REGIONAL IMPACT ANALYSIS OF EUROPEAN POLICY SPENDING IN A RURAL REMOTE AREA (CAITHNESS & SUTHERLAND, SCOTLAND, UK)

Holger Bergmann and Kenneth J. Thomson

h.bergmann@abdn.ac.uk

GEWISOLA

2008

Paper prepared for presentation at the 48th annual conference of the GEWISOLA (German Association of Agricultural Economists)
"Coping with Risk in Agriculture and the Food Sector"
Bonn, Germany, September 24. – 26. 2008

REGIONAL IMPACT ANALYSIS OF EUROPEAN POLICY SPENDING IN A RURAL REMOTE AREA (CAITHNESS & SUTHERLAND, SCOTLAND, UK)[1]

Holger Bergmann[*] und Ken Thomson[**]

Abstract

A modified version of a system dynamics model constructed for an EU-wide case-study project (TOP-MARD) using STELLA software was used to simulate the effects of a number of development scenarios for a remote rural area in Northern Scotland, i.e. Caithness & Sutherland, which is characterised by a high regional importance of agriculture for the local economy. In this paper, the context of the modelling work in policy and socio-economic terms is first described. This is followed by the specification of the model and of the several modelling scenarios, which relate to the reconfiguration of Pillar 2 spending within the area and an reversal of recent Structural Funds spending for 2007 onwards. The modelling results are discussed, in terms of regional population and economic trends, from 2001 to 2015. Finally, some conclusions are drawn, both about the implications of the results for such remote rural regions, and about the usefulness of this type of modelling exercise for policy analysis of rural development measures.

Keywords

modelling, input-output, systems dynamics, rural viability.

1 Introduction

The socio-economic development of rural areas is a concept of rising policy significance in the European Union (EU). Particularly remote rural areas in the EU are often characterised by falling and aging populations, fragile economies, and ecological systems under threat from pull-out of agricultural production. Thus, the role of policy is particularly important, since individuals in remote areas with a high share of agricultural employment are heavily dependent on farm incomes, the public sector is a large part of the economy, and nature conservation measures are often already widespread. Economic development in such areas can either be limited by the propensity to out-migrate (e.g. many parts of Central and the far North and West of Europe), and subsequently out-migration especially of younger well educated people has been identified as the most important reason for development failure.

Clearly, the range of policies impacting on such areas is wide, and includes:

- Pillar 1 of the CAP, i.e. single farm payments, payments still "coupled" to agricultural areas or livestock, and market support via border tariffs etc., especially on milk and red meats
- Pillar 2 of the CAP, now being reformulated in terms of three "Axes", for farm/forestry competitiveness, environmental friendly land management, and rural diversification and improved "quality of life" (QoL), respectively

---

[*] Dr. sc. agr. Holger Bergmann, Departments für Agrarökonomie & Rurale Entwicklung, Georg-August-Universität Göttingen, Platz der Göttinger Sieben 5, 37073 Göttingen, E-Mail: hbergma1@gwdg.de

[**] Prof. emeritus Ken Thomson, University of Aberdeen, Department of Geography & Environment

[1] We are grateful for helpful comments during this research from the people of Caithness and Sutherland, and specifically to Eann Sinclair, Anna MacConnell and Katrina MacNab. This publication derives from the EU-funded project 'Towards a Policy Model of Multifunctional Agriculture and Rural Development' (TOP-MARD), with collaborating partners from 11 European States.

- Structural and cohesion funding for infrastructure and the promotion of general economic development
- Environmental regulation under EU and national/regional legislation, to protect certain areas (e.g. national parks) or wildlife species (Natura sites); such regulation often impacts on agricultural practices and incomes, both positively (e.g. tourism) and negatively (certain operations being banned, e.g. wind farms, large scale industrial developments, etc.)
- National/regional policy expenditure and regulations, e.g. for transport, education, health services and housing, as well as social security payments for the unemployed, ill or aged.

Modelling such a wide range of concerns, activities and policies is a formidable task, beyond the capacity of standard economic tools such as input-output or social accounting matrices, time-series econometric regression, or mathematical optimisation. Difficulties include:

- combinations of biophysical, demographic and economic behaviour
- lack of data, within some of the above areas and/or across time
- competing or uncertain policy objectives, e.g. economic, environmental and socio-cultural “sustainability”, and local-national/EU differences in political attitudes.

Thus far, modelling efforts – e.g. within the CAPRI, ESPON, SENSOR and MEA-SCOPE projects (see reference list) – have seldom attempted to encompass the full range of issues and activities mentioned above. Some have interpreted “rural” as “agricultural”, perhaps with a few environmental components, e.g. fertiliser use or methane emissions, within the latter, while others have modelled regional economies, usually in a comparative static way but with few social or environmental aspects. Attempts have been made to model water catchment, nitrogen pollution or landscape areas, but these have proved expensive in construction time and data requirements. Others focus on individual farm areas or businesses, which may be useful in terms of differential impacts but do not allow appraisal at an aggregate level. The recent emphasis (CEC, 2007) on QoL has introduced another socio-economic dimension to analytic demands.

Recent efforts have had a tendency to highly complex models resulting in increasing numbers of output indicators, partially driven by policy demands as well as by the capability of modellers to supply (Happe and Bahlmann, 2008).

This paper reports an effort to utilise the “dynamic systems” approach adopted within the FP6 research project TOP-MARD (Towards a Policy Model of Multifunctional Agriculture and Rural Development), which has focussed on case studies of rural regions (generally NUTS3) within ten EU member states and Norway (UHI, 2007). The core model (POMMARD) has been developed by software specialists in a U.S. university, and has become available for specific adaptation and application within any of these case study areas via the input of area-specific data and the modification of model elements, e.g. representation of the regional economy, or local land-use systems.

The paper first outlines the case study area in Scotland UK, and then the structure of the core POMMARD model. Then it describes how the model was applied to the case study area, including a small number of scenarios used for simulation work. Results of these simulation exercises are reported, before concluding with some more general conclusions about this type of “derived modelling” and its use in policy guidance.

2 Caithness and Sutherland

The (former) counties of Caithness and Sutherland comprise the extreme north of the mainland of Scotland in the United Kingdom, and are characterised by remoteness, very low population density (especially in the interior), upland agriculture and “wilderness”, and heavy policy intervention. Following the suppression of the highlands rebellion of 1745-46, the area was “cleared” of much of its indigenous population (and thus their agricultural and other activities) in the late eighteenth and early nineteenth centuries. This exodus of the native population was reinforced by later developments in industrialisation, imperial colonisation, and two world wars.

Table 1: Key Data for Caithness and Sutherland, Scotland, 2001

Population	**Total (head)**	**Change 1991 to 2001**
Aged 0 to 19	9,177	-1,275
Aged 20 to 64	22,584	-601
Aged 65 and over	7,212	923
Total	38,973	-953
Land Use	**Area (ha)**	**Change 1995 to 2001**
Tillage	13,597	4,634
Grass, rough and common grazings	543,442	-46,496
Agricultural woodland	11,771	2,947
Other area	1,747	-1,992
Total	570,556	-40,907
of which Sites of Special Scientific Interest (SSSIs)[2]	214,741	+43,390
Livestock	**Numbers**	**Change 1995 to 2001**
Total sheep	467,525	-17,486
Total cattle	59,944	-1,506
Total pigs	4,131	4,002
Agricultural Labour	**Head**	**Change 1995 to 2001**
Total (includes part-time and casual)	3,896	239
Economy	**Employment (FTEs)**	**Total Demand for Products (£ million)**
Primary sector	2,818	38.4
of which agriculture:	2,231	13.8
Secondary sector	3,897	417.6
of which nuclear fuels (Dounreay):	993	63.8
Private services	6,407	349.5
Public services	4,197	98.0
Total	17,319	903.5

Sources: population and agricultural censuses, and official Annual Business Inquiry.

Note: FTE = full-time equivalent (job).

Most of the land outside the few towns became the property of large “estates”, often owned by outsiders normally resident in England or even abroad, with land use dominated by sports shooting for deer and grouse, and sport fishing. Agriculture was mainly confined to sheep breeding (with lambs being “finished” elsewhere), often combined with other occupations (small-scale coastal fishing, service jobs), in the “crofting” system. Table 1 presents some basic statistics for the area.

[2] Caithness and Sutherland provide more than 20% of all Scottish SSSIs but has only 10% of the Scottish surface.

Efforts to support the regional economy and society of the Scottish highlands have been underway since the late nineteenth century, most notably with the establishment of the Highlands and Islands Development Board in the 1960s. In the 1980s, the HIDB was converted into Highlands and Islands Enterprise (HIE), which administers and coordinates development initiatives via Local Enterprise Companies (LECs) such as that for Caithness and Sutherland.

A major feature of the Caithness and Sutherland economy is the Dounreay nuclear site, which was established in the 1960s as an experimental "fast breeder" reactor for the development of technology for the generation of cheaper electricity. At its peak, the site, which is located about 15km west of the town of Thurso (population 9,000), directly employed about 1,100 Full time equivalent jobs, most of them highly skilled and paid. This employment dominated the local economy, which has few other major employers except the public sector (schools and colleges, health, etc.) and a small number of manufacturers and construction or transport contractors. In general the regional economic effect of Dounreay during that period was that almost every family's income in the North-West of Caithness was heavily dependent on it. However, the technical and economic results from Dounreay were disappointing, and in 2000 it was decided to "decommission" (i.e. run down and clean up, especially radioactive spills) the site over a 30-year time period. At time of writing, the site employs about 2,400 personnel, both directly and via contractors (BERGMANN, 2007).

Agricultural policy in the area is naturally dominated by the Common Agricultural Policy (CAP), primarily in terms of support for sheep and beef farming (now converted into the Single Farm and Less Favoured Area payments) and agri-environmental payments, now via Land Management Contracts (about to become Rural Development Contracts within the new Scottish Rural Development Programme, SRDP). Table 2 gives some detail on this support for the agricultural sector in Caithness and Sutherland, along with available information on other policy support[3]. It is notable that Pillar 2 spending now exceeds Pillar 1 spending (or will do so, when the SRDP begins operations after Commission approval), to a ratio of over 2:1.

[3] For easier comparison, 2000-2006 measures have wherever possible been categorised under those for the period 2007 to 2013. Of possible Pillar 2 measures, Scotland in general has only adopted three: afforestation, Less Favoured Area, and agri-environmental schemes. Structural Fund measures were financed within the framework of the Highland and Islands Special Transition Programme, and included former EAGGF measures e.g. farm investment, and the adaptation & development of rural areas. During the period 2007-2013, the Highland and Island Convergence Programme will apply.

Table 2: EU Spending in Caithness and Sutherland (£'000, annualised)

	Until 2006	From 2007
Common Agricultural Policy, of which:	**17,074**	**26,196**
- Pillar 1	9,865	10,013
- Pillar 2, of which:	5,149	16,183
- Axis 1	1,034	4,174
- Axis 2	3,990	9,477
- Axis3 (incl. LEADER £0.4K and £90K resp.)	123	2,440
Structural Funds, of which:	**8,937**	**4,469**
- ERDF	4,526	2,263
- ESF	1,771	886
- FIFG	2,640	1,320

Notes: "Until 2006" data based on post-MTR CAP reform spending (SG, 2007A); "From 2007" data based on SCOTTISH RURAL DEVELOPMENT PLAN (SG, 2007B).

3 The POMMARD Model

The POMMARD model is built with the Stella© software (ISEE, 2007), representing stocks and flows using user-defined variables, parameters, equations and time periods. According to the supplier, "intuitive icon-based graphical interface simplifies model building" and understanding, and also data input and output, via spreadsheets and "convertors". The use of this software within TOP-MARD was intended to both cover the wide range of project interest, and to enable modelling to be done by some national teams who were not familiar with analysis across the range, e.g. input-modelling, agri-environmental features, or QoL measurement.

POMMARD is used to simulate the behaviour of a rural region as a whole (i.e. not individual farms or other businesses) in terms of its demography, economy, environment and QoL over a number of years (at least 15, in the case of TOP-MARD). It contains 11 modules: Land Use (see below), Agriculture, Non-Commodity Outputs or NCOs (environmental), Economy, Investment, Human Resources (demography), Quality of Life, and Tourism, together with Initial Conditions, Scenario Controls and Indicators (i.e. major model results). Figure 1 depicts the graphical model interface.

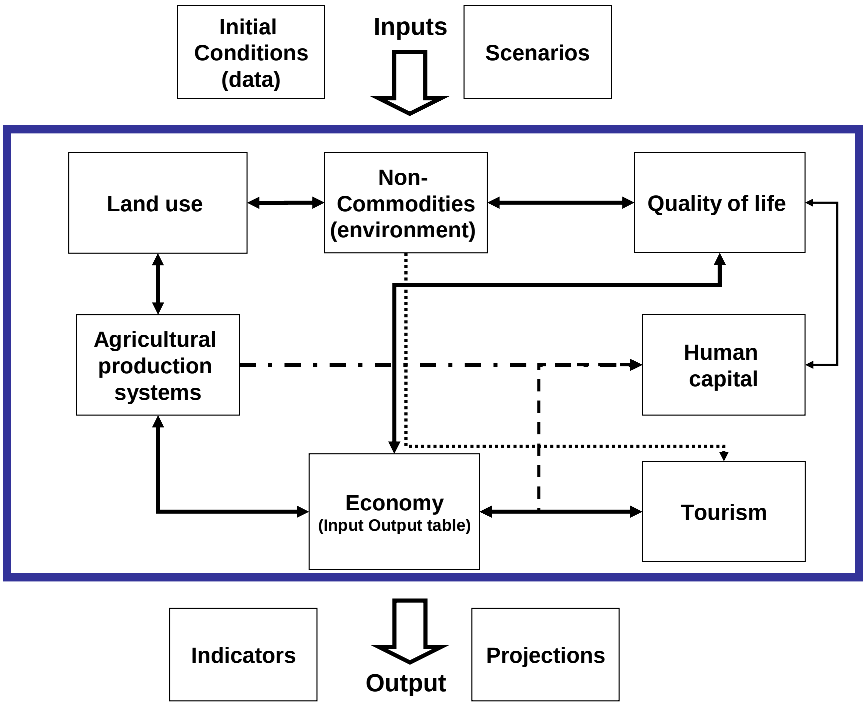
The scientific approach behind POMMARD is based on JOHNSON (1986) and LEONTIEF (1953) in which dynamic regional shifts are included into a localised IO table. Furthermore the initial IO approach has been amended during the TOP-MARD insofar that a specific Social Accounting Matrix (SAM) including production activities, institutional as well as different capitals and Quality of life indicators has been developed (BRYDEN ET AL. 2008).

The primary engines of the model are final demand by economic sector (23 in the core model), and land use by up to 8 agricultural (and other, e.g. forestry) production systems. Such use, specified by shares of total regional area, determines the amounts of labour employed in these systems, and the output of farm commodities and environmental non-commodities. The regional economy is modelled via an input-output table to which a "households" row and column are added, while the Investment module modifies the capacity of each sector. However, unlike many models of economic relationships, the model is partially supply-oriented, insofar as agricultural activity supplements other demand drivers.

The regional population is modelled in some detail, e.g. four age groups and six educational levels (in and after primary (age 14), secondary (age 19), and tertiary education, respectively (age 22)). These age-education cohorts are represented in the employment and migration vectors.

The core version of POMMARD was under development throughout 2006 and 2008, and a preliminary version was delivered to the 11 case study area teams in November 2007, along with a 90-page manual or guide. This version required “beta testing”, i.e. checking for evaluation and correctness by potential users such as the authors of this paper. At time of writing, some minor POMMARD parts and equations are still under development for the model, but the latest and final version 1.4 has been calibrated for the Scottish case study area (based on official data sources and projections for the region) and validated for the period 2001 to 2007 (based on recently published data for population, agriculture and the whole economy in Caithness and Sutherland). In these early stages of the modelling process the calibration of the model was mainly done by comparing projected model outputs and published data about the development of the population size. Due to the nearly static economic structures of the region projections were further more compared to own calculations based on multipliers II of an separately estimated IO table.

Figure 1: The Structure of the POMMARD Model



4 Modelling Structure and Scenario Specifications

In order to apply POMMARD to Caithness and Sutherland, the core version was modified in a number of ways, as follows:

- The number of sectors was altered to 19 (plus Households), in order to fit the UK SIC structure. This includes separate sectors for Agriculture, Forestry, Food Manufacturing and Nuclear Fuels. Tourist expenditures in the area were represented in a vector as an element of final demand alongside with changes in stocks, exports, governmental demand, etc. The hospitality sector (Hotels and Restaurants) was proxied by Hotels and Catering labour.
- Agriculture and Forestry vectors were separated within the land use module of the model, and their final demands distributed to 7 agricultural and one forestry production systems.

Initial data was then supplied to the model, primarily for the following variables and parameters for the year 2001 and subsequent change:

- Input-output (I-O) coefficients
- Final demand values, by sector
- Population levels and birth and death rates, by age-education cohort
- Coefficients for: land-labour and -NCO ratios, and migration shares (by age-education cohort)
- Rates of changes in total final demand and in labour productivity (both 1.5% p.a.)
- EU policy expenditures (see Table 2) and other expenditures, e.g. Dounreay
- Afforestation (of arable land) falling from 1,000 ha per year in 2001 to 200 ha per year by 2030.

In most cases, such data was derived from official sources, e.g. the population and agricultural censuses, business and visitor surveys, and agency publications. The I-O coefficients were calculated using an adapted GRIT procedure (JENSEN ET AL., 1979) based on the official national (Scottish) I-O table including the household sector. Some data was derived from fieldwork (interviews with farm households and other local residents) carried out within the TOP-MARD study.

Calibration of the model took basically place in adaptation of the labour market participation figures by age cohort and qualification level. Due to the fact that C&S has a surprisingly stable economy over time probably due to the high percentage that public expenditures are of the total regional production value, the comparison between "real" and projected data showed only small derivations.

The "Initial Base" scenario involved using the above data to run POMMARD from year 2001 to year 2030 without further modification. In general terms, this simulation produced a stable economy providing employment of almost 16,000 full-time equivalents (FTEs) but with a slowly decreasing population due to out-migration of younger persons (often with higher education) and with slowly increasing shares of older people.

In order to provide a more satisfactory basis for current analysis, a "Main Base" scenario was implemented by inserting changes in EU policy expenditures for the year 2007 onwards (see Table 2) , with an additional £11 million per year being spent on CAP Pillar 2 measures in the area, and £3.5 million less being spent on ERDF and ESF expenditures, as the Highlands and Islands Special Transition Programme runs out (HIPP 2007). The additional £11 million per year increases total final household expenditures, as it is assumed that in such an extensively farmed area no production changes or adaptations need be made. Furthermore due to the fact the above mentioned Dounreay facility will be definitely closed by the year 2031, the main baseline includes the actual and projected expenditure patterns related to Dounreay.

Four "alternative" scenarios were then specified in order to explore the implications of various policy options for the viability of rural remote areas. Three of these scenarios represent extreme versions of the Commission's new Axis structure within Pillar 2 of the CAP. The fourth alternative scenario increases structural funds expenditure in the region by 50%. In more detail, these scenarios were:

1. CAP Pillar 2 Axis 1: all current (planned) Pillar 2 expenditure in Caithness and Sutherland switched into Axis 1, i.e. farm modernisation and investments in direct marketing. This corresponds to an EU strategy of reacting to high world levels of demand for food and fuel by once again increasing support for initiatives designed to improve the output and competitiveness of EU agriculture. More specifically, this scenario assumes an annual increase in both agricultural productivity and output by 2%. The increased Axis 1 spending is allocated to two sectors: 80% to Construction and 20% to Real Estate and Consultancy.

2. CAP Pillar 2 Axis 2: All current (planned) Pillar 2 expenditure in Caithness and Sutherland switched into Axis 2, i.e. for payments to farmers for environmental improvements and land management. This corresponds to continued strengthening of the EU (and especially UK) strategy of increasing support for nature conservation. More specifically, this scenario involves only additional household income, due to the fact that there is not much to do in the area to produce environmental goods and services other than what farmers do already and the Less Favoured Areas scheme has a significant amount (more than 50%) of Axis 2 expenditures in the area already. Furthermore, it is assumed that 66% of the agri-environmental expenditures are not spent in the region as additional household income, but are paid (directly to farmers who reside elsewhere, or indirectly, as rent paid by tenant farmers) to landowners in other regions or countries.
3. CAP Pillar 2 Axis 3: All current (planned) Pillar 2 expenditure in Caithness and Sutherland switched into Axis 3, i.e. improvement of local community facilities as well as supporting education and initialisation of local development agencies and groups with the intention to raise public and private funds for the further development of the area: More specifically, this scenario assumes that each £1 of EU expenditures will attract £2 from other sources as a leverage effect . In modelling terms, it is assumed that the Axis 3 expenditures (including the attracted funds) were distributed equally to the three following sectors: construction, “real estate and consultancy” and education.
4. Structural funds: an increase of 50% from 2007 onwards, i.e. a reversal of the actual decrease projected for the new planning period 2007 to 2013 compared to 2000-2006 (see table 2 for more specific information). More specifically, this was modelled as an equal increase of final demand in the two sectors private services (real estate and consultancy, etc.) and education, as most of the expenditures in the region were spent to improve the knowledge of the workforce.

5 Model Results

Figure 2 shows in graphical form the evolution until the year 2031 of a few key model output (“indicator”) results for this Main Base scenario, covering the economic and social effects of the 2007 changes in Common Agricultural and Regional Policies. Based on the experience in this research in contrast to official policy demand, residents were purely interested in a limited number of economic and social indicators to analyse the effects of regional development (e.g. economic: change in regional gross value added per capita, social: change in the number of regional jobs and change in regional population size). Therefore the presentation follows this bottom-up demand rather than to present a huge number of top-down demanded indicators.

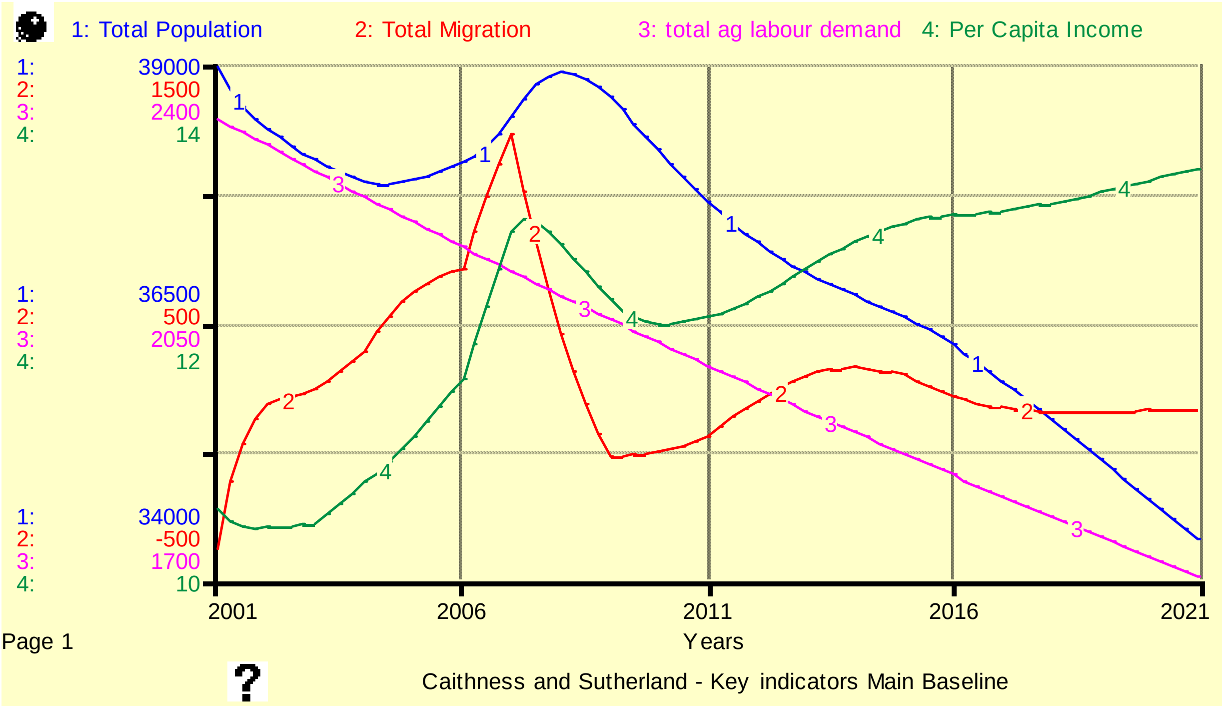
Table 3: Main Baseline Results for Caithness and Sutherland, 2001 to 2024

		2010	**2015**
Total Population	head	40,511	39,096
in-migration	head	586	903
Per capita income	€ 1,000	9.98	10.47
Age Cohort 0-19	head	9,452	9,181
Age Cohort – 65+	head	8,363	8,630

Source: model run, 20 February 2008.

Table 3 shows more detailed numerical results for selected years out to 2015. This scenario results in a slight decrease (and ageing) of the population, and a fairly stable economy as well as provision of ecological goods and services. Since overall final demand is assumed to increase at 1.5% annually, per capita income increases by about £500 (about €750, or 15%) over the period to 2015.

Figure 2: Example of an POMMARD output: Main Base Scenario Evolution: Population, Total Annual Net-Migration (in heads), Total Agricultural Employment (in FTEs), Per Capita income (in £1,000)



Source: model simulation run, 21 February 2008.

Table 4 shows the model-projected results of the four different "alternative scenario" policy changes in the area, for three demographic and one economic key indicators, compared to the Main Base scenario levels of these indicators.

All scenarios only slightly affect the level of population in 2015 compared to the Main Base. While the Axis 3 scenario would increase the population by 3.74%, the Axis 2 one would accelerate depopulation (see Table 1) and decrease population by 2.4% by 2015. Between those two extremes, the Axis 1 and the Structural Funds scenarios both result in a slight increase in population.

More specifically, as children represent the future of a viable rural community, the figures for the age cohort 0 to 19 show that the best way to increase the number of children in the area is Axis 3, while the worst scenario compared to the Main Base is the Axis 2 one. Since the model calculations imply that children have parents who are active in the workforce (which decreases at the same rate, from 16,000 in 2010 to 15,500 FTE in 2015 in the Main Base), the workforce in all four scenarios mirror these numbers.

Retirees (the over-65 cohort) are somewhat independently calculated, and, compared to the main baseline, the Axis 3 scenario increases their absolute number by 3.81% while the Axis 2 one results in a decrease. In the main baseline, the share of retirees in the population rose from 20% to 22% in 2015, and therefore in the long run the population of Caithness and Sutherland would age over-proportionally. However, as past experience shows it is unlikely that in coming times more retirees are to in-migrate for quality of life or cheaper housing reasons as the area has long dark winters and long distances to cope with[4].

---

[4] Anecdotal evidence of several local residents is that most retirees buy a house and after a year out-migrate due to the fact that they expected a higher quality of life and in most cases a better social life, which is difficult in a

Amongst the alternative scenarios, none is able to increase the per capita income due to the fact that in the main baseline the most important employer (Dounreay) provides most of the high-income jobs and, whatever alternative is chosen, new jobs are not able to pay as high wages and salaries. The worst alternative scenario is the Axis 2 one, as it assumes that up to 66% of the additional agri-environmental funding will go to absentee landowners. The best of the alternatives regarding per capita income is the Axis 1 scenario which decreases the average per capita incomes by only 0.96%. Since some structural funds are spent on education, which is not a very highly paid occupation in the Scottish Highlands, this scenario would decrease per capita income by 1.53%, while the Axis 3 scenario would decrease per capita income by 1.91%. Overall, given that in other parts of Scotland per capita incomes are significantly higher, the results indicate that structural fund spending would increase the propensity to out-migrate of young residents (e.g. per capita incomes in Aberdeenshire are roughly 70% higher).

Table 4: Scenario Impacts: Output Indicators for Four Alternative Scenarios compared to Main Base Scenario (%s)

Alternative Scenarios (1-4)	**2010**	**2015**
Total Population		
Axis 1	0.65%	0.35%
Axis 2 66%	-2.48%	-2.40%
Axis 3 – Leverage effect of 200%	4.05%	3.74%
Structural Funds	0.56%	0.54%
Age cohort 0-19		
Axis 1	0.68%	0.34%
Axis 2 66%	-2.77%	-2.51%
Axis 3 – Leverage effect of 200%	4.20%	3.81%
Structural Funds	0.61%	0.57%
Age cohort over 65		
Axis 1	0.32%	0.28%
Axis 2 66%	-1.06%	-1.31%
Axis 3 – Leverage effect of 200%	4.20%	3.81%
Structural Funds	0.26%	0.32%
per capita income		
Axis 1	-1.10%	-0.96%
Axis 2 66%	-1.30%	-2.29%
Axis 3 – Leverage effect of 200%	-0.50%	-1.91%
Structural Funds	-1.40%	-1.53%

Source: model run, 21 February 2008.

6 Conclusions

Various conclusions can be drawn from the modelling exercises reported above, although further work and experience are needed to consolidate and extend these.

sparsely populated area with large distances to and between various facilities. This retirees behaviour is in sharp contrast to urbanised and peri-rural/-urban areas across Scotland, were indeed increased retirees in-migration and stay for the rest of their life took place since the early 1990s and increased significantly the population share of retirees.

1) Perhaps exceptionally for European regions, Caithness and Sutherland can expect more EAFRD money being spent in the period 2007 to 2013 compared to the preceding period 2000 to 2006. For this reason, the CAP reforms imply that more people will stay in agriculture than would otherwise have been the case, and that the increased Axis 2 spending will have mostly positive effects on the local economy. Overall, however, the biggest impact on the local society and economy is not related to European Union funding but to a national policy measure, the decommissioning of a nuclear site which is part of the main baseline. However, in an era of globalisation, even the effect of such national measures may be more and more negligible, and may lead to further depopulation.
2) The main effect of the Main Baseline scenario (changes in CAP modulation and a change in the regional Structural Funds programmes) is that such measures indeed support the viability of rural communities. However, ESF and ERDF spending on support for education and training appears to increase the propensity to out-migrate, and the lower planned level of such spending after 2007 will reduce the leakage of people from rural areas as they are less well educated as a consequence of spending less, and thus affect population levels positively.
3) Regarding the scenarios runs, concentrating Pillar 2 spending on farm investment via Axis 1 does prevent further depopulation to a very small extent. However, since farming systems and marketing in the region seem very difficult to change, it can not be expected that such investment will increase per capita income, nor can this happen in the other scenarios for a diversity of reasons (most of them related to the very high propensity to out-migrate and the over average high educational levels of rural citizens in the far north of Scotland). Focussing CAP Pillar 2 spending on Axis 2 while assuming that absentee landowners will get most of the money, i.e. farm household income payments, in such a remote rural and extensively farmed area appears not to be a viable option . However, if policy could ensure that all Axis 2 expenditures are effectively spent in the region, this might have a very positive effect on per capita incomes as well as on population size.
4) The best way to avoid further depopulation and to protect rural communities appears to be investment using Axis 3 spending in the hope of a leverage effect. In the absence of such leverage effects, then the past decision to decrease structural funds should be reversed, or all Pillar 2 money should be invested in Axis 1.

The advantages of a system-dynamic modelling approach based on limited data is valuable in modelling the regional development policies, since a wide range of economic, ecological and social effects of policy changes may be modelled, at least crudely. The POMMARD model was also flexible, in that additional variables, modules and linkages could be added relatively easily. Moreover, the time-series nature of such models contrasts favourably with the comparative-static nature of much econometric modelling. One of the most important advantages of the approach is that it allowed us to model the regional economy with a satisfying degree of accuracy while ensuring that the results were relevant for both local policy makers as well as residents.

However, a rather high degree of arbitrariness was required for initial conditions and behavioural coefficients, and the complexity of the POMMARD structure made beta testing quite difficult at times. Future research should seek to improve the data bases and to calibrate the existing model so that it can be used not only in the 11 case study areas of the TOP-MARD project but anywhere in rural Europe.

References

BERGMANN, H. (2008) Dounreay Decommissioning - Economic Effects of a Large-Scale Rural De-Industrialisation (paper in preparation), University of Aberdeen Business School.

BRYDEN, J.; JOHNSON, T.; REFSGAARD, K., DAX, T. AND ARANDIA, A. (2008) Scientific Approach, Chapter 3 of the final TOP-MARD report to the EC, unpublished

CAPRI PROJECT: see www.ilr1.uni-bonn.de/agpo/rsrch/capri/capri_e.htm (accessed 4 January 2008).

COMMISSION OF THE EUROPEAN COMMUNITIES (CEC) (2007) Rural Development policy 2007-2013, Brussels. http://ec.europa.eu/agriculture/rurdev/index_en.htm.

ESPON PROJECT: see http://www.espon.org.uk (accessed 4 January 2008).

HAPPE, K. AND BAHLMANN, A. (2008): Doing policy in the lab! Options for the future use of model-based policy analysis for complex decision-making, Paper presented at the 107th European Association of Agricultural Economists Seminar " Modelling Agricultural and Rural Development Policies", Seville, January 29th - February 1st, 2008, http://agecon.lib.umn.edu/cgi-bin/pdf_view.pl?paperid=29477&ftype=.pdf, accessed 20th February 2008

HIGHLANDS AND ISLANDS PARTNERSHIP PROGRAMME (HIPP) (2007) Highlands and Islands Special Transitional Programme 2000 to 2006 and the Highlands and Islands Convergence Programme 2007 to 2013, www.hipp.org.uk.

ISEE SYSTEMS (2007) Stella Version 9, Lebanon, NH 03766 USA. www.iseesystems.com.

JENSEN R.C., MANDEVILLE T.D. AND KARUNARATNE N.D. (1979) Regional Economic Planning: Generation of Regional Input-Output Analysis. Croom Helm, London.

JOHNSON, T. G. (1986), "A Dynamic Input Output Model for Small Regions." Review of Regional Studies 16:1 (Spring): 14 23.

LEONTIEF, W. (1953), "Dynamic Analysis." In Studies in the Structure of the American Economy: Theoretical and Empirical Explorations in Input-Output Analysis. New York: Oxford University Press, pp. 53-90.

MEA-SCOPE PROJECT: see http://www.mea-scope.org/ (accessed 4 January 2008).

NUCLEAR DECOMMISSIONING AUTHORITY (NDA) AND UNITED KINGDOM ATOMIC ENERGY AUTHORITY (UKAEA) (2006) Dounreay Site Summary – 2006/7 Lifetime Plan, PSWBS Site ref. 10, www.nda.gov.uk/documents/loader.cfm?url=/commonspot/security/getfile.cfm&pageid=3962 (accessed 30 December 2007).

SCOTTISH EXECUTIVE (SE) (2006) Scottish Tourism – The Next Decade. Edinburgh. http://www.scotland.gov.uk/Publications/2006/03/03145848/0.

SCOTTISH GOVERNMENT (SG) (2007a) Administration of Common Agricultural Policy Schemes in Scotland: Annual Report for 2005, Edinburgh. www.scotland.gov.uk/Publications/2006/12/01164556/0, and reports for earlier years (published by Scottish Executive; same home website).

SCOTTISH GOVERNMENT (SG) (2007b) Scottish Rural Development Plan. Edinburgh. http://www.scotland.gov.uk/Publications/2007/12/10103119/14.

SENSOR PROJECT: see http://www.sensor-ip.org (accessed 4 January 2008).

UNIVERSITY OF THE HIGHLANDS AND ISLANDS (UHI) http://www.uhi.ac.uk/uhi-academic-partners/policyweb/topmard/home (accessed 4 January 2008).