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Full Research Article

SAM multipliers and subsystems: structural analysis of the Basilicata's agri-food sector

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Abstract. Local agri-food products are conceived as a form of cultural capital, representing potentially fruitful resources for rural development. Italy and its regions offer a rich and diverse agricultural and food heritage that has led to the creation of numerous quality agri-food systems. Despite their ability to absorb disturbances and maintain their functions, it is important to develop economic models targeted to analyse the relationships among the components of food systems, in order to identify their strengths and weaknesses and drive the implementation of sectoral policies. In view of the new Rural Development Programme (2014-2020), the aim of this work is to analyse the structure of the Basilicata's agri-food system using a multi-sector model based on a two-region SAM, specifically developed for Basilicata, an Italian region characterised by a highly specialised agri-food sector. Results show that the availability of a highly disaggregate multi-sector model of the regional economy may be a valuable supporting tool to design regional policies for innovation and for the development of rural areas, laying the foundation for further analysis.

Keywords. Rural development, agri-food systems, multi-sector model, SAM multipliers, subsystem approach.

JEL codes. E16, R15.

1. Introduction

Agri-food is considered as one of the most crucial sectors for economic growth, as it is the main source of livelihood that makes growth possible (Dethier and Effenberger, 2012; Schultz, 1964). Over the last few years, different studies have emphasised the contribution that agri-food can make for rural development, on the regional scale (Ilbery and Kneafsey, 2000; Kneafsey *et al*., 2001; Marsden *et al*., 2000; Murdoch *et al*., 2000; Parrott et al., 2002; Tregear *et al*., 2007).

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Local agri-food products are conceived as a form of cultural capital; according to the principles of the endogenous development theory (Ray, 1998; Terluin, 2003), they represent potentially fruitful resources for development, as they can incorporate and add value to many local resources with features that are peculiar to a specific area (Brunori and Rossi, 2000; Marsden *et al*., 2000).

This awareness, combined with the growing consumers' demand for healthy and safe food, has induced producers to explore new ways of doing business, through initiatives that take over the idea that localised agri-food systems could provide not only economic but also social and environmental benefits, thereby combining marketing with political, socioeconomic and cultural activities that improve collective well-being (Volpentesta and Ammirato, 2012).

In Basilicata region (southern Italy), agri-food makes a significant contribution to the regional economy in terms of output, employment and exports. The sector contributed €771 million in value added to the Basilicata economy in 2014 (ISTAT, 2016a). While its contribution to the regional economy is small relative to other sectors, the Basilicata agri-food sector is of strategic importance for the sustainable development of rural communities. The spatial distribution of the production activities, as well as the presence of potential food and wine tourism products with geographical designations (Bencivenga *et al*., 2016), provide it with a key role in sustaining remote rural areas through the generation of income and jobs.

Different elements show the presence of a valuable "quality" potential in the regional agri-food sector that may be exploited to increase the competitiveness of the regional economy. In the near future, the new 2014-2020 programming period of Rural Development Programme (RDP) will play a major role in enhancing innovation for agriculture, forestry and food industry providing financial support to business choices directed to improve economic and environmental performances, and promoting the organization of competitive food chains. The design and the implementation of regional policy, however, should be increasingly oriented by relevant knowledge on the structure of economy.

There are different approaches applied in the analysis of agribusiness[1]. Cook and Chadded (2000) describe their evolution linked to the agribusiness, agri-food system and sub-sector (filière) concepts. However, it is important to point out that any strategy of sectoral development should be based on top-down multi-sector approaches, which take into account the dynamics of the agri-food production activities within the wider regional economic system.

By the mid-1950s, Davis and Goldberg (1976) developed the "agribusiness" concept valuating the extent and amount of agricultural and industrial relationships, by the use of the Leonetief input-output (I-O) model. Since Davis and Goldberg's work, the input-

[1] According to David and Goldberg's definition (Davis and Goldberg, 1976), agribusiness includes three components: 1. the farm supplies aggregate including all intermediate consumptions of agriculture (backwards linkages of agriculture); 2. the farming aggregate composed by all operations of crop cultivation and livestock breeding at the farm level; 3. the processing and distribution aggregate composed by all operations of storage, processing and marketing of agricultural products both for food and non food uses. The processing component can be divide into two further components, the fiber processing and the food processing. This further decomposition of agribusiness allows to separate two subsystems: 1. the agri-food block, including a part of the farming aggregate (agricultural products for food production) and the food processing and marketing component ; 2. the agri-industry block composed by the remaining part of the farming aggregate (non food products) and fiber processing and marketing component.

output analysis has largely been used to study the structure of an economy both at the regional and national level. With reference to Italy, among others, Chang Thing Fa (1981) and Chang Ting Fa *et al.* (2013) use a triangulation method of I-O tables to analyse the structural change of the agribusiness at Italian and European level, respectively. Belletti (1992), using an I-O subsystem approach, analyses the agri-food sector in more detail studying the delocalization of the agri-food supply chain in Tuscany region. However, there are some limitations in using Leotief input-output approach. In the Leotief model, *"…the omission of the general equilibrium links relating output to factorial income and final consumption may be of critical relevance both in aggregate terms (lost gross output) and in the rank ordering of sectors (hierarchy shifting)"* (Cardenete and Sancho, 2006: 322).

These limitations can be overcome by extending the conventional I-O methodology in a Social Accounting Matrix (SAM) (Miller and Blair, 2009; Rocchi *et al.*, 2015; Viccaro *et al.*, 2015). In addition to the inter-industry transactions specific to input-output tables, a SAM include balanced accounts for factors, institutions (such as producers, consumers, government) and foreign sectors, closing the cycle of the income distribution and spending.

There are numerous examples of the use of SAM models in the context of agricultural and food analysis. Caskie *et al.* (1999) use a regional SAM to analyse the impact (in term of output, income and employment) of a reduction in the final demand in beef on Northern Ireland's economy. Psaltopoulos *et al.* (2006) evaluate the impact of CAP measures on rural development in Archanes area (Crete, Greece) using an inter-regional SAM. The possibility to decompose through multiregional model the multiplier effects in inter-regional and intraregional effects is helpful to understand in depth the differences in economy structure among regions, in this case between rural and urban areas. Other examples of SAM-based studies are reported in Rocchi (2009), Vega *et al.* (2014), Cardenete *et al.* (2014) e more recently Campoy-Muñoz *et al.* (2017).

The cited work by Cardenete and colleagues shows the effectiveness of multiplier analysis by using SAM models in order to avoid the "missing linkages" typical of the Leontief models.

Based on that, the objective of this work is to analyse the structure of Basilicata's agri-food sector using a multi-sector linear model based on a two-region SAM, specially developed for Basilicata.

Through the SAM multiplier matrix (Miller and Blair, 2009), we will evaluate the contribution of each production sector in the agri-food sector to the regional economy and after, following the sub-system approach proposed by Momigliano and Siniscalco (1982), we will analyse the shares of the production sectors represented in the model that are directly and indirectly committed to satisfy the final demand towards different categories of food. In the light of results of the analysis, a set of policy implication will be discussed.

In the following section the potential development linked to the "quality" of agri-food production in Basilicata is shortly discussed. Section 3 presents the SAM and describes the model used in the analysis. The main results are provided and discussed in section 4 while some final remarks are proposed to reader in section 5.

2. The "quality" potential of the agri-food sector in Basilicata

Basilicata's agri-food sector plays a major role in the regional economy, due to the significant weight of employment in agriculture and the wide range of typical and quality

agri-food products (eight products with a PDO/PGI), besides the number of farms and research bodies involved in the sector.

The share of the agriculture's contribution to the total value added is definitely the highest in Italy (5.4% against about 2% at the national level) (ISTAT, 2016a). Considering Basilicata's entrepreneurial community, the agriculture has the highest number of firms operating in the region (Table 1), which reflects, however, the small average size of agricultural holdings.

As to the food industry, its contribution to the overall value added is lower compared to agriculture (2.3%) achieving, however, one of the highest levels on the national scale: this is due to the fact that a large part of the sector still focuses on the production and trade of low value added agri-food products. The importance of the food industry within the regional economy can be clearly seen when considering the manufacturing sector only: food industry ranks just after the *automotive* sector, both in terms of value added produced (20% vs. 35%) and number of labour units employed (just over 3,200 against about 4,500) (ISTAT, 2016a); food industry is the first in terms of number of operating firms (Table 2), which are mainly small and medium enterprises.

The analysis of foreign trade enables an outline of the structure and trends of Basilicata's agri-food sector. The most interesting aspect is the reduction in imports recorded just after the economic crisis of 2007 till now, both for the agricultural products (-18%) and for food and beverages (-39%), combined with a significant increase in exports, equal to +24.5% for agriculture and +49% for the food sector (ISTAT, 2016b). Basilicata's food exports in 2015 were above EUR 36 million, mostly represented by bakery products accounting for 55% of exports (about EUR 20 million), followed by vegetable fats and oils, mainly olive oil (14%) and beverages (10%), basically related to wine exports.

Another important factor is the trend of food export observed over the last few years. Compared to the trend of the other manufacturing sectors (Figure 1), food is the only industry that has not been affected by the negative impact of the economic crisis of 2007, but rather continued to grow.

Table 1. Number and % of Basilicata's operating firms by economic sectors (2015).

Sector	n°	%
Agriculture	17,500	34%
Construction	6,161	12%
Other services	11,987	23%
Trade	12,428	24%
Manufacturing	3,818	7%
Total	51,894	100%

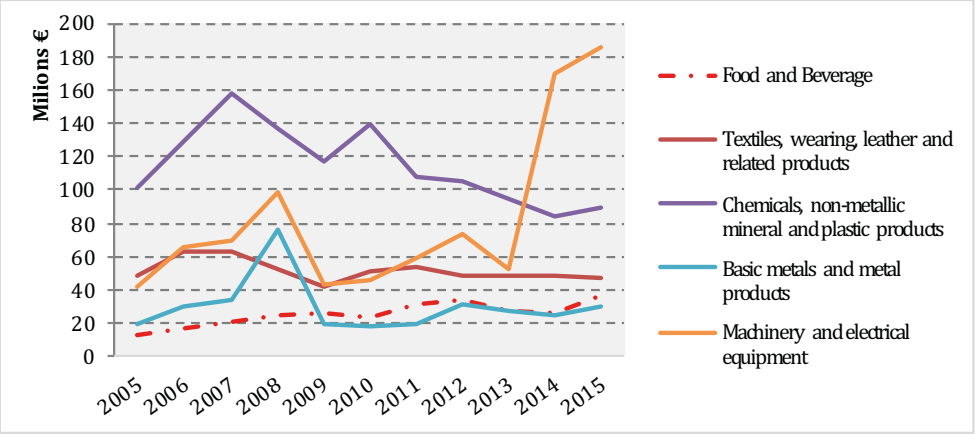
Source: own calculations on ISTAT data (ISTAT, 2016a).

Table 2. Number and % of Basilicata's manufacturing firms (2015).

Sector	n°	%
Food and Beverage	895	23%
Textiles, wearing, leather and related products	300	8%
Wood and of products of wood	553	14%
Chemicals and plastic products	112	3%
Non-metallic mineral products	308	8%
Basic metals and metal products	778	20%
Machinery and electrical equipment	266	7%
Motor vehicles, trailers and semi-trailers	39	1%
Others manufacturing	567	15%
Total	3,818	100%

Source: own calculations on ISTAT data (ISTAT, 2016a).

Figure 1. Trend of export of the main sectors of Basilicata's manufacturing industry[1] (2005-2015)



Source: own calculations on ISTAT data (ISTAT, 2016b).

[1] The graph does not show the automotive sector, due to a purely graphical reason, given the significant amount of exports (over 2.2 billion of euro in 2015). Even this sector, however, shows a drop just after 2007, with a gradual recovery starting only from 2014.

These positive results seem to have been affected by the quality upgrading of exported products and the subsequent strengthening of those factors, such as certified quality, innovation (organic products) and originality, which constitute the established strengths of image abroad.

A recent study on the commercial performance of regional agri-food sectors in Italy between 1991 and 2012 confirms the good performance of Basilicata in foreign trade, mainly related to the level of specialization of its productions (Platania *et al.*, 2015).

Evidence of the main regional specializations, in economic but also cultural and social terms, derives from some experiences of specialized territorial clusters with a broad production base, such as the *Distretto Agroindustriale del Vulture* (6,489 businesses covering 15 municipalities), the *Distretto Agroalimentare di Qualità del Metapontino* (7,430 businesses covering 12 municipalities), which have been operating since 2004, and the most recent rural districts (since 2010), including the *Distretto rurale di Pollino-Lagonegrese* (27 municipalities) and the *Distretto delle Colline e delle Montagne Materane* (19 municipalities).

These clustering systems, involving the largest part of the region, focus on quality specialized productions (wine, olive oil, mineral waters, dairy products, pork meat processing, fresh pasta, bakery products, fruit and vegetables and cereal production, preserved food, honey) and their promotion through tourism activities.

Considering the potential integration that agri-food production activities have with the tourism sector, tourist flows can be an asset in the forthcoming years to promote the development of Basilicata agri-food sector, especially with reference to the opportunities offered by "Matera 2019", event, when the town of "Sassi" will be European Capital of Culture. Based on a direct interview to the agribusiness operators working in Basilicata's agri-food districts, even though the event has not yet generated any impact on the sector, the

shared perception of operators is that it can offer good development opportunities in the forthcoming years.

A further aspect of interest that emerged from the interviews is the great attention the agribusiness operators attach to research, development, training and innovation in the sector. Indeed, based on the analysis conducted by the European Commission on the European regions' innovation capacity in 2014, Basilicata was classified as "Moderate Innovator" (European Commission, 2016).

Investments in innovation in order to improve the competitiveness of the sector (Contò *et al*., 2009) may be supported by the research institutions present in the region that are already operating in that direction. Other notable initiatives include the spin-offs coming out of research, recognized by the University of Basilicata since 2012 in the following areas: environment, new agri-food products (donkey milk) and innovative services.

Finally, the new 2014-2020 programming period of Rural Development Programme (RDP) represents an opportunity to increase the competitiveness of the regional economy, providing financial support to business choices directed to improve economic and environmental performances, and promoting the organization of competitive agri-food supply chains. In this context, the structural analysis of the Basilicata's agri-food sector presented in the following paragraphs will provide a set results with interesting policy implications.

3. Materials and methods

3.1 A two-region SAM model

In the present study, the structure of the regional agri-food sector has been analysed using a two-region SAM model (Basilicata vs. Rest of Italy) with a detailed disaggregation of accounts for agriculture and food industry production activities (see section 3.3 below).

The SAM (Miller and Blair, 2009) is a two-entry matrix recording the flows occurring between all actors of an economic system, in a given place and for a given time period (usually one year). Each row/column pair represents respectively the inflows and the outflows of a given account, so that by definition the matrix is balanced (the row totals must equal the column totals). A SAM may be considered as an expansion or a generalization of a Leontief input-output table. While in the latter, emphasis is laid on the production system, in the SAM the perspective is larger. The simultaneous representation of the accounts for production activities, production factors, institutions (households, firms, and public administration), capital formation and exchanges with the rest of the world makes it possible to follow the formation of value-added and its distribution and redistribution in the form of income to the institutions.

SAMs are crucial databases for many quantitative models (e.g. SAM linear models and Computable General Equilibrium models). Beside their statistical content, SAMs are a useful tool to evaluate policy interventions both at the national and regional level. Through the solution of a linear model (establishing an appropriate "closure rule": Miller and Blair, 2009), it is possible to analyse the structural features of the economy and calculate the impact that exogenous changes on single components have on the whole economic system. In our study, the closure rule considers as exogenous the accounts for national Government, capital formation and the rest of the world' so that the resulting SAM multi-

pliers take thus the value of Leontevian-Keynesian multipliers.

Let us consider the matrix of SAM coefficients of a single region "r" (Miller and Blair, 2009: 515):

$$S^{rr} = \begin{bmatrix} A & 0 & C \\ V & 0 & 0 \\ 0 & Y & H \end{bmatrix} \quad [1]$$

where A is the matrix of inter-industry technical coefficients, C is the matrix of endogenous final expenditure coefficients, V is the matrix of endogenous value-added factors shares, Y is the matrix of endogenous coefficients distributing income to institutions and H is the matrix of endogenous coefficients for income re-distribution among institutions.

The structure of the matrix of SAM direct coefficients of our two-region model, as in any two-region I-O model, is (Miller and Blair, 2009: 77-80):

$$S = \begin{bmatrix} S^{bb} & S^{bi} \\ S^{ib} & S^{ii} \end{bmatrix} \quad [2]$$

where the blocks along the main diagonal account for flows within the two regions (b = Basilicata and i = rest of Italy) while the blocks along the other diagonal represent the (commodity and financial) flows between the two regions.

By solving the linear system $x = Sx + f$ (where x is the vector of totals of endogenous accounts and f is the vector of exogenous account flows) for x, we have:

$$x = (I - S)^{-1}f \quad [3]$$

where $M = (I - S)^{-1}$ is the matrix of SAM multipliers.

Each coefficient quantifies the total increase for each account i deriving from a unit exogenous shock on the account j. Note that since the SAM-based model endogenizes transactions that not included in the input-output interindustry models, the SAM multipliers will generally result larger than the input-output ones.

The advantage of using a two-region disaggregation of accounts lies in the possibility of considering the rest of Italy as being endogenous to the model; this makes it possible to breakdown impacts on Basilicata's economy calculating not only the total but also the intra- and interregional impacts (spillovers and feedbacks). If the calculated matrix of multipliers M enables the estimate of the total impact, the breakdown of the matrix of accounting coefficients S into intraregional $\begin{bmatrix} S^{bb} & 0 \\ 0 & S^{ii} \end{bmatrix}$ and interregional elements $\begin{bmatrix} 0 & S^{bi} \\ S^{ib} & 0 \end{bmatrix}$ enables to calculate the following[2]:

Intraregional effects: $M_{\text{intra}} = (I - \tilde{S})^{-1}$ [4]

[2] For details of the multiplier decomposition for multi-region model see the chapter "Decompositions in an interregional context" (Miller and Blair, 2009: 286-288).

where $\tilde{S} = \begin{bmatrix} S^{bb} & 0 \\ 0 & S^{ii} \end{bmatrix}$;

Interregional spillover effects: $M_{spill} = I + S^{\star}$ [5]

where $S^{*} = \left(I - \tilde{S}\right)^{-1}(S - \tilde{S})$;

Interregional feedback effects: $M_{feed} = [I - (S^{*})^{2}]^{-1}$ [6]

3.2 The sub-system approach

Starting from the concept of *vertically integrated sector* (Pasinetti, 1973), the structural analysis of Basilicata's agri-food sector has been integrated by the sub-system I-O approach that makes it possible to study an individual sector, or group of sectors, that is considered a subsystem which interacts with the rest of the productive system (Belletti, 1992; Llop and Tol, 2013; Momigliano and Siniscalco, 1982; Montresor and Marzetti, 2010). In particular, we use the approach proposed by Momigliano and Siniscalco (1982), extending Belletti's work (Belletti, 1992) in a two-regional model.

The input-output approach is based on the representation of the interdependencies existing between different economic sectors. In fact, the level of activation of different production processes in the sectors of the economy depends not only on the final demand directed to them, but indirectly, via the circular flow of the economy, on the final demand directed towards all sectors. In the subsystem approach the production system is divided into blocks, constituted by the shares of the production sectors represented in the original matrix that are directly and indirectly committed to satisfy the final demand towards different categories of goods.

Let be A the matrix of accounting coefficients representing only the interdependencies existing among production sectors (industries) in the economy. The re-classification of economic quantities from the production sectors to the different "blocks" of the economy working to meet the final demand towards different sectors, may be carried out using the following "**B** operator" (Momigliano and Siniscalco, 1982: 155):

$$B = \hat{x}^{-1}(I - A)^{-1}\hat{f} \quad [7]$$

where the symbol ^ indicates diagonalisation. A generic element b_{ij} of the matrix B is the share of activity of the i sector triggered by the final demand directed to the j sector. Thus the sum of all rows of matrix B is 1, since the level of activation of different production sectors is completely covered by the production required by the final demand towards the whole production system.

Any economic quantity may be reclassified from sectors to "blocks" by multiplication, using the operator B. For instance, if l is the vector of employment in different sectors, the matrix L:

$$L = \hat{l}B \quad [8]$$

subdivides the labour employed in different sectors among different blocks ("subsystems") of the economy. Through matrix *L* it will be possible not only to assess the relative importance of different subsystems in terms of employment but also to characterise the composition of different subsystems in terms of "shares" of the original sectors. The same operation may be carried out using the vector of value added of different sectors.

The reclassification by subsystems is based only on the matrix of coefficients representing the interdependencies existing between different production sectors (the *A* submatrix in the right side of equation 1), implicitly using a Leontevian-type multiplier that does not consider feedbacks through consumption as in the SAM multiplier decomposition proposed in the previous section. However, the application of the sub-system approach to a two-region model, like that used in this study, makes it possible to extend the analysis to the participation of each region's sectors in the fulfilment of the demand addressed to the production sectors of the other region.

3.3 A social accounting matrix for the agri-food system analysis

The SAM used in this study is a two-region (Basilicata *vs*. Rest of Italy) matrix referring to 2011, produced in collaboration with the Regional Institute for Economic Planning of Tuscany (IRPET, Florence) with most recent statistical records available.

The structure of the matrix includes a total of 347 accounts, concerning 51 production activities, 64 goods and 3 production factors (employment and self-employment, and capital), 3 types of institutions (households, businesses, public administration) in the two regions. The household sector is subdivided by income deciles into ten groups, whereas the public administration is distinguished as local and central. There are of course also the accounts entitled to the capital formation and to real and financial flows with the rest of the world.

In order to analyse the structure of Basilicata's agri-food sector, the accounts concerning agriculture and the food industry have been broken down in some detail for both Basilicata and the rest of Italy, using the matrix of inter-industry technical coefficients derived from the national supply-use table produced by the *Dipartimento di Scienze per l'Economia e l'Impresa* of the University of Florence for the year 2009 (Rocchi *et al*., 2016). By combining it with the official statistics made available by ISTAT for the year 2011 (value added, employment, import, export), the accounts concerning the food industry activities have been broken down into ten sub-sectors and relative commodities:

1. Meat
2. Fish
3. Olive oil
4. Vegetable oils, sugar, pasta
5. Vegetables and fruits
6. Dairy products
7. Cereals
8. Animal feed
9. Wine
10. Water and other beverage

The agricultural sector, conversely, has been subdivided using the data of RICA (Rete di Informazione Contabile Agricola) (CREA, 2016) as well as the available data of

FADN (Farm Accountancy Data Network) (European Commission, 2016b). By combining the two databases, the agricultural sector has been initially broken down into 8 groups of businesses by type of farming for the rest of Italy, and into 5 production activities for Basilicata. In order to ensure a greater consistency of the analysis, the Italian agriculture has been subsequently regrouped in the following 5 subsectors:

1. Cereal grains
2. Horticulture
3. Permanent crops
4. Livestock
5. Mixed

Agricultural commodities are grouped under the heading of agricultural products while the final demand is represented by consumption functions (bundle of commodities classified according to the COICOP classification). Discrepancies between row and column totals of accounts after disaggregation were reconciled balancing the table according the Stone-Camperhown-Meade approach (Round, 2003).

4. Results

4.1 The structure of Basilicata's agri-food sector based on the matrix of multipliers

According to the SAM, in 2011 the output value of the fifteen sectors of Basilicata's agri-food system amounted to about EUR 1.2 billion, 7.9% of the regional total value. The agri-food share increases when considering the value added (8.3%) and, above all, employment (16.6%). High values are due, as previously mentioned, to the importance of agriculture, which is a typically a labour intensive sector, within Basilicata's economy.

Table 3 compares the output multipliers of seven macro-sectors making up Basilicata's production system, as it is represented in the SAM.

The first two rows indicate the increase in final output required to satisfy 1 EUR of additional demand addressed to each macro-sector. Since Basilicata is a region framed within a national economy, a significant share of activation is transmitted outside its regional boundaries. For example, a one-million additional demand addressed to Basili-

Table 3. Output multipliers in Basilicata's economy macro-sectors.

	Agriculture	Other primary activities	Food industry	Other manufacturing	Constructions	Trade and services	Public administration
Bas' output	2.813	2.745	3.017	2.922	3.027	2.829	2.803
RoI' output	0.934	0.819	1.243	1.156	1.015	0.931	0.848
RoI/Bas (%)*	*34.0%*	*32.0%*	*38.1%*	*37.5%*	*33.4%*	*33.8%*	*32.2%*
Labour**	64.3	0.8	8.7	5.7	19.3	18.4	26.8

*Bas: Basilicata; RoI: Rest of Italy.
**Labour Unit for millions of euro.

cata's agriculture generates a 2.8 million increase in the output produced by Basilicata's economy (mostly in the agricultural sector but also in all other sectors), and nearly one million Euros in the rest of the Italian economy. As a whole, the share of the output multiplier operating outside regional boundaries is about 30 to 40%. Significantly, agriculture also shows the highest employment multiplier, whereas the food industry shows a multiplier value that is basically in line (although slightly above) the average of the other manufacturing activities.

The analysis of multipliers is detailed in Table 4 that proposes data referred to the fifteen sectors in which agri-food has been broken down. The table shows the results of the regional breakdown of multipliers. The three columns to the right of the total multiplier break down the multiplier effect (that is the output growth generated in addition to the initial stimulus) into three components: the *regional effect*, i.e. the additional output generated by interdependencies (among industries and through final consumption) within the region; the *interregional spillover*, which is the impact transmitted outside the regional boundaries and generating an increase in the activity in different sectors in the rest of Italy; and the *interregional feedback*, i.e. the additional increase in the regional output resulting from the output growth in the rest of Italy.

The share of each subsector within the two components of agri-food system (agriculture and food industry) is shown in the second column. It can be noted that most of the regional agricultural output is produced by the farms "specialised" in arable crops and animal husbandry, and by the farms classified as "mixed". To assess these data we should

Table 4. Regional breakdown of output multipliers in the agri-food sectors.

	Macro-sectors' output (%)	Total multiplier	Regional effects	Interregional spillover	Interregional feedback	RoI/Bas* (%)
Agriculture						
Cereal grains	13.2%	2.814	0.866	0.944	0.004	109.01%
Horticulture	0.0%	2.473	0.705	0.765	0.003	108.51%
Permanent crops	6.5%	3.060	1.048	1.008	0.003	96.18%
Livestock	67.1%	2.641	0.744	0.893	0.004	120.03%
Mixed	13.2%	3.068	0.963	1.101	0.004	114.33%
Food industry						
Meat	6.0%	3.268	1.048	1.214	0.006	115.84%
Fish	0.7%	2.774	0.864	0.907	0.003	104.98%
Olive oil	6.0%	3.438	1.207	1.226	0.006	101.57%
Vegetable oils, sugar, pasta	41.6%	3.154	0.967	1.182	0.005	122.23%
Vegetables and fruits	5.9%	3.268	1.066	1.197	0.006	112.29%
Dairy products	17.4%	3.277	0.987	1.284	0.006	130.09%
Cereals	3.2%	3.331	1.115	1.210	0.006	108.52%
Animal feed	1.1%	3.327	1.018	1.303	0.006	128.00%
Wine	5.7%	3.311	1.038	1.268	0.005	122.16%
Water and other beverage	12.5%	3.481	1.029	1.447	0.005	140.62%

*Bas: Basilicata; RoI: Rest of Italy.

consider that the type of farming (based on which the agricultural sector is broken down) classifies farms (typically multi-product firms) based on the *prevalence* of certain production processes. A farm is classified as "specialised" in a given process if the latter represents at least two thirds of the output value. Hence the output produced in the farms classified as "livestock farms" is not consisting solely of livestock products but includes also a significant share of other products. Similarly the output produced by the other groups of farms consists for its part of a basket of goods.

The output multipliers tend to be higher in the food industry than in the agricultural activities. In the first case the initial impact determined by the final demand addressed towards the sectors generates almost always a three times larger total increase of the output produced: in the case of olive oil and of the beverage industry, the overall growth of output is about three and half times the initial stimulus. This is a quite typical structural difference, because in the agricultural activities a lower ratio between intermediate consumption and output results in a lower impact on the activities supplying inputs.

Considering the regional breakdown of multipliers, since Basilicata is a small regional economy open to the rest of the Italian production system, it is not surprising that the "return" feedback towards Basilicata's production activities is negligible. Conversely, spillovers towards the rest of Italy are significant, thereby certifying how Basilicata's production activities depend on imports from the rest of Italy. Spillovers tend to be higher for industrial activities. The last column of the table sums up these results showing the percentage ratio between the share of the multiplier effect remaining in the region (regional effect plus feedback) and the spillover component. Only in the case of farms specialised in permanent crops, the additional growth of the output that remains within Basilicata is higher than that "transmitted" to the rest of the Italian economy. The industrial activities most open to the rest of Italy are the dairy and the beverage industries. These are two important sectors within Basilicata's food industry, accounting for about 30% of the output value: especially in the case of dairy industry, this figure could suggest interesting spaces for an additional integration with the regional agriculture. On the other hand, the olive oil industry shows a higher integration with the regional production system, with an internal multiplier effect that is equal to the produced spillovers: although this is a minor sector in terms of output value, it proves that the commitment to quality can have positive impacts on the rest of the regional economy.

4.2 Sub-system analysis

The structural analysis of Basilicata's agri-food system can be enhanced through in-depth studies using the results of the subsystem-analysis. Figures 2 and 3 show the contribution of each subsector of Basilicata's agri-food sector to four different subsystems of the Italian economy (Basilicata and Rest of Italy) satisfying certain "blocks" of final demand. Since the four blocks represent the total final demand in the SAM, the total of the per cent values of each row is always 100.

Comparing the data classified as "sector" in the two figures, it is possible to see how industrial activities tend to meet the sector-specific demand more than agricultural activities (with the only exception of those of the farms specialised in horticulture that represent, however, a negligible component of Basilicata's agriculture). The participation in the subsystems associated with the demand of the other sectors of Basilicata's agri-food

Figure 2. Share of Basilicata's agricultural sectors to the various "blocks" of the production area.

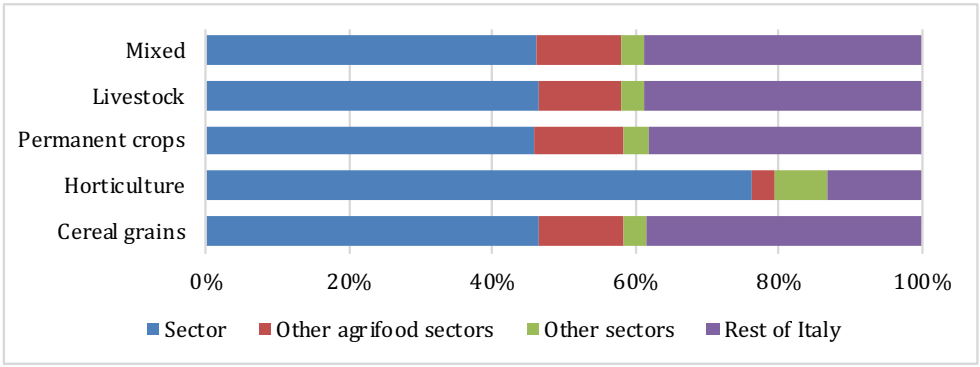
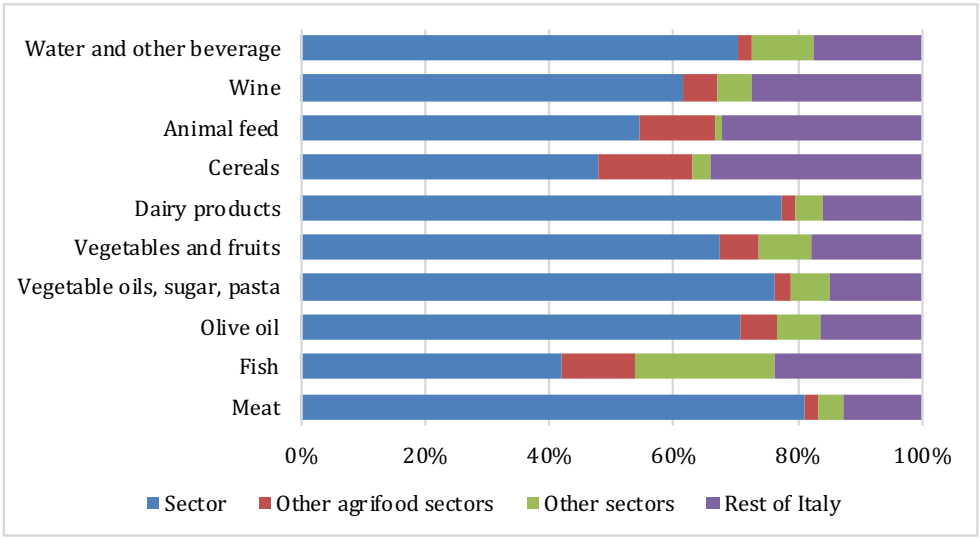


Figure 3. Share of Basilicata's food sectors to the various "blocks" of the production area.



industry is quite variable in the case of the regional food industry, ranging from 15% of the activity of grains and starch products to 2.2% of the meat-processing industry. The value is more homogeneous in the case of agricultural sectors, which commit, on average, around 11% of their activity to the participation in other subsystems. The datum shows the degree of integration among the components of the agri-food system and could be an interesting indicator of possible areas for innovation to promote its competitiveness.

Considering the participation in subsystems oriented to the final demand of the other regions (Rest of Italy), the higher percentage in agricultural subsectors may be assessed as

an interesting opportunity for the economy in so far as it expresses the capacity of "attracting" (either directly or indirectly) a higher share of final demand towards the regional production system. However, since Basilicata is a small economy open to the rest of the national economy, it would be important to assess the stability of this participation to the subsystems of the rest of the Italian economy. Much depends on the upgrading of agricultural products directed towards the rest of the national production system: in the case of *commodities* without a specific quality differentiation (as may be the case of cereal production), they would suffer pressures from regional (or international) potential competitors.

Tables 5 and 6 show the composition of the subsystems satisfying the final regional demand (broken down into macro-sectors of activity). The composition is expressed both in terms of employment and value added produced. The analysis of composition is repeated using two different breakdowns of the final demand, in order to fully exploit both sectoral and regional breakdown of the model.

Interdependencies between agriculture and food industry obviously appear especially in the subsystem concerning the food industry, which includes Basilicata's agricultural activities accounting for 26.9% of employment and 11.6% of the value added produced. To satisfy the demand of food industry products, however, the relevant subsystem also activates the agriculture of the other regions (12.5% of subsystem employment and 9% of the value added), in addition to a far more important component in services' activities. This is again an indicator of interesting areas of integration that might be boosted up in the regional system. The participation of other sectors of Basilicata's economy in the food industry subsystem could probably be increased, resulting lower than that in other subsystems of regional manufacturing.

The same analysis of Tables 5 and 6 is proposed again in Table 7, except that subsystems are referred to the final demand oriented towards the single sectors of Basilicata's

Table 5. Composition of subsystems in terms of employment: macro-sectors.

Subsystems	Final regional demand				
	Agriculture	Food industry	Other manufacturing and constructions	Trade and services	Public administration
Regional agriculture	92.3%	26.9%	0.4%	1.1%	0.2%
Regional food industry	0.2%	30.6%	0.1%	0.4%	0.1%
Rest of Italy' agriculture	1.8%	12.5%	0.9%	1.1%	0.2%
Other manufacturing and constructions	2.1%	7.2%	67.9%	5.1%	4.7%
Trade and services	3.2%	21.3%	28.9%	90.9%	9.8%
Public administration	0.4%	1.5%	2.0%	1.4%	85.1%
Regional agri-food sector	92.5%	57.5%	0.4%	1.5%	0.2%
Rest of regional economy	2.7%	13.9%	71.3%	85.4%	94.0%
Rest of Italian economy	4.8%	28.6%	28.3%	13.1%	5.8%
Labour (LU x 1,000)	15.2	10.7	56.6	55.1	67.1

Table 6. Composition of subsystems in terms of value-added: macro-sectors.

Subsystems	Final regional demand				
	Agriculture	Food industry	Other manufacturing and constructions	Trade and services	Public administration
Regional agriculture	79.6%	11.6%	0.1%	0.3%	0.1%
Regional food industry	0.5%	36.5%	0.1%	0.3%	0.1%
Rest of Italy' agriculture	3.3%	9.0%	6.0%	1.6%	0.9%
Other manufacturing and constructions	6.4%	11.6%	63.6%	5.3%	5.6%
Trade and services	9.7%	30.0%	29.0%	91.6%	12.1%
Public administration	0.5%	1.3%	1.2%	0.8%	81.3%
Regional agri-food sector	80.1%	48.0%	0.2%	0.6%	0.1%
Rest of regional economy	7.4%	18.0%	67.1%	84.3%	91.3%
Rest of Italian economy	12.5%	34.0%	32.7%	15.1%	8.6%
Value-added (M€)	320	456	3 347	3 450	3 334

Table 7. Subsystem composition: sectors of Basilicata's agri-food system.

Regional subsystems	Employment			Value-added		
	Regional agri-food sector	Rest of regional economy	Rest of Italian economy	Regional agri-food sector	Rest of regional economy	Rest of Italian economy
Cereal grains	97.0%	1.1%	1.9%	73.2%	9.9%	16.9%
Horticulture	100.0%	0.0%	0.0%	96.2%	0.9%	2.9%
Woody	96.4%	2.3%	1.3%	57.5%	24.5%	18.0%
Livestock	83.5%	4.9%	11.6%	85.2%	4.8%	10.0%
Mixed	82.2%	6.4%	11.4%	68.1%	11.6%	20.2%
Meat	62.7%	10.2%	27.1%	51.6%	14.9%	33.5%
Fish	54.9%	17.9%	27.2%	48.4%	18.6%	33.0%
Olive oil	56.2%	15.7%	28.1%	32.3%	26.9%	40.8%
Vegetable oils, sugar, pasta	58.6%	15.3%	26.1%	52.1%	18.1%	29.9%
Vegetables and fruits	61.6%	11.0%	27.4%	48.9%	16.5%	34.6%
Dairy products	60.6%	9.2%	30.2%	52.4%	12.1%	35.5%
Cereals	64.3%	8.8%	26.8%	50.5%	14.5%	34.9%
Animal feed	55.0%	12.1%	32.9%	44.6%	16.1%	39.2%
Wine	53.7%	16.8%	29.5%	39.3%	22.6%	38.1%
Water and other beverage	42.2%	20.7%	37.1%	34.3%	23.7%	42.0%

agri-food production activities. For the sake of convenience, the presentation of data has been transposed, with the subsystem components into columns (totals of rows equal to 100). Table 7 shows the subsystem composition in terms of regional location of activities.

Table 8. Final demand composition of the restaurant and accommodation services.

Subsystems	Employment		Value-added	
	Basilicata	Rest of Italy	Basilicata	Rest of Italy
Regional agriculture	3.0%	7.3%	1.4%	3.7%
Regional food industry	1.7%	2.8%	2.3%	3.4%
Other primary activities	3.8%	0.3%	3.7%	0.4%
Other manufacturing and constructions	4.4%	3.3%	8.2%	5.2%
Trade and services	86.3%	85.6%	83.5%	86.4%
Public administration	0.8%	0.7%	0.8%	0.9%

Except for the case of the few farms classified as specialized in horticultural production and showing a sub-system virtually "self-contained" at the regional level (notably in terms of employment generated both directly and indirectly), activities involving animal husbandry (both specialized and mixed) are, among the agricultural ones, those with the highest participation of non-regional components to the satisfaction of final demand. In the case of food industry products, the level of participation in the subsystems by non-regional production activities is quite homogenous, especially in terms of employment.

The comparison of the "parallel" subsystems referred to the final demand in the two regions (Basilicata and Rest of Italy) can provide relevant additional indications. Table 8 shows the case of the two regional subsystems devoted to fulfill the final demand for accommodation and food services. These are production activities that might benefit from a regionally-based integration with the agri-food sector, in particular with a view to qualitative differentiation and promotion of typical regional products.

The level of participation of both regional agriculture and food industry is lower in the case of the Basilicata's subsystem as compared with "the average" of the rest of Italy. This means that the final demand towards Basilicata's activities supplying restaurant and accommodation services is less able to activate production and employment within the regional borders than those operating in the rest of Italy. Such results suggest the existence of an unexploited space for the integration of tourism activities with the local agri-food system.

5. Conclusions

This study has proposed a structural analysis of Basilicata's agri-food system, based on a two-region SAM model, appropriately broken down. The objective of the analysis was to make available helpful information for defining sectoral regional policies, associated with the implementation of the new programming period of Rural Development policies. The 2014-2020 Rural Development Programme actually offers a major opportunity to increase the regional system competitiveness, by providing public funds equal to EUR 680 million.

Agri-food is an important component of Basilicata's economy, not only in terms of value produced and employment created, but especially for its quality production and local production systems in which all steps of supply chains (agricultural, industrial, and

marketing steps) find their coordination. The structural analysis of interdependencies between the various components of the agri-food system, via the two-region model, has highlighted important areas of further integration that could drive innovation processes.

To enhance the positive impact of agri-food production activities on the regional economic development, two basic strategies may be followed. The first consists in attracting increasing shares of non-regional demand towards Basilicata's products. In this respect, the growth of exports in challenging times, like the recent ones, indicates that first steps in that direction have been made. But the scope for improvement and strengthening in this broad area is still large, encompassing the trade with the other Italian regions. Basilicata's agri-food system (in particular its agricultural component) invests a relevant part of its activities for the direct or indirect fulfillment of the final agri-food demand of the other regions. This is a segment of activity requiring a specific strategy to consolidate the comparative advantages to base them mostly on unique features of the regional system, including the quality of the environment, the specificities of the varieties produced, and the knowledge of the context related to production traditions. If the participation in the market of agricultural *commodities* (like in the case of cereals for the pasta industry) is an important business segment in Basilicata's agri-food system, it can and must be made stable by innovation processes aimed at increasing product qualitative differentiation.

The second strategy could be described as the strengthening of interdependencies within the regional production system aimed at increasing the share of the multiplier effect remaining within the regional economic system. The subsystem analysis has demonstrated that there are large areas for increasing integration within regional food chains, in particular between agricultural production and industrial processing. In this sense, rural development policies, especially the measures aimed to promote coordinated actions at the district scale, may be a good basis for creating local supply chains and tighter links among regional production activities. This process, however, should again be driven by qualitative differentiation. If, on the one hand, "shorter" food chains can increase the regional multiplier effect through an enhanced integration between agriculture and food industry, they could also represent an important factor to upgrade (and hence add value to) production, with the possibility of increasing "downstream" integration with other regional sectors. The analysis has shown that in Basilicata the integration with food and restaurant and accommodation services is lower than in other Italian regions. But there also is much room for intensifying the interdependencies of the regional agri-food system with elements of the public administration (such as, for instance, public providing activities in school canteens or in hospitals). These market opportunities would be useful to improve final consumers' awareness of regional production peculiarities and might have long-term additional effects on the growth of demand addressed towards the regional production system.

Results show that the availability of a highly disaggregate multi-sector model of the regional economy is a valuable tool in supporting the design of regional policies for innovation and for the development of rural areas. The structural analysis described in this paper could be further extended at the level of each single chain, with the characterization of the main *forward* and *backward* linkages and the interaction with the rest of the national economy.

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