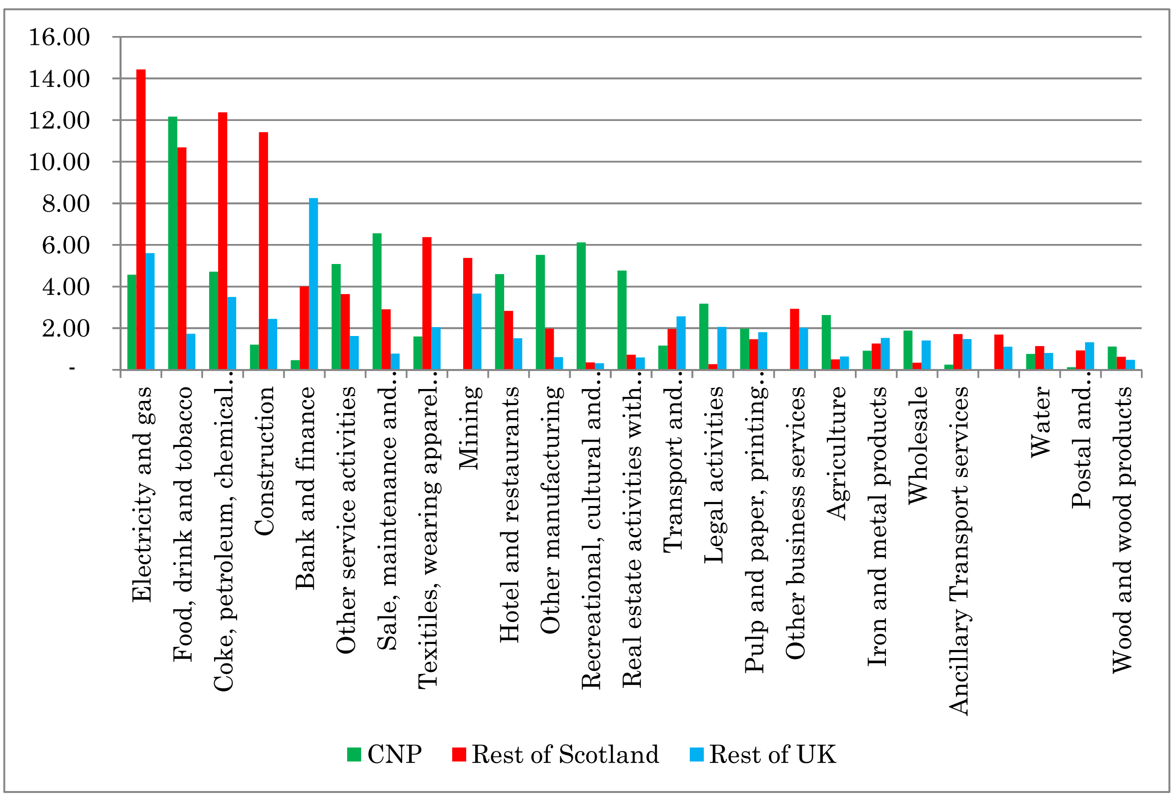


Figure 8. Economic effects of the household consumption increase in CNP (unit: million £)

It appears that in general, household expenditures have a large effect on the food processing industry in the Park, as well as on sale, maintenance and repair activities and recreational activities. Furthermore, there are significant effects on activities in the rest of Scotland, mainly in the electricity and gas sector, the coke and petroleum sector and the construction sector. In the rest of the UK, the Bank and Finance sector in particular benefits from expenditures by CNP residents.

5. Conclusions

This paper demonstrates how, even for small areas such as the CNP in Scotland, survey information combined with secondary data and existing input-output tables can be integrated into a useful policy tool.

The triple-layer input-output model first allowed to distinguish key-sectors for the economy. These appeared to be the recreational, cultural and sports activities, as well as the construction sector, which both are two smaller sectors with high multipliers. In addition, the two largest sectors but with a medium-sized multiplier, viz. the retail and hotel and restaurant sector, are of major importance.

Both the construction and the retail sectors are largely dependent on local customers. Therefore, we have also paid attention to the consumer behaviour of CNP households. It appears that in general, household expenditures have a large effect on the food processing industry in the Park, as well as on sales, maintenance and repair activities and recreational activities.

Furthermore, our analysis suggests that the CNP authorities should facilitate people, who have family in the park, or who grew up in the CNP, to be able to buy a house there as well, since those are the people that in particular use local retail (and construction) services. One of the problems of the Park is the increasing price of houses, and the difficulty for local people to buy one. Our study also shows that people who have a history in the CNP and/or who work there, have stronger ties and are more likely to spend their money in the Park.

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