General Equilibrium Analysis of the Spatial Impacts of Rural Policy

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ABSTRACT

General equilibrium (GE) techniques have recently been used to simulate policy impacts for neighbouring or different rural areas, thus focussing on the important spatial aspect of such policies. A Social Accounting Matrix (SAM) represents production, households, government, etc. in matrix form, while computable GE models introduce greater behavioural flexibility at the cost of parameterisation. Several SAM and CGE models have recently been built for rural regions, while others have tried to represent rural-urban linkages.

This paper presents two SAM applications, and one current CGE approach. The first SAM was developed for the analysis of the economic impact of Objective 1 policy on six remote rural areas, including two in Greece. Six specific regional SAMs were used to quantify the growth-generation effects of EU policies and scenarios on these local economies. The second effort used a hybrid three-area SAM for two different rural areas and an adjacent city in Crete to assess the diffusion patterns of economic impacts generated by three types of CAP measure in one of the rural areas. A CGE example, from the ongoing TERA project, seeks to model the determinants of economic agglomeration, and will attempt to cope with rural/urban distance and environmental externalities.

Advantages of the SAM approach include its simplicity and availability of data and software. Disadvantages include significant data needs, linear behaviour, no real modelling of growth (development) or price changes, and the fact that some policies apply to many sectors in unknown way. The CGE approach may overcome some of these problems.

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1. Introduction

In recent years, the diversification of EU rural areas in terms of their structures and characteristics, the attempts at "integration" of EU development policies, and the general widening of the rural-urban interface have all resulted into a number of quantitative analysis efforts aimed at rural (including agricultural) policy evaluation at the territorial level. These efforts seem likely to intensify as evaluations become necessary of new 2007-2013 Rural Development Programmes and of other changes (e.g. a reformed Less Favoured Areas regime following the "health check" of the CAP in 2008).

Different tools and approaches have been used to evaluate the repercussions of rural policies, often as regards targeted groups (Bossard *et al*., 2000). Quantitative evaluations range from descriptive techniques, rational checking procedures and local growth indicators, through cost-benefit and multi-criteria analyses, to sophisticated macro- and micro- models (for a review, see Psaltopoulos, 2004). Several studies have used some form of qualitative analysis to evaluate rural policy (Midmore, 1998). Evaluation of CAP effects has also taken a number of directions, such as emphasising environmental or competitive aspects, and such evaluation has become part of overall regional analysis in the Cohesion Reports of the European Commission (1996, 2001 and 2004), and elsewhere (e.g. Shucksmith *et al*., 2005, for the ESPON Programme).

It has been often argued that the potential effects of policy are not equally distributed amongst EU rural regions (European Commission, 1996). Most of these areas begin from distinctly different starting points in terms of their development, and

there is significant diversity in terms of population change and densities, natural resource endowments, economic and social structures, and environmental conditions. In addition, there has been an active debate over 'cohesion' and the role of 'balanced' and 'polycentric' development in the EU, focusing on regional and urban-rural interactions (Davoudi, 2002; European Commission, 2001 and 2004). It has also been argued that the comprehensiveness of policies that target rural areas is rather limited, due to the various interconnections and interdependencies between rural and urban space (Baldock *et al.*, 2001).

Since the early 1990s, and after the reform of the EU Structural Funds, rural areas in Southern Europe have been recipients of considerable development policy assistance. However, in practice, and especially in these countries, most EU funding to rural areas continued to be directed through the CAP's Agricultural Fund, either from its Guarantee Section for market and farm income support, or from its Guidance Section for structural rural development, and such an approach appears to be being replicated in several New Member States within the new European Agricultural Fund for Rural Development. In many Mediterranean countries, agriculture is still regarded as 'the heart beat of rural areas', and that rural development policy, often focussing on the agro-food chain, can induce the realisation of economic benefits from major investments carried out under EU regional and cohesion policies (European Commission, 2005).

Thus, the economic effects of such rural development policy expenditure continue to be of interest, and in particular the geographical spread of these effects, including leakage to neighbouring areas, urban or rural. The links between town and country have become the focus of increased attention, e.g. in the Cork Declaration (1997) which states that "*Support for diversification of economic and social activity*

must focus on providing the framework for self-sustaining private and community-based initiatives [including] strengthening the role of small towns as integral parts of rural areas and key development factors…", while researchers in the Marketowns project have commented that: "*One strategy is to use small towns as 'sub-poles' in rural economic development but the effectiveness of such a strategy depends not only on the size of the various multipliers but their spatial distribution*" (Courtney and Errington, 2003)

Within this context, modelling efforts have increasingly attempted to capture, if only in broad terms, spatial processes affecting the rural economy. Taking into account the relevance of development policy to a wide range of beneficiaries, several researchers have opted to apply general equilibrium (GE) methods (I/O, SAM, CGE) in order to assess policy impacts at the rural territorial level. This is especially important for Mediterranean countries, most of which have large and populous rural areas which however often vary widely in levels and types of development, including the added-value activities of the agro-food chain.

This paper presents three relevant applications of the GE modelling framework. The following section first discusses some general issues relevant to the nature of rural policy analysis through such an approach. This is followed by the presentation of the three applications. The first was developed for the analysis of the economic impact of Objective 1 policy on six remote rural areas of Scotland, Finland and Greece, through the construction of regional SAMs. The second utilizes an inter-regional SAM model to evaluate the impacts of CAP measures implemented in Archanes, an agriculturally dependent local economy in Crete. In the third application, current efforts to model the determinants of economic agglomeration at

the rural vs. urban level through a rural/urban CGE model are briefly reported[1]. Finally, the paper considers the advantages of GE techniques to deal with the assessment of spatial policy impacts and (more generally) territorial policy evaluation. It also deals with problems associated with the application of SAM and CGE analysis at the regional level, as well as with the relevant limitations and their associated impacts on findings and policy implications.

2. General Equilibrium Modelling for Rural Policy Analysis

The selection of an evaluation technique mainly depends on the policy actions to be evaluated and on the focus of the evaluation. A general equilibrium approach seems appropriate for evaluating the impact of development policy in a local economy as a whole. Modeling based on the Social Accounting Matrix (SAM) technique (Pyatt and Roe, 1977) allows the identification of the economic effects of policy funding on both investment and direct income transfers in a local economy. In turn, an inter-regional SAM model can discern the relative importance of all linkages within a locality but also the significance of spatial interdependencies.

The SAM[2] approach to policy analysis offers some attractions in this context. It expands the input-output activity/commodity matrix of production to other ("social") sectors or "institutions", such as households, government, capital (investment) and trade (exports and imports). The method represents all monetary flows for the modelled economy in double-entry row and column accounts which balance to represent a (dynamic) equilibrium. In principle (i.e. if data is available), the

[1] It is expected that, by the time that the Conference takes place, results from this particular effort will be available for a first public presentation.

[2] SAM is sometimes taken to denote Social Accounting Model(ling) rather than Social Accounting Matrix. We prefer the (original?) definition since this distinguishes the core database from assumptions (linearity, marginality, equilibrium) about economic behaviour that are made when utilising it for modelling purposes.

structure is flexible, since sectors (e.g. agriculture, services, households) can each be treated at the desired appropriate level of aggregation. However, the linearity of the matrix is a behavioural simplification, compared to more flexible computable general equilibrium (CGE) models which however (usually) require parameters to be "guesstimated".

As regards the spatial dimension, some SAM efforts have developed from the initial national versions by attempting to capture, in broad terms, processes in different areas. Thus many regional SAM models have been built, several for rural areas (Marcouiller *et al.*, 1995; Leatherman and Marcouiller, 1996; Roberts, 2003; 2005), while others have tried to represent rural-urban interdependence and linkages in various ways (Roberts, 1998; Mayfield and van Leeuwen, 2005). In some (so far, rather few) cases, these modelling efforts have been closely linked to rural region typologies, e.g. as seen to be of interest to the European Commission (Giray *et al.*, 2006).

CGE models have particular attractions for policy analysis in offering a comprehensive representation of the economy, with a SAM as the "data base". This approach promises the possibility of focussing on a wide range of effects of interest to policy makers, and of producing internally consistent results, while allowing concentration on sectors of primary concern. Naturally, data availability and the need to define and to parameterise the size, nature and economic behaviour of different sectors and sub-sectors often severely limit modellers' ability to exploit these potentials. The equilibrium characteristic of CGE modelling is common to most economic analysis, but poses problems for policy evaluation (or at least for the interpretation of such evaluations) if government intervention is seen - as it often is - to be concerned with either accelerating or slowing down adjustment from a non-

sustainable (i.e. non-equilibrium) situation. While adjustment rates can be incorporated into essentially comparative-static modelling, or to impose trigger levels (e.g. for factor mobility, as done by Kilkenny, 1993), such features are usually highly judgemental, i.e. arbitrary, and may have a critical influence on estimates of policy effects.

In terms of rural spatial analysis, an early effort by Kilkenny (1993) constructed a rural-urban inter-regional CGE model for the US and simulated the effects of terminating farm subsidies for both economies. In another effort, Kilkenny (1998) developed an explicitly spatial rural-urban CGE approach to take into account distances between locations, natural resource dependence and low population densities in order to explain rural/urban agglomeration economies. In this effort, there is a focus on rural-urban transport costs in the context of rural development, but transport policy measures are not explicitly considered. Further, several CGE models have been built to evaluate agricultural policy changes, often related to trade measures. Most appear to be standard one-region CGE models, with agriculture as a production sector but with no explicit spatial features (Thomson, 2006).

3. Three Applications

In the rest of this paper, three relevant applications of the general equilibrium framework are presented. The first application was developed for the analysis of the economic impact of Objective 1 policy on three agriculturally dependent and three economically diversified remote rural areas of Greece, Scotland and Finland (Psaltopoulos *et al.*, 2004). For this assessment, six specific study-area (regional) SAMs were built using the hybrid GRIT regionalization technique developed by Jensen *et al*. (1979); this was followed by the quantification of the growth-generation effects of EU support and development policies on these local economies. Policy

impacts were distinguished into i) investment and transfer effects, i.e. effects strictly related to policy investment (e.g. infrastructure) and transfers (CAP Guarantee); and ii) capacity-adjustment effects, i.e. effects related to economic activity generated through the utilisation of productive resources stimulated by development policy expenditure. The impacts of EU policy scenarios on the six rural economies studied were also estimated.

Table 1 shows that in the Greek study area of Evrytania (which received a higher level of assistance as a share of its regional gross output), effects were significant, especially in terms of employment and firm income. These effects are mostly attributed to ERDF measures, as Evrytania is not an agriculturally dependent economy. Policy impacts on the economy of the Scottish Western Isles were much lower.

Table 1: Effects of policy expenditure, 1989-93 (% av. annual increase compared with baselines: Greece 1988, Scotland 1989)

	Gross Output	Firm Income	Employment
Greece: Evrytania			
Public Investment Prog.	1.46	2.36	3.09
Integ. Medit. Prog.	3.72	5.87	7.81
ERDF Operational Prog.	13.14	21.39	27.78
CAP Guarantee	1.25	8.22	2.82
CAP Guidance	2.91	12.42	6.41
Scotland: Western Isles			
ERDF Operational Prog.	1.27	1.78	2.60
ESF Operational Prog.	0.15	0.18	0.29
LEADER	0.35	0.42	0.67
CAP Total	1.55	3.28	3.56

Capacity-adjustment effects, estimated by selection of appropriate EU-funded projects for each region, are shown in Table 2. In the case of the Greek regions, the effects are large: Evrytania shows potential increases of between 20 and 30 per cent in income terms and over 60 per cent in employment terms, while Aitoloakarnania shows increases of 20 and 30 per cent respectively. The main economic benefits for Evrytania arise by increasing capacity for tourism, and for Aitoloakarnania through cultivation restructuring and investment in fisheries. In Scotland, the effects are much smaller and arise from expenditure on agriculture and construction (e.g. of hotels).

Table 2: Capacity-adjustment effects of policy expenditure, 1989-93 (% av. annual increase compared with baselines: Greece 1988, Scotland 1989)

	Output	Household Income	Employment
Greece: Evrytania			
- Tourism	18.4	12.6	42.8
- Other Sectors	10.3	6.7	22.0
Total	28.7	19.3	64.8
Greece: Aitoloakarnania	18.1	8.9	30.6
Scotland: Western Isles			
- Agriculture	0.86	1.13	0.36
- Construction (for Tourism, etc.)	0.54	1.20	0.68
- Other Sectors	0.10	0.59	0.19
Total	1.50	2.92	1.23
Scotland: Wigtown & Stewartry	2.63	4.02	2.25

Source: Authors' calculations

Table 3 indicates the economic impacts of each of three Scenarios in terms of average annual changes in employment in the six study areas in period 2000-2006. In the economically diversified study areas, the Trend Scenario would produce positive effects in all three study regions, due to the continuation of the high level of support.

In Evrytania, the estimated impacts are significant, in N. Karelia employment effects are marginal, while estimated effects for the W. Isles seem satisfactory. The Agenda 2000 Scenario reduces the available structural funds in Evrytania by 14 per cent, while effects could be fairly important for the W. Isles due to the reclassification of Objective areas at NUTS II level. In N. Karelia, the change from Objective 6 to new Objective 1 status would make the Agenda 2000 Scenario quite attractive. The Non-Cohesion Scenario would clearly benefit Evrytania, where the high number of farms would attract strong CAP support. The W. Isles and N. Karelia would lose with respect to their current status.

Table 3: Employment Effects of Structural Policy Scenarios, 2000-2006 (% av. annual increase compared with baselines: Greece 1988, Scotland 1989, Finland 1993)

	Scenario		
	Trend	**Agenda 2000**	**Non-Cohesion**
Greece: Evrytania	26.6	21.3	38.5
Greece: Aitoloakarnania	38.5	3.5	24.3
Scotland: Western Isles	3.2	1.0	1.4
Scotland: Wigtown & Stewartry	5.1	4.6	1.5
Finland: North Karelia	0.6	1.2	0.8
Finland: S. Ostrobothnia	-0.4	-2.2	-0.2

Source: Authors' calculations

In the case of the agriculturally dependent study areas, Agenda 2000 would negatively affect economies with reduced policy support, such as in Wigtown and Stewartry. In Aitoloakarnania, a significant decline of impacts is projected (compared to those of the Trend scenario) due to reductions in CAP Guarantee payments. In S. Ostrobothnia, CAP Guarantee cuts generate substantially negative impacts. These regions would be much better off with the then-current Structural Policy and CAP

expenditure than under Agenda 2000. The results for the Non-Cohesion Scenario reflect the characteristics of the study regions: Aitoloakarnania would receive a very high level of CAP support, but structural development funds would substantially decline; as a result, estimated impacts are lower compared to those of the Trend scenario. Wigtown and Stewartry would lose almost 80 per cent of CAP subsidies but structural development funds would increase. In total (compared to the Trend Scenario), both funds and estimated impacts would decline by nearly 75 per cent. Finally, in the case of South Ostrobothnia, the doubling of CAP Guarantee subsidies generates much larger impacts compared to the two other scenarios.

The second effort evaluates the inter-regional impacts of CAP measures implemented in Archanes, a dynamic but agriculturally dependent local economy in Crete (Greece). This is accomplished through the construction of a hybrid three-area SAM for Archanes, N. Kazantzakis (a less-developed neighbouring rural area) and Heraklion (the adjacent urban centre). This inter-regional SAM captures interactions between these three rural-urban localities and assesses the diffusion patterns of economic impacts generated by three types of CAP measures, i.e. market/income support, farm development, and diversification aid (Psaltopoulos *et al.*, 2006).

Table 4 presents aggregate household multipliers for the three areas, distinguished by income group; these figures indicate the impact on total household incomes in a region from a unitary change in the income of a rural/urban household group. Results show that the Heraklion aggregate multiplier is higher than those of the two rural areas, while income multipliers in Archanes are higher than those in N. Kazantzakis. Also, it seems that the diffusion of rural area household income impacts (especially in N. Kazantzakis) is considerably stronger towards the urban area of Heraklion, and rather weak between them. Moreover, middle-income households of

Archanes and the low-income households of N. Kazantzakis seem to possess higher income-generating potential than the high-income group in both areas.

Table 4: Household Multipliers: Archanes, N. Kazantzakis, Heraklion, 1998

Archanes	**Archanes**	**N.Kazantzakis**	**Heraklion**	**Aggregate**
Low-income	1.324	0.030	0.198	1.552
Middle-income	1.321	0.035	0.255	1.611
High-income	1.216	0.029	0.187	1.432
N. Kazantzakis	**Archanes**	**N.Kazantzakis**	**Heraklion**	**Aggregate**
Low-income	0.025	1.219	0.253	1.497
Middle-income	0.025	1.216	0.254	1.495
High-income	0.019	1.172	0.269	1.460
Heraklion	**Archanes**	**N.Kazantzakis**	**Heraklion**	**Aggregate**
All households	0.009	0.007	1.773	1.789

Source: Authors' calculations

Table 5 presents the indirect impacts (i.e. effects excluding the initial direct impact) of CAP (Pillar 1 and 2) spending in Archanes on output, firm income and employment in Archanes itself, N. Kazantzakis and Heraklion. Results indicate that, for the Archanes economy, the indirect impacts of farm income support measures are by far the highest, especially in the case of employment. Taking into account their much lower share in total CAP spending in the area, measures for economic diversification seem to generate satisfactory output and employment impacts in Archanes. The diffusion of economic impacts away from the Archanes economy is rather lower than expected for a small open local economy. The proportions of economic impacts of CAP measures that remain in Archanes are especially high in the case of the output (48% of total inter-regional indirect impacts stay in Archanes) and employment (54.5%) effects generated by economic diversification measures, in terms of the firm income (49.6%) effects generated by aids to increased farm productivity and household income (60%) effects generated by Guarantee subsidies. Economic benefits leak primarily to the urban area of Heraklion, and only marginally to the less developed agriculturally dependent N. Kazantzakis. Farm subsidies leak

significant firm income benefits (46.2%) to Heraklion, measures aiming to increase farm productivity leak output benefits (46.2%), while diversification measures generate similar diffusion patterns in the case of employment (32.0%). Income support subsidies generate comparatively high diffusion to N. Kazantzakis, in the case of generated firm income (12.3%) and employment (16.0%), while diversification measures generate comparatively low benefits in this lagging rural area.

Table 6: CAP Expenditure Effects, Archanes 1988-1998 (mil. Drs., av. annual increase)

	Archanes	**N. Kazantzakis**	**Heraklion**
Farm Income Support			
Output	241.8	69.1	240.2
Firm Income	94.6	27.9	105.1
Employment (jobs)	143	43	82
Aids to Farm Productivity			
Output	57.2	17.9	64.6
Firm Income	34.4	7.2	27.7
Employment (jobs)	38	11	22
Aids to Econ. Diversification			
Output	24.5	5.7	20.8
Firm Income	8.6	1.9	7.7
Employment (jobs)	12	3	7

Source: Authors' calculations

The third application discussed here relates to work currently in progress within the FP6 research project "Territorial Aspects of Enterprise Development in Remote Rural Areas' (TERA), whose aim is "*identifying territorial economic factors that could become key elements of consideration in a possible new development policy framework …, and investigating the degree of compatibility between these factors and current policy efforts in remote rural areas*". The TERA CGE model(s), based on

Kilkenny (1993) and Phimister *et al.*, 2006, "*will comprehensively deal with distance, specify more than two categories of goods, portray the effects of agricultural direct support and also try to formalise the existence of key externalities (such as quality of life)*". To meet these goals, Thomson (2006) suggests that the CGE models should reflect the following:

- Agriculture, along with tourism, deserves particular specification, along with "heavy" industry, private and public services (separately, and perhaps distinguishing local and central control), construction, and transport.
- The transport sector deserves special attention, including not only improvements in major transport routes, but also local transport and fuel costs.
- Environmental policy is an important part of EU policy in rural areas, and impacts on the "attractiveness" of rural locations for new development (and/or residence), both positively and negatively (through planning constraints on development).
- CGE modelling of remote rural areas may be particularly useful in assessing the effect of macroeconomic policy (e.g. general taxation, employment regulations) in such regions. Such intervention clearly has an effect on enterprises everywhere, and its importance relative to both "average" areas and to explicit rural development instruments should be assessable through CGE modelling.

4. Conclusions

This paper has presented three applications of the General Equilibrium modelling framework for the assessment of rural policy spatial impacts, and has attempted to reveal the advantages of this modelling approach to deal with (more generally) territorial policy evaluation.

Advantages of the SAM approach in dealing with the assessment of spatial policy impacts, particularly where it is desired to utilize pre-defined or official rural

typologies include its scope (multiple economic and social sectors), simplicity (structure and linear behaviour), ability to isolate policy effects from those of other influences; techniques (e.g. GRIT) for data generation), software (spreadsheet or GAMS) and regional differentiation.

Disadvantages of the SAM approach include significant data needs (implying that few regions can be handled), no real modelling of the growth process (development), and the fact that some policies (e.g. “soft” enterprise aids) apply to many sectors in unknown ways. Other include the assumptions of fixed input structure, unlimited capacity of primary factors to each and every sector, and no price effects in the system. In principle, a CGE approach built on fundamental micro-economic principles and including non-linear feedback mechanisms can be used to model both price and volume changes. However, difficulties in calibration (especially at a small-area level) may lead to aggregated CGE models that can address efficiency questions but are perhaps not so suitable for sectoral analysis. In the case of small, open economies, resource competition cannot be regarded as very intense; and labour and capital can be considered as fairly flexible (elastic) in supply, as also land, except for agriculture where its use can be regarded as rather static. Also, it is unlikely that modest external shocks (typical of policy) would induce significant changes in prices, volumes and factor distributions of every sector.

In general, it seems that the provision of stochastic estimates by using a parametric approach, would involve alternative assumptions equally or more vulnerable to criticism. However, significant price responses would be likely to reduce the estimated effects, although care would be needed as to the direction of policy (or other economic) change, since behaviour is likely to be asymmetric, at least in the short and medium runs, as (e.g.) farmers consider expansion or contraction.

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