Estimating Spatial Employment Impacts of the CAP through Social Accounting Analysis

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Abstract:

This paper presents the analytical properties of Social Accounting Analyses methods, especially models based on simple and extended Social Accounting Matrices (SAM) and their application to the investigation of spatial economic interactions and flows patterns, including those associated with the spatial employment impacts of the CAP. Section 2 presents the structure, assumptions and characteristics of interregional SAMs and deals with their modeling properties, which make possible the investigation of spatial economic interactions. Section 3 presents recent developments in SAM construction and model applications relevant to the analysis of such issues, including that of CAP employment impacts. Finally, the Chapter concludes with a short critical evaluation of advantages and shortcomings of the SAM approach to analyze and interpret the determinants of the spatial distribution of economic activity and suggests future research directions.

Key words: Impact Assessment, General Equilibrium, Common Agricultural Policy, Rural Employment.

1. Introduction

Various quantitative methods have been applied to the analysis of the spatial distribution of economic activity and the underlying forces, which drive this distribution. Regional science has been largely credited with the development of such analytical techniques, which include location analysis, urban complex analysis, as well as general equilibrium tools such as spatial econometric, gravity, input-output and social accounting analysis. More than frequently, these modeling tools concentrated on the practical applications in regional planning, economic development, etc. (Isard *et al.,* 1998) and rather “sacrificed” mainstream economic theory (at least in the opinion of economic purists) in favor of practical analysis. Indicatively, constant returns and linear production and consumption functions are popular assumptions for those criticizing the analytical rigor of these approaches, which have nevertheless contributed to the understanding of the geography of economic behavior. Subsequent theoretical advances by the new economic geography literature (e.g. Fujita *et al.,* 1999; Puga, 1999) focused on external and internal increasing returns and transport costs and led to the development of canonical models (Baldwin *et al.,* 2003). However, despite satisfying the rigorous tenets of mainstream economics, these “theoretically-sound” models have been criticized for being either too abstract or/and rather unsuitable for sound empirical analysis (Boddy, 1999). To sum up, it seems that a trade-off exists between theoretical rigor and operational capacity; operational models for applied analysis seem to constitute tools, which are able to detect the pattern of spatial economic interactions, but are hardly able to explain complex forces (including policy), which jointly determine the spatial distribution of economic activity.

The introduction of Social accounting analysis models goes back to work by Richard Stone, while later, Czamanski (1973) and Pyatt and Thorbecke (1976) formalized this tool and indicated its possible use as a conceptual framework for policy purposes. A SAM presents (in a single matrix) interactions between production activities, production factor accounts, institutional accounts (households, government, firms) and the rest of the world in an economy during a given year. It is a single entry accounting system represented in the form of a square matrix, where each institution accounts for a column for its purchases and a row for its sales (Pyatt and Round, 1985).

To a certain extent, a SAM may be considered as an expansion or a generalization of Leontief’s Input-Output (IO) table. SAMs not only capture inter-industry linkages, but also provide information on the links between production and institutions (differing according to factor ownership) and those associated with household expenditure, which depend on both the pattern and spatial habits of consumption. In this context, SAMs can be utilized for the analysis of both distributional and growth issues and at the regional level, have been particularly applied to analysis of the impacts of various development policies (Pyatt and Roe, 1977; Pyatt and Thorbecke, 1976; Thorbecke, 2000).

Models based on interregional SAMs (Round, 1985) have been built and utilized for the investigation of agglomeration and (perhaps more generally) spatial distribution of economic activity and the impacts of policies across economic space. Applications have focused on the comparative static investigation of core-periphery (and rural-urban) relationships and changes in industry and household location and trade patterns. Though built on a fixed price, fixed input structure and perfect supply elasticity assumptions, the ability of SAMs to analytically portray in detail all kinds of interactions within and between more than one economy and their capacity to analyze distributional and growth issues within a single framework, have facilitated their application to the analysis of spillover (Hamilton *et al.*, 1991) and backwash effects (Gaile, 1980), as well as both structural change (Jackson *et al.*, 1990) and path analysis (Defourny and Thorbecke, 1984) and policy impact investigations (Isard *et al.*, 1998).

Within this context, this paper presents the analytical properties of SAMs and their application to the investigation of spatial economic interactions and flows patterns, including those associated with the employment impacts of the CAP. The next section presents the structure and characteristics of interregional SAMs and deals with their modeling properties, which make possible the investigation of spatial economic interactions. Section 3 presents recent developments in SAM construction and model applications relevant to the analysis of such issues, including that of CAP employment impacts. Finally, the paper concludes with a brief critical evaluation of advantages and shortcomings of the SAM approach to analyze and interpret the determinants of the spatial distribution of economic activity.

2. Model Structure and Analytical Properties

2.1 Model Structure and Analytical Properties

Interregional SAMs originate from the development of interregional IO models (Isard, 1951), which were built in order to measure and model economic interconnections between regions. As noted by Miller and Blair (2009), in a single-region IO model, exports and imports are treated as exogenous; however, especially in the case of smaller economies, the role of exports and imports is rather important, as they account for inputs to production and consumption and sales of outputs. Furthermore, a single-region IO model cannot be used to assess interregional economic spillover effects, i.e. positive effects on the economy of region 2 induced by increased final demand for a product produced in region 1 and attributed to the fact that in order to produce this product, region 1 firms buy inputs from region 2. Also, in the same manner, single region models cannot account for interregional feedback effects originating by the fact that (e.g.) in order to produce output demanded by region 1 firms, region 2 firms might have to purchase inputs from region 1 firms.

The above-mentioned weakness of single-region models illustrates the most important problem of interregional IO modeling, i.e. the estimation of transactions between regions. In fact, an interregional IO model requires a complete set of both intra- and interregional data, i.e. (in the case of a two-region model) recording transactions from sector i in region r to sector j in region s (Miller and Blair, 2009). In practice, this means that data requirements grow with the number of regions (a three-region model has six interregional matrices, a four-region model has 12, etc.). Hence, due to unsurpassed problems of data availability, Chenery (1953) and Moses (1955) developed the multi-regional IO model (MRIO), which ignores information regarding the origin of a given output (see also Polenske, 1995).

If obtaining interregional data in order to build an interregional IO table is a very demanding task, one can surely see that obtaining data for constructing an interregional SAM is a considerably more problematic assignment. However, a breakthrough on this issue was made by Round (1985), who showed that at least in a two-region system, the design of an interregional SAM can facilitate meeting minimal extra requirements of interregional flows data. An interregional SAM model recognizes two types of direct flows between its areas: the geographical movement of commodities, either for final consumption or for intermediate use in production, and the transfers of payments for factor services, mainly in the form of employment income earned by households from one area working in another. The model areas also trade and transfer money to exogenous accounts, including rest-of-world and government accounts. The model can consistently estimate new equilibria for the structure of production, the distribution of factor incomes and the pattern of consumer demands in all areas, simultaneously, based on the necessary equilibrium conditions.

The aggregate interregional multiplier matrix, M, captures all the relationships in the system. It takes into account the effect of relationships within each area relating to income distribution and the structure of production and also the dependencies between the regions resulting from interregional flows. M may be decomposed into two different multiplier matrices, the intra-regional multiplier effects matrix, M_{r1}, which shows the multiplier effects that result from linkages wholly within each of the regions taken separately, and the interregional multiplier effects matrix, $M_{rz,}$ which captures the (spatial) repercussions between the accounts of one region and those of the other two, excluding the within-region effects. Together, they capture the total repercussions within and between endogenous accounts in the interregional system, and explain the relative importance of the various types of linkages and interdependencies that exist between the areas. By endogenizing production, factor and household accounts, the basic equation of an interregional SAM model can be represented as (Round, 1985; Roberts, 1998):

$$\mathbf{y} = \mathbf{Zy} + \mathbf{x} \qquad (1)$$

where $\mathbf{y}$ = column vector of endogenous accounts incomes in the three areas

$\mathbf{Z}$ = transaction coefficient matrix including linkages within and between areas

$\mathbf{x}$ = column vector of exogenous expenditures

The aggregate interregional multipliers are estimated as:

$$\mathbf{y} = (\mathbf{I} - \mathbf{Z})^{-1}\,\mathbf{x} = \mathbf{Mx} \qquad (2)$$

The interregional SAM model for (indicatively) a three–region system can be expressed in partitioned form as follows:

$$\begin{bmatrix} \mathbf{y_1} \\ \mathbf{y_2} \\ \mathbf{y_3} \end{bmatrix} = \begin{bmatrix} \mathbf{Z_{11}} & \mathbf{\tilde{z}_{12}} & \mathbf{\tilde{z}_{13}} \\ \mathbf{\tilde{z}_{21}} & \mathbf{Z_{22}} & \mathbf{\tilde{z}_{23}} \\ \mathbf{\tilde{z}_{31}} & \mathbf{\tilde{z}_{32}} & \mathbf{Z_{33}} \end{bmatrix} \begin{bmatrix} \mathbf{y_1} \\ \mathbf{y_2} \\ \mathbf{y_3} \end{bmatrix} + \begin{bmatrix} \mathbf{x_1} \\ \mathbf{x_2} \\ \mathbf{x_3} \end{bmatrix} \qquad (3)$$

where subscripts 1, 2, 3 relate to the three regions of the system, and superscript ~ to the off-diagonal sub-matrices.

The multipliers within and between regions are thus derived as:

$$\begin{bmatrix} \mathbf{y_1} \\ \mathbf{y_2} \\ \mathbf{y_3} \end{bmatrix} = \begin{bmatrix} \mathbf{Z_{11}} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{Z_{22}} & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & \mathbf{Z_{33}} \end{bmatrix} \begin{bmatrix} \mathbf{y_1} \\ \mathbf{y_2} \\ \mathbf{y_3} \end{bmatrix} + \begin{bmatrix} \mathbf{0} & \mathbf{\tilde{z}_{12}} & \mathbf{\tilde{z}_{13}} \\ \mathbf{\tilde{z}_{21}} & \mathbf{0} & \mathbf{\tilde{z}_{23}} \\ \mathbf{\tilde{z}_{31}} & \mathbf{\tilde{z}_{32}} & \mathbf{0} \end{bmatrix} \begin{bmatrix} \mathbf{y_1} \\ \mathbf{y_2} \\ \mathbf{y_3} \end{bmatrix} + \begin{bmatrix} \mathbf{x_1} \\ \mathbf{x_2} \\ \mathbf{x_3} \end{bmatrix} \qquad (4)$$

$$\begin{bmatrix} \mathbf{y_1} \\ \mathbf{y_2} \\ \mathbf{y_3} \end{bmatrix} = \begin{bmatrix} (\mathbf{I} - \mathbf{Z_{11}})^{-1} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & (\mathbf{I} - \mathbf{Z_{22}})^{-1} & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & (\mathbf{I} - \mathbf{Z_{33}})^{-1} \end{bmatrix} \left\{ \begin{bmatrix} \mathbf{0} & \mathbf{\tilde{z}_{12}} & \mathbf{\tilde{z}_{13}} \\ \mathbf{\tilde{z}_{21}} & \mathbf{0} & \mathbf{\tilde{z}_{23}} \\ \mathbf{\tilde{z}_{31}} & \mathbf{\tilde{z}_{32}} & \mathbf{0} \end{bmatrix} \begin{bmatrix} \mathbf{y_1} \\ \mathbf{y_2} \\ \mathbf{y_3} \end{bmatrix} + \begin{bmatrix} \mathbf{x_1} \\ \mathbf{x_2} \\ \mathbf{x_3} \end{bmatrix} \right\} \qquad (5)$$

$$\begin{bmatrix} y_1 \\ y_2 \\ y_3 \end{bmatrix} = \begin{bmatrix} 0 & (I - Z_{11})^{-1}\tilde{z}_{12} & (I - Z_{11})^{-1}\tilde{z}_{13} \\ (I - Z_{22})^{-1}\tilde{z}_{21} & 0 & (I - Z_{22})^{-1}\tilde{z}_{23} \\ (I - Z_{33})^{-1}\tilde{z}_{31} & (I - Z_{33})^{-1}\tilde{z}_{32} & 0 \end{bmatrix} \begin{bmatrix} y_1 \\ y_2 \\ y_3 \end{bmatrix}$$

$$+ \begin{bmatrix} (I - Z_{11})^{-1} & 0 & 0 \\ 0 & (I - Z_{22})^{-1} & 0 \\ 0 & 0 & (I - Z_{33})^{-1} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} \quad (6)$$

By defining $\mathbf{D_{ij}} = (\mathbf{I} - \mathbf{Z_{ii}})^{-1}\mathbf{z_{ij}}$

$$\begin{bmatrix} y_1 \\ y_2 \\ y_3 \end{bmatrix} = \begin{bmatrix} I & -D_{12} & -D_{13} \\ -D_{21} & I & -D_{23} \\ -D_{31} & -D_{32} & I \end{bmatrix} \begin{bmatrix} (I - Z_{11})^{-1} & 0 & 0 \\ 0 & (I - Z_{22})^{-1} & 0 \\ 0 & 0 & (I - Z_{33})^{-1} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} \quad (7)$$

or

$$\mathbf{y} = \mathbf{M_{rz}}\mathbf{M_{r1}}\mathbf{x} \quad (8)$$

The interregional multipliers in $\mathbf{M_{rz}}$ depend upon the linkages represented by $\mathbf{z_{12}}$, $\mathbf{z_{13}}$, $\mathbf{z_{21}}$, $\mathbf{z_{23}}$, $\mathbf{z_{31}}$ and $\mathbf{z_{32}}$, while the degree of departure of $\mathbf{M_{rz}}$ from the identity matrix depends on the strength of bilateral trade linkages and other endogenous interregional transfers. The matrix $\mathbf{M_{rz}}$ can be further decomposed to show interregional open and closed loop effects (Round, 1985). The interregional open loop multiplier matrix, $\mathbf{M_{r2}}$, captures the effect that one region has upon the others, after accounting for all own-region effects, while the interregional closed loop multiplier matrix, $\mathbf{M_{r3}}$, shows impacts which pass through the accounts in the other regions before returning to the region of origin: in other words, it shows the interregional feedback effects. The total multiplier relationship in the system can be expressed as:

$$\mathbf{y} = \mathbf{M_{r3}}\mathbf{M_{r2}}\mathbf{M_{r1}}\mathbf{x} \quad (9)$$

which clarifies the nature of the separate effects involved in the interregional system. The total interregional multiplier effect for ‘own regions’ is obtained as the product of $\mathbf{M_{r3}}$ and $\mathbf{M_{r1}}$; while the equivalent multiplier effect of one region upon the others is the product of the appropriate interregional open loop ($\mathbf{M_{r2}}$) and the total ‘own region’ effect for the other regions. The intra-regional multiplier matrix $\mathbf{M_{r1}}$ can be decomposed into the product of three multiplier matrices, $\mathbf{M3_{r1}}$, $\mathbf{M2_{r1}}$ and $\mathbf{M1_{r1}}$, which reflect inter-account, cross-account and intra-account effects, respectively (Pyatt and Round, 1979).

2.2 Structural Change Analysis

Changes in regional inter-industry structure have frustrated researchers for decades. Interconnections between changes in production, consumption and income distribution provide major challenges in terms of the identification of an appropriate framework of analysis. The identification of methods that estimate sectoral interdependence is an important issue in development planning, as policy-makers prefer to 'target' sectors with comparatively high inter-industry links, which in turn can facilitate an extensive round of economy-wide effects triggered by changes in final demand (Diamond, 1974). Although the regional development process may be associated with substantial structural change, the ability to quantify and examine the nature of this change has been limited by a lack of data on changes in inter-industry linkages over time. Several studies have examined structural changes of economies by comparing IO models for different time periods. Notably Leontief (1953), Vaccara and Simon (1968) and Carter (1970) have examined structural changes in national economies by comparing IO models for different time periods. Interest in the study of structural change remerged in the 1980s (Rose and Miernyk, 1989). Some indicative studies are those of Feldman *et al.* (1987) and Hewings *et al.* (1989). The rarity of comparable regional models for two different periods has restricted this type of investigation of regional structural change. Comparison of IO tables over time for one country or across regions of a given country, have attracted attention, mainly to identify patterns of changes of these tables.

While the analysis of structural changes with the use of IO models has become commonplace, examples of SAMs are still relatively few. However, Roberts and Thomson (2000) using the SAM model consider the nature and sources of structural change in peripheral rural areas for the period 1988-1997 and the implications for rural development policy.

The causative matrix approach for the analysis of temporal changes in IO analysis, was presented by Jackson *et al*. (1990). We show here that this method can be extended to an interregional SAM framework. In this manner, this method identifies not only the contributions of economic sectors and inter-sectoral interrelationships in each economy but also focuses on the contributions of economic sectors of each area upon the other areas of the interregional system (changes on interregional interdependencies and linkages). In this context, one can utilize either the technical coefficients matrix, **A**, or the inverse matrix. Jackson *et al.* (1990) used the inverse matrix in order to compute changes in output multipliers. The main diagonal of the Leontief inverse matrix accommodates the interpretation of the elements of the causative matrix. According to these, the transition matrix (standardized Leontief inverse) is computed by the formula:

$$\mathbf{K} = \mathbf{Z}\mathbf{M}^{-1} \quad (10)$$

where **K** = the transition matrix

Z = the Leontief inverse matrix

M = the diagonal matrix whose elements M_{jj} equal the sum of the jth column of **Z** matrix.

The elements of each column of the Leontief inverse matrix are normalized by their perspective column sums, as the transition matrices must have column sums equal to 1. This process standardizes for changes in the magnitude of output multipliers, and focuses the analysis upon the relative influences of each sector on each other sector. Therefore, a typical element $k_{ij} \in \mathbf{K}$ reflects state i's influence on the change of j output multiplier.

Using the two times period's t and t+1 the corresponding transition matrices, $\mathbf{K_{t+1}}$ and $\mathbf{K_t}$ are linked by the formula:

$$\mathbf{K_{t+1}} = \mathbf{C}\mathbf{K_t} \quad (11)$$

where $\mathbf{K_{t+1}}$ and $\mathbf{K_t}$ are estimated according to equation (10) and **C** is the causative matrix, which is defined as:

$$\mathbf{C} = \mathbf{K_{t+1}}\mathbf{K_t^{-1}} \quad (12)$$

Matrix **C** captures the combined interactions between the transition matrices, $\mathbf{K_t}$ and $\mathbf{K_{t+1}}$, through the interpretation of the elements and rows of **C**. It is also called left causative matrix and is appropriate for the interpretation of changes in backward linkages. Except from positive terms, matrix **C** may contains negative terms, where a negative c_{ik} implies a reduction in sector i's contribution to sectors j's output multiplier due to the presence of sector k. The sectors that contribute to j's output multiplier can be seen as competitive sectors. Therefore, c_{ik} can be explained as the impacts of sector k on the capability of sector i to contribute to output multipliers of the other sectors.

All columns sums of **C** equal 1. Row sums greater than 1 indicate sectors that are becoming more competitive in supplying the requirements of the other sectors indicating larger contributions to output multipliers. In other words, the corresponding sectors are recording larger impacts when final demand in other sectors change (and vice versa in the case of row sums less than 1). Negative deviations of the diagonal elements of sectors from 1 imply decreased relative internalization of their own final demand output impacts. In other words, these sectors generate less output to themselves (and vise versa in the case of positive deviations of the diagonal elements from 1). The causative matrix approach has the advantage of capturing both the direct changes in interactions and the relative changes due to the presence of other sectors. Also, it provides a magnifying glass for viewing the inter-industry portion of system-wide structural change.

In structural analysis applied to matrix structures of production, such as SAM analysis, to determine how the structure of an economy has changed over time is an interesting question. This can be shown on production and employment data. The differences in output and employment levels in the structure of the interregional economy can be depicted with the help of the interregional SAM model basic equation:

$$\mathbf{X} = \mathbf{Zy} \tag{13}$$

where **X** is a column vector of total outputs of the three areas; **Z** is the inter-regional Leontief inverse matrix that captures all the relationships in the interregional system (aggregate interregional multiplier matrix); and **y** is a column vector of final demands. It takes into account the effect of relationships within each area relating to income distribution and the structure of production and also the dependencies between the regions resulting from inter-regional flows; and **y** is a column vector of final demands in (indicatively) three areas.

If the differences in gross output between two different years, t and t+1, are expressed by equation (12), then following Skolka (1989), the two general categories of structural changes that determine them can be identified as changes in aggregate interregional technical coefficients and changes in final demand. Thus:

$$\mathbf{\Delta X} = (\mathbf{Z}_{t+1} - \mathbf{Z}_{t})\mathbf{y}_{t+1} + \mathbf{Z}_{t}(\mathbf{y}_{t+1} - \mathbf{y}_{t}) \tag{14}$$

where $\mathbf{\Delta X}$ is the difference in total outputs of each region and $\mathbf{Z}_t$ and $\mathbf{Z}_{t+1}$, and $\mathbf{y}_t$ and $\mathbf{y}_{t+1}$ are the aggregate interregional inverse matrices and the final demands of the three regions, respectively.

In the first term of the right hand side of equation (14), differences in the aggregate interregional inverse matrices of interregional input coefficients weighted with the t+1 level of final demand, result in the gross production change between period t and t+1 that is attributed exclusively to changing aggregate interregional technical coefficients, given period t+1 final demand. In the second term, the difference of final demand weighted with the aggregate interregional inverse input coefficients of the year t results in the gross production change between period t and t+1 that is solely attributable to changes in final demand.

In the case of the interregional SAM model, changes due to aggregate interregional technical coefficients and final demand can be further decomposed in order to specify changes in linkages within each area and between the areas. The differences in total output of each region that is attributable only to changes in aggregate interregional technical coefficients can be decomposed to changes in intra-regional (within a region) and interregional coefficients (between the three regions). These can be expressed as:

$$[(Z^{11}_{t+1} - Z^{11}_{t})y^{1}{}_{t+1} + (Z^{12}_{t+1} - Z^{12}_{t})y^{2}_{t+1} + (Z^{13}_{t+1} - Z^{13}_{t})y^{3}_{t+1}] \qquad (15)$$

$$[(Z^{21}_{t+1} - Z^{21}_{t})y^{1}_{t+1} + (Z^{22}_{t+1} - Z^{22}_{t})y^{2}_{t+1} + (Z^{23}_{t+1} - Z^{23}_{t})y^{3}_{t+1}] \qquad (16)$$

$$[(Z^{31}_{t+1} - Z^{31}_{t})y^{1}_{t+1} + (Z^{32}_{t+1} - Z^{32}_{t})y^{2}_{t+1} + (Z^{33}_{t+1} - Z^{33}_{t})y^{3}_{t+1}] \qquad (17)$$

The first term of equation (15) shows changes in gross production of area 1 that is attributable totally to changing intra-regional technical coefficients, meaning changes solely due to technical relationships between region's 1 sectors. The second and third term of equation (15) show changes that are attributable only to changes in interregional technical coefficients, i.e. changes in the gross output of region 1 between period t+1 and t that is own to changes in linkages of region 1 with region 2 and 3, respectively. In the same way, the first and third term in equation (16) show changes in gross output of region 2 that are owned to changes in linkages of region 2 with region 1 and 3, while the second term shows changes in intra-regional technical coefficients. In equation (17) the first and second term show changes in gross output of region 3 attributed to changes in interregional linkages of region 3 with region 1 and 2, while the last term shows changes that are due to intra-regional technical coefficients.

Within the above concept, changes in gross output of each region that is attributable only to changes in final demand can be further decomposed to show changes in gross output of each region that is due to changes in final demand of the other regions. According to that, changes in final demand can be expressed as:

$$[Z_t(y^1_{t+1} - y^1_t) + Z(y^2_{t+1} - y^2_t) + Z_t(y^3_{t+1} - y^3_t)] \qquad (18)$$

$$[Z_t(y^1_{t+1}-y^1_t)+Z_t(y^2_{t+1}-y^2_t)+Z_t(y^3_{t+1}-y^3_t)] \quad (19)$$

$$[Z_t(y^1_{t+1}-y^1_t)+Z_t(y^2_{t+1}-y^2_t)+Z_t(y^3_{t+1}-y^3_t)] \quad (20)$$

In equation (18), the first term shows changes in gross production of region 1 that is attributable only to changes in final demand of that region. Respectively, the second and third term shows changes in gross output of region 1 that is due to changes in the final demand of region 2 and 3. Therefore, changes in gross output of each area in the interregional system, between two different years, t and t+1, are expressed as:

$$\Delta X_1 = [(Z^{11}_{t+1}-Z^{11}_t)y^1{}_{t+1}+(Z^{12}_{t+1}-Z^{12}_t)y^2_{t+1}+(Z^{13}_{t+1}-Z^{13}_t)y^3_{t+1}]+[Z_t(y^1_{t+1}-y^1_t)+ Z(y^2_{t+1}-y^2_t)+Z_t(y^3_{t+1}-y^3_t)] \quad (21)$$

$$\Delta X_2 = [(Z^{21}_{t+1}-Z^{21}_t)y^1_{t+1}+(Z^{22}_{t+1}-Z^{22}_t)y^2_{t+1}+(Z^{23}_{t+1}-Z^{23}_t)y^3_{t+1}]+[Z_t(y^1_{t+1}-y^1_t)+ Z_t(y^2_{t+1}-y^2_t)+Z_t(y^3_{t+1}-y^3_t)] \quad (22)$$

$$\Delta X_3 = (Z^{31}_{t+1}-Z^{31}_t)y^1_{t+1}+(Z^{32}_{t+1}-Z^{32}_t)y^2_{t+1}+(Z^{33}_{t+1}-Z^{33}_t)y^3_{t+1}]+[Z_t(y^1_{t+1}-y^1_t)+ Z_t(y^2_{t+1}-y^2_t)+Z_t(y^3_{t+1}-y^3_t)] \quad (23)$$

The first term of each equation shows changes on gross output that is only due to changes in intra-regional and interregional technical coefficients, while the second term shows changes that are solely attributable to changes in final demand in each region.

2.3 Structural Path Analysis

The method of structural path analysis within a SAM is attributed to Lantner (1972), Gazon (1976) and Defourny and Thorbecke (1984). In contrast to conventional SAM multiplier decomposition methods, structural path analysis provides a detailed way of decomposing multipliers and identifying the whole network of paths through which influence is transmitted from one sector of origin to its ultimate destination or/and the extent to which different types of households transmit economic influence within the economic system (Roberts, 2005). It starts with changes in exogenous variables and identifies the paths through which structural relationships in an economy lead to ultimate effects on endogenous variables.

In a bi-regional SAM framework the inverse matrix M captures all relationships in the interregional system. It takes into account the effect of relationships within each area associated with income distribution and the structure of production, and also the dependencies between the regions resulting from bi-regional flows. Consequently, bi-regional SAM multipliers provide a means of distinguishing between effects arising from interactions within sets of accounts and across different sets of accounts both within and between the regions. However, these multipliers do not clarify the 'black box', i.e. the structural and behavioural mechanisms responsible for these multiplier effects (Thorbecke, 1998). From a policy standpoint, knowledge of the magnitude of multipliers is important but becomes of even greater operational use if it is complemented by structural path analysis identifying the various paths along which a given injection "travels".

The starting point of the analysis is that the average expenditure propensity, a_{ji}, of an arc (i, j) linking two poles and interpreted as the magnitude of the influence transmitted from pole i to pole j. The measure of this influence can be given through three different quantitative interpretations, namely, (i) direct influence, (ii) total influence and (iii) global influence (Defourny and Thorbecke, 1984; Roberts, 2005) which can be extended to a bi-regional framework. Indicatively, in a bi-regional SAM with n production sectors, the total bi-regional SAM output multiplier of sector i of a region (e.g. region 1) can be estimated as the sum of global influences between sector i and each other production sector of the bi-regional economy (i.e. sectors of regions 1 and 2). In equation form this can be expressed as:

$$\sum_{i-1}^{n} \mathbf{z}_{\mathbf{ji}} = \sum_{i=1}^{n1} \mathbf{z}_{\mathbf{ji}}^{\mathbf{11}} + \sum_{i=1}^{n2} \mathbf{z}_{\mathbf{ji}}^{\mathbf{21}} = \sum_{i=1}^{n1} \sum_{p=1}^{m} \mathbf{I}_{(\mathbf{i} \to \mathbf{j})_{\mathbf{pr1}}}^{\mathbf{T}} + \sum_{i=1}^{n2} \sum_{p=1}^{m} \mathbf{I}_{(\mathbf{i} \to \mathbf{j})_{\mathbf{p21}}}^{\mathbf{T}} \tag{24}$$

where z^{21}_{ji} is the ji element of the bi-regional multiplier matrix, n1 is the number of sectors of region 1, n2 is the number of sectors of region 2 and p_{21} being the paths starting from a region 1 account and having a region 2 account as a destination.

The first term of equation (24) shows the sum of global influence between sector i and each other production sector of region 1. The second term is the sum of global influence between sector i and each other production sector of region 2. Based on the fact that there are linkages between sectors in the two regions, which transmit interregional effects, equation (23) can be expressed as:

$$\sum_{i-1}^{n} \mathbf{z}_{\mathbf{ji}} = \sum_{i=1}^{n1} \sum_{p=1}^{mr1} \mathbf{I}_{(\mathbf{i} \to \mathbf{j})_{\mathbf{pr1}}}^{\mathbf{T}} + \sum_{i=1}^{n1} \sum_{p=1}^{mr2} \mathbf{I}_{(\mathbf{i} \to \mathbf{j})_{\mathbf{pr2}}}^{\mathbf{T}} + \sum_{i=1}^{n2} \sum_{p=1}^{m} \mathbf{I}_{(\mathbf{i} \to \mathbf{j})_{\mathbf{p21}}}^{\mathbf{T}}$$

(25)

The third term first on the right-hand side of equation (25) shows the effect that one region has upon the other, after accounting for own-region effects (i.e. the diffusion of economic activity from region 1 towards region 2, and *vice versa*).

In order to analyse the contribution of different types of households in the bi-regional economy, multiplier effects can be further decomposed (Roberts, 2005). In particular, the global influence between two accounts, i and j in region 1 can be decomposed into that arising from paths through a household account of region 1, p_{h1}, through a household of region 2, p_{h2} (the household account of region 2 acts as a pole between the accounts of region 1) and that arising from paths that do not pass directly through a household account, p_{nh}. That is:

$$\mathbf{z}_{\mathbf{ji}}^{\mathbf{11}} = \mathbf{I}_{(\mathbf{i}\to\mathbf{j})}^{\mathbf{G}} = \sum_{p=1}^{m} \mathbf{I}_{(\mathbf{i}\to\mathbf{j})_{\mathbf{pr1}}}^{\mathbf{T}} = \sum_{p=1}^{h1} \mathbf{I}_{(\mathbf{i}\to\mathbf{j})_{\mathbf{ph1}}}^{\mathbf{T}} + \sum_{p=1}^{mr1-h1} \mathbf{I}_{(\mathbf{i}\to\mathbf{j})_{\mathbf{pnh}}}^{\mathbf{T}} + \sum_{p=1}^{h2} \mathbf{I}_{(\mathbf{i}\to\mathbf{j})_{\mathbf{ph2}}}^{\mathbf{T}} + \sum_{p=1}^{mr2-h2} \mathbf{I}_{(\mathbf{i}\to\mathbf{j})_{\mathbf{pnh}}}^{\mathbf{T}} \quad (26)$$

where h1 is the number of paths including at least one household account of region 1, h2 is the number of paths including at least one household accounts of region 2, m is the number of elementary paths in the bi-regional system between accounts i and j, mr1 is the number of paths including only accounts of region 1 and mr2 is the number of paths that pass through region 2 accounts. In the bi-regional SAM framework, the total own-region output multiplier of sector i is equal to $\sum_{i=1}^{n1} \mathbf{z}_{\mathbf{ji}}^{\mathbf{11}}$. For the structural path analysis this is the sum of global influences between sector i and each other account of region 1 including the paths that pass through region 2 accounts. Consequently, the own-region output multiplier can be expressed as:

$$\sum_{i=1}^{n1} \mathbf{z}_{\mathbf{ji}}^{\mathbf{11}} = \sum_{i=1}^{n1}\sum_{p=1}^{h1} \mathbf{I}_{(\mathbf{i}\to\mathbf{j})_{\mathbf{ph1}}}^{\mathbf{T}} + \sum_{i=1}^{n1}\sum_{p=1}^{mr1-h1} \mathbf{I}_{(\mathbf{i}\to\mathbf{j})_{\mathbf{pnh}}}^{\mathbf{T}} + \sum_{i=1}^{n1}\sum_{p=1}^{h2} \mathbf{I}_{(\mathbf{i}\to\mathbf{j})_{\mathbf{ph2}}}^{\mathbf{T}} + \sum_{i=1}^{n1}\sum_{p=1}^{mr2-h2} \mathbf{I}_{(\mathbf{i}\to\mathbf{j})_{\mathbf{pnh}}}^{\mathbf{T}} \quad (27)$$

The first term in equation (27) indicates the part of own-region output multiplier arising from paths through the household sector of region 1, while the second term shows the proportion of the own-region output multiplier that comes about from paths contained within the production sphere of region 1, the third term shows the part of own-region output multiplier arising from paths through the household sector of region 2 and the final term, the proportion of own-region output multiplier that comes about from paths contained within the production sphere of region 2. The household sector of both regions contributes towards the magnitude of the first and third terms of equation (10), respectively (Roberts, 2005). In the same manner, the household multiplier effect can be further decomposed according to different household types, while the same interpretation stands for the bi-regional SAM output multiplier but now the diffusion of economic activity of region 1 towards region 2 is included:

$$\sum_{i=1}^{n1} z^{11}_{ji} + \sum_{i=1}^{n2} z^{21}_{ji} = \Big[\sum_{i=1}^{n1}\sum_{p=1}^{h1} I^{T}_{(i\to j)ph1} + \sum_{i=1}^{n1}\sum_{p=1}^{mr1-h1} I^{T}_{(i\to j)pnh} + \sum_{i=1}^{n1}\sum_{p=1}^{h2} I^{T}_{(i\to j)ph2} + \sum_{i=1}^{n1}\sum_{p=1}^{mr2-h2} I^{T}_{(i\to j)pnh}\Big] + \Big[\sum_{i=1}^{n2}\sum_{p=1}^{h1} I^{T}_{(i\to j)ph1} + \sum_{i=1}^{n2}\sum_{p=1}^{mr1-h1} I^{T}_{(i\to j)pnh} + \sum_{i=1}^{n2}\sum_{p=1}^{h2} I^{T}_{(i\to j)ph2} + \sum_{i=1}^{n2}\sum_{p=1}^{mr2-h2} I^{T}_{(i\to j)pnh}\Big] \tag{28}$$

3. Applications

In general, examples of bi-regional and interregional SAMs development and applications are rare, due to their high data requirements (Roberts, 2000). Researchers often preferred interregional IO models, which are less data-hungry (for a comprehensive review see Oosterhaven and Polenske, 2009) or/and interregional CGE models (reviewed by Isard and Azis, 1998 and Donaghy, 2009). In some cases, the latter were developed in a manner, which allows them to “embody” New Economic Geography (NEG) theoretical foundations but were not tested with real data (e.g. Kilkenny, 1998). Applications can be grouped by type of analysis and spatial unit. In terms of type, one can distinguish applications dealing with economic interactions and spatial diffusion of economic activity (including diffusion of policy impacts), structural change analysis and structural path analysis. In terms of spatial unit, several interregional SAM applications have contributed to the rural-urban debate, through the construction of bi-regional rural-urban SAMs. However, other applications have dealt with the analysis of core-periphery relationships between and amongst regions.

In the case of regional applications investigating economic linkages, in a seminal paper, Round (1985) constructed an interregional SAM to analyze economic relationships between East and West Malaysia. He exhibited that the design of a bi-regional SAM can be such that data requirements are marginally higher than those associated with the construction of a regional SAM. To do so, interregional flows represented transfers, which augment the receipts of an account in one region and deplete the same functional account in the other region.

Hidayat (1991) constructed a bi-regional SAM, which divided Indonesia into an economically strong Center region and the Outer Islands. He found out that intra-regional multipliers of the Center region were higher compared to their Outer Islands counterparts. Thus, an investment project undertaken in the Center region would have greater direct and indirect economic effects within this region than a similar project would have had in the periphery. He also found that interregional multipliers were stronger in the periphery, meaning that a project undertaken there would trigger greater output and employment effects in the core than vice versa. Also, total multipliers were greater when the origin is in the periphery than in the core. Policy implications of these findings suggest that a greater concentration on the development of the periphery generates higher economic growth for the country as a whole.

D' Antonio *et al.* (1988) constructed a bi-regional SAM for Centre-North (core) and Mezzogiorno (periphery) regions of Italy. Official and unofficial data sources were used to construct the SAM, but lack of trade flow data resulted into the use of an indirect estimate (Round, 1978). Findings confirmed those of Hidayat (1991) and showed that demand effects generated by public expenditure in the periphery, are caught by the core through intermediate and final goods that the industrially weaker area purchases from the stronger one. In another application, Kilkenny (1999) built a three-region (within Iowa) fiscal SAM tracing the spatial pattern in public sector economic activity through to the final beneficiaries of monetary outlays. Her analysis showed that metropolitan areas are more vulnerable to reductions in purchasing power than other counties and that rural counties are the least vulnerable to economic shocks due to the rural cluster's higher degree of interdependence.

Ciaschini and Socci (2007) applied a new backward and forward dispersion approach based on macro multipliers in a bi-regional SAM for Marche. They derived a set of indices of intraregional and interregional dispersion, identified key groups of industries and institutions and evaluated the correlation of impacts between industry and institutional groups. Finally, Sandhu and Schofield (2007) used a hybrid (survey and official data) approach to construct a bi-regional SAM for British Columbia, which distinguishes the Queen Charlotte Basin (QCB) from the rest of the Province. Their analysis showed that exogenous changes occurring in the QCB (core) have greater impacts on other regions than vice versa.

In recent years interest in the role of urban centers in rural development and of small rural towns acting as growth poles that diffuse economic activity into adjacent rural areas, as well as the active debate over structural change in rural areas, cohesion and balanced and polycentric development and the resulting need for effective rural development policy design (Roberts, 2000; Leon, 2005; Psaltopoulos *et al.,* 2006) have all contributed to a rise of research interest in rural-urban interactions. Subsequently, bi-regional, rural-urban SAM models have been developed to study the economic structure of rural economies and assess rural policy impacts.

Here, it is perhaps worth noting interest in the use of SAMs for policy impact assessment is largely due to the fact that SAM multipliers "…add the redistribution of income by different institutions in-between the generation and the spending of income in the IO model; consequently, they are better-suited to study the impact of policy instruments on the distribution of income and poverty." (Oosterhaven and Polenske, 2009; p. 426).

A path-breaking effort to analyze rural-urban interdependencies through a bi-regional SAM was made by Roberts (1998), who adopted the method devised by Round (1985) to construct a rural-urban SAM for Grampian, Scotland. Multiplier decomposition analysis indicated small interregional feedback effects and a reliance of urban industries on rural households for the provision of factor services and as sources of final demand.

Roberts (2000) also used a Grampian rural-urban SAM to the analysis of rural-urban spillovers. She found out that spillover employment effects from urban to rural Grampian are stronger than vice versa and importantly emphasized that results from an IO version of the model would have suggested effects consistent with nodal response. In another effort, van Leeuwen and Mayfield (2004) constructed interregional SAMs for small and medium market towns and their hinterland in the Netherlands. As Roberts (1998; 2000) they utilized survey information and expert opinion for model construction. Multiplier analysis results were largely consistent with those of Roberts (1998).

The nature of rural-urban interdependencies and their diffusion patterns, was investigated by Balamou and Psaltopoulos (2006). To do so they build an interregional SAM, which consisted of an urban area, a dynamic rural area and a rather backward rural area in Crete, Greece. SAM construction involved mechanical methods (Jensen *et al.*, 1979) and a very extensive survey of firms and households in the three areas. Interdependence analysis showed that both rural areas trickle down significant economic benefits to the urban center, while the urban area has marginal linkages with them. Also, in contrast to previous findings (Roberts, 1998), rural output multipliers were found to be smaller than urban ones, especially in the case of the dynamic – diversified rural area. Van Leeuwen (2010) presents the construction of 30 interregional town-hinterland SAMs in 5 European countries. Multiplier analysis shows a considerable variation of interdependence patterns across Europe, while the comparative size of multipliers are in the same line with those of Roberts (1998).

In terms of impact analysis studies, Mayfield and van Leeuwen (2005) utilize their town-hinterland SAMs for the Netherlands and UK to assess impacts of a reduction in agricultural output and the introduction of decoupled support. Results show a significant variation of impacts mostly attributed to agricultural structures. Psaltopoulos *et al.* (2006) apply the Crete interregional SAM to assess the diffusions patterns of three Common Agricultural Policy (CAP) measures, namely farm income support, aids to increased farm productivity and aids to rural economic diversification. Impact analysis results suggest that the diffusion of policy-induced employment impacts from the dynamic rural area (Archanes) is lower than might be expected for a small open local economy, and that benefits leak primarily to the urban centre (Heraklion) and marginally to the backward rural area (N. Kazantzakis). Finally, generated income benefits seem to accrue mostly in favour of high-income households, especially in the case of farm income subsidies. It is also shown that CAP support measures have generated significant impacts for the Archanes economy, especially in terms of employment and household incomes. However, these income support measures are also associated with comparatively high employment, firm and household income benefits for N. Kazantzakis, and especially high firm income benefits for Heraklion. CAP development measures seem more successful in generating employment impacts in Archanes, as well as household income and employment impacts in Heraklion. Farm subsidies mostly generate income for high-income households in both rural areas, while CAP development measures tend to benefit middle-income households.

Through the use of the same model, Balamou and Psaltopoulos (2006) simulate the impacts of a 20% reduction in farm income support spending in Archanes and the transfer of these funds to rural development measures. Results show that reduced spending in farm income support in Archanes creates significant negative impacts on firm and household income, and is not compensated by an equivalent increase in rural development policy spending. These findings do not hold for the diffusion of economic impacts towards N. Kazantzakis and Heraklion; results of this simulation show that positive employment benefits are still diffused to both the wealthier urban area and the adjacent poorer rural area of N. Kazantzakis. Also, Balamou and Psaltopoulos (2008) apply four simulations (increase in agricultural exports; increase in tourism demand; increase in farm subsidies; increase in social welfare spending) of the same financial size to the Crete model. Results show that different policy options generate different economic impacts. An increase in agricultural exports and tourism demand lead into a significant increase in local output and employment. On the contrary, an increase in farm subsidies generate significant benefits for local labour and households and at the same time diffuse notable economic benefits to the less-developed rural area. Finally, an increase in social welfare payments creates the highest benefits to both local households and the economy of the less-developed rural area.

If economic linkage analysis through the use of interregional SAMs is rather rare, structural change and path analyses are even less "popular". In terms of the former, an effort is that of Psaltopoulos and Balamou (2011), which use the three-region SAM to assess the effects of structural policies implemented in the rural town of Archanes (Crete, Southern Greece) during the 1990s, in terms of changes in the structure of the local economy, the extent of economic impacts and their diffusion patterns to adjacent rural and urban localities. Structural changes within a time span of 10 years are estimated using a causative matrix approach, while structural decomposition analysis provides an indication of the attribution of local output growth to changes in the economic structure or final demand. Results reveal that final demand effects on gross production were more important than changes in technical coefficients. Structural policy injections were responsible for around 20.3% of gross production change in Archanes during this period. Also, structural policy specific impacts seem to be quite different, as CAP support measures are associated with comparatively high output and household income benefits for Heraklion and high output and employment benefits for N. Kazantzakis. Finally, there are two structural path analysis investigations using a bi-regional SAM. D' Antonio *et al.* (1988) apply the method introduced by Defourny and Thorbecke (1984) to show that the most important linkage in the transmission process from core to periphery in Italy is that of intermediate goods production, while in the case of transmission from the Mezzogiorno to Centre-North, it is the one that runs through household expenditures.

4. Conclusions

In this paper we attempted to show that despite its rare use, the SAM approach and especially its interregional version can be a useful tool for the detection, analysis and interpretation of the determinants of the spatial distribution of economic activity. Advantages of the SAM approach 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. Others 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 and also suffer from the "black-box syndrome". 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.

Perhaps the rarity of SAM applications which constitutes a clear gap in the literature of spatial economic interaction and flow patterns is an outcome of a "squeeze" of this analytical tool between more "accommodating" IO models and more behavioural – popular CGE applications. Albeit, as Oosterhaven and Polenske (2009; pp. 435-436) mention, despite difficulties in construction, "…the future will continue to feature interregional inter-industry models as the sector-specific and location-specific nature of…impacts of all kinds of exogenous shocks and policy measures require such modelling." Perhaps the advantages of the SAM approach in terms of its capacity to allow for the isolation of policy effects from other economy-wide influences promises further applications of this analytical tool on the investigation of spatial economic interactions.

References

Balamou, E. and D. Psaltopoulos (2006). Nature of Rural-Urban Interdependencies and their Diffusion Patterns in Southern Greece: An Interregional SAM Model. *Review of Urban and Rural Development Studies*, (18), 60-83.

Balamou, E. and D. Psaltopoulos (2008). Rural-Urban Interdependence in Greece: An Interregional SAM Approach. *Economia e Diritto Agroalimentare*, (13), 71-86.

Baldwin, R. E., Forslid, R., Martin, P., Ottaviano, G.I.P. and F. Robert-Nicoud (2003). *Economic Geography and Public Policy*. Princeton, Princeton University Press.

Boddy, M. (1999). Regions, Competitiveness and Competitive Regions: A Critique of Geographical Economics (Paper presented to the ERSA Conference, Dublin, August 1999).

Carter, A. (1970). Structural Change in the American Economy. Cambridge, Harvard University Press.

Chenery, H.B. (1953). Regional Analysis. In: H.B. Chenery, P.G. Clark and V.C. Pinna (eds.) *The Structure and Growth of the Italian Economy*, (pp. 76-96). Rome, US Mutual Security Agency.

Ciaschini, M. and C. Socci (2007). Bi-regional SAM Linkages: A Modified Backward and Forward Dispersion Approach. *Review of Urban and Rural Development Studies*, (19), 233-254.

Czamanski, S. (1973). *Regional and Interregional Social Accounting*. Lexington, Lexington Books.

D'Antonio, M., Colaizzo, R. and G. Leonello (1988). Mezzogiorno/Centre-North: a Two-Region Model for the Italian Economy. *Journal of Policy Modeling*, (10), 437-451.

Defourny, J. and E. Thorbecke (1984). Structural Path Analysis and Multiplier Decomposition within a Social Accounting Matrix Framework. *Economic Journal*, (94), 111-136.

Diamond, J. (1974). The Analysis of Structural Constrains in Developing Economies: A Case Study. *Oxford Bulletin of Economic Statistics*, (36), 95-108.

Donaghy, K.P. (2009). CGE Modeling in Space: A Survey. In: R. Capello and P. Nijkamp (eds.) *Handbook of Regional Growth and Development Theories*, (pp. 389-422). Cheltenham, Edward Elgar.

Feldman, J., McClain, F. and K. Palmer (1987). Sources of Structural Change in the United States, 1963-78: An Input-Output Perspective. *Review of Economics and Statistics*, (69), 503-510.

Fujita, M., Krugman, P. and A. Venables (1999). *The Spatial Economy*. Cambridge MA, MIT Press.

Gaile, G. L. (1980). The Spread-Backwash Concept. *Regional Studies*,(14), 15-25.

Gazon, J. (1976). *Transmission de l'influence Economique: Une Approche Structurale.* Collection de l' I.M.E. no.13, Paris, Sirey.

Hamilton J.R., Whittlesey N.K., Robinson M.H. and J. Elllis (1991). Economic Impacts, Value Added, and Benefits in Regional Project Analysis. *American Journal of Agricultural Economics*, (73), 334-44.

Hewings, J. D., Fonseca, M., Guilhoto, J. and M. Sonis (1989). Key Sectors and Structural Change in the Brazilian Economy: A Comparison of Alternative Approaches and their Policy Implications. *Geoffrey Journal of Policy Modeling,* (11), 67-90.

Hidayat, T. (1991). The Construction of a Two-Region SAM for Indonesia and its Application to some Equity Issues (Unpublished PhD thesis, Department of Economics, Cornell University).

Isard, W. (1951). Interregional and Regional Input-Output Analysis: A Model of a Space Economy. *Review of Economics and Statistics*, (33), 318-328.

Isard, W., Azis, I.J., Drennan, M.P., Miller, R.E., Saltzman, S. and E. Thorbecke (1998). *Methods of Interregional and Regional Analysis*. Aldershot, Ashgate.

Isard, W. and I.J. Azis (1998). Applied General Interregional Equilibrium. In: W. Isard, I.J. Azis, M.P. Drennan, R.E. Miller, S. Saltzman and E. Thorbecke (eds.) *Methods of Interregional and Regional Analysis*, (pp. 333-400). Aldershot, Ashgate.

Jackson, R.W., Rogerson, P., Plane, D. and B. Huallachain (1990). A Causative Matrix Approach to Interpreting Structural Change. *Economic Systems Research,* (2), 259-270.

Jensen, R.C., Mandeville, T.D. and N.D. Karunaratne (1979). *Regional Economic Planning*. London, Croom Helm.

Kilkenny, M. (1998). Transport Costs and Rural Development. *Journal of Regional Science*, (38), 293-312.

Kilkenny, M. (1999). Interregional Fiscal Accounting. *Growth and Change*, (30), 567-589.

Lantner, R. (1972). Recherche sur l'Interprétation du Déterminant d'Une Matrice Input Output. *Revue d'Economie Politique,* (82), 435-442.

Leon, Y. (2005). Rural Development in Europe. *European Review of Agricultural Economics*, (32), 301-317.

Leontief, W. (1953). *Studies in the Structure of the American Economy*. Harvard University Press.

Mayfield, L. and M. van Leeuwen (2005). Does the CAP Boost Rural Development? A Critical Assessment with SAM Analyses in UK and Dutch Rural Towns and their Hinterlands (Paper presented to the 79th AES Conference, Nottingham, 4-6 April).

Miller, R.E. (1998). Regional and Interregional Input-Output Analysis. In: W. Isard, I.J. Azis, M.P. Drennan, R.E. Miller, S. Saltzman and E. Thorbecke (eds.) *Methods of Interregional and Regional Analysis*, (pp. 41-133). Aldershot, Ashgate.

Miller, R.E. and P.D. Blair (2009). *Input-Output Analysis: Foundations and Extensions*. Cambridge, Cambridge University Press.

Moses, L.N. (1955). The Stability of Interregional Trading Patterns and Input-Output Analysis. *American Economic Review*, (45), 803-832.

Oosterhaven, J. and K.R. Polenske (2009). Modern Regional Input-Output and Impact Analysis. In: R. Capello and P. Nijkamp (eds.) *Handbook of Regional Growth and Development Theories*, (pp. 423-439). Cheltenham, Edward Elgar.

Polenske, K.R. (1995). Leontief's Spatial Economic Analyses. *Structural Change and Economic Dynamics*, (6), 309-318.

Psaltopoulos, D., Balamou, E. and K.J. Thomson (2006). Rural-Urban Impacts of CAP Measures in Greece: An Inter-regional SAM Approach. *Journal of Agricultural Economics*, (57), 441-458.

Psaltopoulos, D. and E. Balamou (2011). Structural Development Policies and Structural Change in Rural/Urban Areas in Greece: An Interregional SAM Analysis. *Ekonomika Poljoprivrede*, (58), 387-411.

Puga, D. (1999). The Rise and Fall of Regional Inequalities. *European Economic Review*, (43), 303-334.

Pyatt, G. (1988). A SAM Approach to Modeling. *Journal of Policy Modeling*, (10), 327-352.

Pyatt, G. and A.N. Roe (1977). *Social Accounting for Development Planning with Special Reference to Sri Lanka*. New York, Cambridge University Press.

Pyatt, G. and J.I. Round (1979). Accounting and Fixed Price Multipliers in a Social Accounting Framework. *Economic Journal*, (89), 850-873.

Pyatt, G. and J.I. Round (eds.) (1985). *Social Accounting Matrices: A Basis for Planning*. Washington DC, World Bank.

Pyatt, G. and E. Thorbecke (1976). *Planning Techniques for a Better Future*. Geneva, ILO.

Roberts, D. (1998). Rural-Urban Interdependencies: Analysis Using an Interregional SAM Model. *European Review of Agricultural Economics*, (25), 506-527.

Roberts, D. (2000). The Spatial Diffusion of Secondary Impacts: Rural-Urban Spillovers in Grampian, Scotland. *Land Economics*, (76), 395-412.

Roberts, D. (2005). The Role of Households in Sustaining Rural Economies: A Structural Path Analysis. *European Review of Agricultural Economics*, (32), 393-420.

Roberts, D. and K.J. Thomson (2000). Sources of Structural Change in Peripheral Rural Areas: The Case of the Western Isles, 1988/89 to 1997 (Paper presented to the International Conference: European Rural Policy at the Crossroads, Aberdeen, 29 June – 1 July).

Rose, A. and W. Miernyk (1989). Input-Output Analysis: The First Fifty Years. *Economic Systems Research*, (1), 229-271.

Round, J.I. (1978). An Interregional Input-Output Approach to the Evaluation of Non-Survey Methods. *Journal of Regional Science*, (18), 179-194.

Round, J.I. (1985). Decomposing Multipliers for Economic Systems Involving Regional and World Trade. *Economic Journal*, (95), 383-399.

Sandhu, G.S. and J.A. Schofield (2007). A Bi-Regional Economic Impact Model for the Province of British Columbia: A Social Accounting Matrix Approach. *Canadian Journal of Regional Science*, (31), 1-20.

Skolka, J. (1989). Input-Output Structural Decomposition for Austria. *Journal of Policy Modeling*, (11), 45-66.

Thorbecke, E. (1998). Social Accounting Matrices and Social Accounting Analysis. In: W. Isard, I.J. Azis, M.P. Drennan, R.E. Miller, S. Saltzman and E. Thorbecke (eds.) *Methods of Interregional and Regional Analysis*, (pp. 281-331). Aldershot, Ashgate.

Thorbecke E. (2000). The Use of Social Accounting Matrices in Modeling (Paper presented to the 26th General Conference of the International Association for Research in Income and Wealth, Cracow, 27 August – 2 September).

Vaccara, B. and N.W. Simon (1968). Factors Affecting Postwar Industrial Composition of Real product. In: J.W. Kendrick (ed.) *The Industrial Composition of Income and Product*, (pp. 19-58). New York, Columbia University Press.

Van Leeuwen, E.S. (2010). *Urban-Rural Interactions: Towns as Focus Points in Rural Development*. Berlin, Springer-Verlag.

Van Leeuwen, M. and L. Mayfield (2004). Local Interdependence of Small and Medium-Sized Towns in the Netherlands: An Interregional SAM Analysis (Paper presented to the to the 78th AES Conference, London, 2-4 April).