Specialization And Concentration Of Agricultural Production In The Region Of Central Macedonia (Greece)

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Abstract. The purpose of this study is to examine the concentration and specialization trends of crop and livestock production in the Region of Central Macedonia, Greece, during the 1980-2006 period. The Region of Central Macedonia is ranked second in terms of GDP and population among the 13 Greek Regions and the total value of its primary production is the highest in the country. The analysis indicates low specialization coefficients for most of the Prefectures in the Region, and high concentration coefficients for crops of particular economic and social importance for small areas of some Prefectures, such as olives and tree crops. Traditional livestock sectors such as cow, sheep and goat farming are widespread in the Region, while, recently introduced activities, such as pork and poultry production, exhibit considerably high concentration coefficients. These findings can be of interest in the design of appropriate management strategies either for market-oriented or formerly highly protected sectors.

Keywords: Concentration indexes, Specialization coefficients, Concentration coefficients, Land use, Agricultural policy

1 Introduction

Recent developments in Greek economy have highlighted the necessity of competitive economic activities, which will contribute to the improvement of basic economic indicators and will reverse negative trends of employment. European Union (EU) policies have affected the performance of all sectors of the Greek

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economy in multiple ways during the past three decades. Amongst them, the Common Agricultural Policy (CAP) and its consequences on the Greek agricultural sector since the country's adhesion in 1981 constitute the most illustrative examples. Protectionism in the sector brought about considerable improvements in farm incomes which, combined with structural interventions and rural development policies, contributed highly to the development of Greek rural areas. Nevertheless, the vast expansion of heavily subsidized farming and livestock production activities rendered the Greek agricultural sector sensitive to the CAP reforms, especially after 1992. As a result, trade constraints altered the Greek trade balance and the farming sector and isolated agricultural production from market demands, which, consequently, affected the Greek economy as a whole.

The agricultural sector in Greece, despite its diminishing contribution in GDP and employment, maintains a relatively high role in the Greek economy. Crop and livestock production support manufacturing and the multiplicative effects of relevant investments boost rural economy. At the local or the regional level, agriculture supports rural family incomes and employment and reverses depopulation and marginalization of remote, mountainous and less-favored areas. This rough presentation of the Greek farming sector illustrates its potential for supporting activities which would assist the recovery of the national economy.

Under the light of the new CAP reform in 2013 (European Commission, 2013), a further liberalization of agricultural markets is expected to cause additional problems in the sector's performance and to affect its multifunctional character, creating simultaneously new opportunities. After a long period of protectionism, the operation of a liberalized agricultural sector in the context of financial stress constitutes a major challenge for Greek policy-makers, which could provide considerable development opportunities, if appropriate strategies were developed. A late or poor response to these conditions, on the other hand, would deteriorate existing deficiencies and would pose additional pressures on the fragile Greek economic system. Furthermore, growing public awareness concerning environmental protection points to a shift towards environmental-friendly activities and farming practices, which would mitigate pressures on ecosystems and would contribute to the maintenance of biodiversity and water resources (European Commission, 2000).

Within this context, the structure of agricultural production and its temporal and spatial evolution can provide valuable information concerning the prospects of the sector. Such an examination will reveal activities of major importance, in terms of their expansion at the regional or the national level, and small-scale activities at local level, which take advantage of local particularities and comparative advantages and play a vital role in local economies. Furthermore, it permits the examination of the degree to which agricultural production is diversified at a certain geographical level (local, regional and/or national). Apparently, this approach becomes highly relevant to the design of development projects and farm policies, while it can also inform environmental policies, by recognizing linkages between cropping and husbandry systems and environmental quality.

The issues of changes in cropping patterns and of the restructuring of crop and livestock production have been examined by numerous authors. The main methodological approaches include mathematical programming models and Multiple Criteria Analysis (Dooley et al., 2009; Manos et al., 2010; Zerger et al., 2011). These

papers focus on the achievement of goals through the maximization of an objective function, but do not examine the factors that lead to the formulation of particular cropping patterns and activities. However, the use of concentration indexes regarding the description of the Greek agricultural sector has been limited (Samathrakis, 1997; Samathrakis, 1998, Samathrakis, 1999). These studies discuss the effects of the CAP on the structure of farming and livestock production activities until 1996, but do not consider environmental protection policies as well as the impact of the CAP reforms in 2000 and 2006. Singh and Dhillon (2004) and Leeuwen et al. (2010) examine concentration and specialization, without providing interpretations of the trends they record.

The purpose of this study is to examine the concentration of crop and livestock production as well as the degree of specialization in crop agricultural and livestock sectors of the Region of Central Macedonia in Greece. The choice of this particular Region is justified in terms of its importance in crop and livestock production at the national level and on its high contribution to the Greek agricultural economy. The methodological framework includes the calculation of concentration indexes for particular sectors at the Prefectural level and of concentration and specialization coefficients (Vate, 1983) for sectors at the regional level and for each Prefecture respectively. The analysis is based on official data from the Greek Statistical Authority concerning the value of agricultural production for certain years of the 1982-2006 period, in order to account for changes induced by the implementation of the CAP.

2 The Region of Central Macedonia

The Region of Central Macedonia (RCM) includes seven (7) Prefectures (Imathia, Thessaloniki, Kilkis, Pella, Pieria, Serres, Chalkidiki) and it is the most developed among Greek northern Regions, which is due to rich endowments to natural and human resources, its strategic geographical position, urban development (mainly the city of Thessaloniki, which is the second most populated city in Greece) and the dynamic structure of production activities. The primary sector of RCM stood for 22.6% of the total value of primary production in Greece, which is the highest among 13 Regions (Hellenic Statistical Authority, 2014a). According to the Regional Accounts of the Hellenic Statistical Authority (2014b) sectoral contribution to the Gross Value Added in RCM for the 2011 was 7.7%, 14.8% και 77.5% for the primary, secondary and tertiary sectors respectively. Furthermore, about 16.7% of the labor force in RCM was employed in agriculture in 2011 (Hellenic Statistical Authority, 2014c).

This rough presentation of RCM illustrates the particular role of the agricultural sector in Regional economy. The development of the agricultural sector in RCM is linked to the efficient use of existing natural resources and to transportation, marketing and processing infrastructures. According to the Agriculture and Livestock Census in 2009 there were 136,378 crop farms, of average size 4.71ha, operating in RCM. Irrigated land accounts for 49.2% of total agricultural land, which constitutes a significant advantage for RCM's farming sector. The prevailing farming types were

formulated under the influence of the CAP, which favored the expansion of cereal and tobacco in non-irrigated areas and of cotton, sugar beet and maize in irrigated areas. Tree crops and vineyards are also important for the Region. The livestock breeding sector is of major importance for RCM; dairy farming is the most important, but several other activities (sheep –goat, poultry and pork farming) can be found in most areas. It should be noticed that agriculture and livestock breeding constitute a major (or the only) sources of income and employment for numerous mountainous and less-favored areas in RCM.

3 Methodological framework

Concentration indexes constitute one of the numerous methodological tools for the examination of regional economies. These indexes provide an interpretation of the relative importance of a product, in terms of concentration, among geographic units. In spite of their computational simplicity, these indexes cannot fully account for the degree of specialization of a region in a particular product or the degree of specialization of a Prefecture, which would enable comparisons among Regions, Prefectures and products (Samathrakis, 1997).

The drawbacks of the aforementioned indexes are mitigated with the introduction of concentration and specialization coefficients. These coefficients constitute an obvious separation criterion of Prefectures for each product under consideration or, symmetrically, a separation criterion of products in respect to each Prefecture, regardless the nature of the products. Specifically, the discrimination of Prefectures or products on the basis of the value of the concentration index (smaller or larger than 1) is typically similar to the segmentation technique of Belson (Hugues et al., 1970).

These coefficients can be applied in two cases (Samathrakis, 1997). The concentration coefficient is a synthetic measure which permits a distinction among Prefectures, revealing the degree to which a product is concentrated at the regional level. The specialization coefficient, on the other hand, constitutes a synthetic criterion of separation of the products under consideration and reflects the degree to which a Prefecture is specialized in certain products.

The calculation methodology of specialization coefficients includes five steps (Samathrakis, 1997).

A. Construction of the concentration index matrix, following Formula (1).

$$PCI_{ij} = [GVP_{ij} / TGVP_j] / [RGVP_i / TRGVP] \quad \textbf{(1)}$$

where

PCI_{ij}: the Concentration Index for j=1,2,…n Prefectures and i=1,2,…m products,

GVP_{ij}: the Gross Value of agricultural Production of each product in each Prefecture,

$TGVP_j$: the Total Gross Value of agricultural Production in each Prefecture,

$RGVP_i$: the Gross Value of Production of each product in the Region and

TRGVP: the Total Gross Value of agricultural Production η in the Region.

This index reflects the specialization of each Prefecture in certain activities and allows for comparisons between each Prefecture and the Region. The index equals zero (0) if the product under consideration is not produced in a Prefecture, while there is not a specific maximum value. If the index exceeds 1, the product is relatively more frequent in a particular Prefecture than in the Region and, consequently, the Prefecture has relative position more important to the specific product than to other products .

If the value of the ratio is greater than 1, this means that this product is relatively more frequent in this county than in the Region and same time that this State has relative position more important to the specific product than for other products.

B. Construction of the derived specialization index matrix for each product, by focusing on "Core Prefectures", that is the Prefectures for which the concentration index value exceeds 100 for a particular product.

C. Calculation of deviations between "actual" and "theoretical" values of the derived matrix (E_i) for each product. "Theoretical" values correspond to those obtained if the relative percentage of a product in "Core Prefectures" was equal to the corresponding percentage for all products. The separation of Prefectures based on values of the concentration index that exceed 100 defines a classification for which the deviation is maximized. This attribute forms the basis for the segmentation criterion.

D. Calculation of maximum deviations (E^*_i) for each product. For any given regional distribution of the product under consideration the index E_i reaches a maximum (denoted E^*_i). This maximum is linked to the concept of "ideal partition", which would enable to forecast the concentration of a product with zero error probability.

E. Calculation of the concentration coefficient (S_i) for each product (E_i/E^*_i). The coefficient obtains values within the {0,1} interval and permits comparisons of concentration indexes for each product in the Region. Hence, the production of X is more concentrated than the production of Y if $S_X > S_Y$.

By means of the same methodological steps, but reversing products and Prefectures, one may obtain specialization coefficients for a Prefecture (S_j). Prefecture A is, then, more specialized than Prefecture B if $S_A > S_B$.

Data for the calculation of specialization and concentration coefficients include the Gross Value of production for most crops and livestock sectors in all seven Prefectures of the Region of Central Macedonia. The analysis focuses on years 1982, 1986, 1991, 1996, 2003 and 2006, which cover for the whole period from the adhesion of Greece in the EEC (1981) to the implementation of the most recent CAP reform (Regulation (EC) 1782/2003, European Commission, 2003).

4 Results of the analysis

The concentration coefficients for the main products in RCM for the 1982-2006 period are presented in Table 1.

Table 1. Concentration coefficients of the main agricultural and livestock products in the Region of Central Macedonia (1982 – 2006)

PRODUCTS	Years					
	1982	1986	1991	1996	2003	2006
Cereal	0.31	0.25	0.24	0.28	0.14	0.17
Durum wheat	0.53	0.37	0.60	0.33	0.46	0.29
Maize	0.28	0.26	0.25	0.13	0.28	0.27
Rice	0.81	0.57	0.56	0.58	0.52	0.51
Industrial and aromatic plants	0.24	0.20	0.23	0.35	0.32	0.36
Cotton	0.32	0.23	0.12	0.30	0.24	0.38
Sugar Beet	0.34	0.36	0.40	0.45	0.32	0.34
Tobacco	0.29	0.35	0.30	0.38	0.43	0.42
Sunflower	0.51	0.48	0.57	0.76	0.59	0.62
Vegetables	0.15	0.21	0.21	0.18	0.17	0.12
Potatoes	0.25	0.24	0.36	0.48	0.28	0.35
Industrial tomato	0.26	0.24	0.29	0.26	0.16	0.17
Edible legumes	0.22	0.33	0.47	0.60	0.68	0.35
Legumes for fodder	0.29	0.54	0.61	0.78	0.43	0.35
Fodder crops	0.21	0.29	0.20	0.26	0.24	0.25
Olive oil	0.79	0.62	0.81	0.63	0.59	0.59
Wine	0.39	0.28	0.37	0.35	0.18	0.25
Fruit	0.65	0.64	0.65	0.68	0.61	0.54
Apples	0.61	0.55	0.50	0.61	0.60	0.55
Apricots	0.73	0.65	0.87	0.63	0.66	0.52
Peaches	0.66	0.69	0.71	0.69	0.65	0.59
Cherries	0.50	0.58	0.47	0.64	0.57	0.55
Nuts	0.34	0.30	0.30	0.34	0.45	0.43
Beef cattle meat	0.17	0.15	0.20	0.27	0.30	0.30
Lamb meat	0.08	0.12	0.11	0.12	0.18	0.19
Goat meat	0.14	0.18	0.18	0.18	0.26	0.25
Pork meat	0.12	0.21	0.22	0.35	0.46	0.43
Poultry meat	0.21	0.38	0.29	0.25	0.31	0.49
Cow milk	0.23	0.27	0.28	0.43	0.44	0.48
Sheep milk	0.14	0.16	0.12	0.16	0.13	0.19
Goat milk	0.19	0.18	0.20	0.20	0.22	0.20
Eggs	0.14	0.38	0.26	0.34	0.39	0.35

The results do not indicate high concentration trends for arable crops in RCM, which are found in almost all areas of the Region. Concentration indexes for each Prefecture are reported in the Appendix.

4.1 Concentration of agricultural production in the Region of Central Macedonia

4.1.1 Crop Production

Cereal are the main crops in non-irrigated, mountainous and less-favored areas. Durum wheat is cultivated by most farms in these areas, mainly because of heavy subsidization, especially from 1981 to 2006, as the quality premium substantially increased prices. The corresponding concentration coefficient varies between years, depending on international prices and weather conditions, which affect yields. Durum wheat is suitable for marginal land and is characterized by low input requirements, which results in a rather positive environmental impact.

Rice production in the Region is highly concentrated, as the concentration coefficient varies from 0.51-0.81. The two centers of rice production in Central Macedonia are in Thessaloniki and Serres, where its economic and environmental role is vital, as it develops sloping and low-quality land, which is inappropriate for other crops.

Cotton is a predominant crop in Greece and of particular importance for RCM. It extends in irrigated areas of almost all Prefectures and exhibits high concentration indexes in the Prefectures of Serres, Pella (especially in Giannitsa plain) and Imathia (especially during the early years of implementation of CAP in Greece). The subsidy system, based on acreage, substantially improved farm incomes in the Region; however, the high concentration of cotton crops in protected areas with environmental problems (Lake Kerkini in Serres, Axios Delta in Thessaloniki) resulted in extended pollution of water reserves, due to intensive use of agrochemical inputs (nitrogen, herbicides, insecticides) (Ragkos and Psychoudakis, 2009).

Sugar beet constitutes a crop of major economic importance for Greek agriculture. Its production is based on contract farming, supervised by the Hellenic Sugar Industry (HSI). The HSI is responsible for the implementation of the EU policy in the sugar sector and also for sugar beet procession and the production of sugar. Central Macedonia is one of the main Regions in sugar production. The concentration coefficient of the crop in the Region is relatively high, which implies the existence of sugar beet production cells, developed around the sugar processing factories in RCM. During the years under consideration, one observes a declining concentration index for sugar beet in Pella, with a corresponding increase in the concentration index in Serres, which is due to developments in the operation of the sugar factories in the two Prefectures.

Tobacco constitutes a heavily subsidized crop which boosted farm incomes, contributed to the reversion of depopulation trends in rural areas and affected their social structures. The subsidy system induced the expansion of foreign irrigated varieties (Virginia, Burley) at the expense of domestic quality varieties (Basmas),

which, nonetheless, had competitive advantages in markets, formulating tobacco production cells in the Prefectures of Pieria, Serres (particularly in Nigrita and Visaltia) and Pella. Concentration coefficients for tobacco increase from 1982 to 2006, when subsidies were decoupled from production.

Sunflower constitutes an alternative crop to tobacco and winter cereal, in order to develop non-irrigated areas of the Region under the light of CAP reforms. Its perspective in the production of biofuel results in a considerably high concentration coefficient, which implies its major importance for certain areas in the Region. During the first years of the period under examination the main production centers of sunflowers were met in Pella, Kilkis and Thessaloniki; recently (2003 and thereafter) the relevant concentration index is very high for the Prefecture of Imathia.

The concentration coefficient for vegetables is low during the 1982-2006 period, as their production is scattered in numerous areas of all the Prefectures. Protectionism in the vegetable sector has been relatively low, compared to other crops, hence vegetable crops stand for a small percentage of the total irrigated area. Nevertheless, they constitute the basic perspective for the farming sector of RCM, as they adapt well to soil and climate conditions, they develop its comparative advantages and are predominantly market-oriented. Opportunities of the sector are linked to the improvement of transportation, marketing and processing infrastructure, which would induce the creation of production cells in specific areas, increasing the concentration coefficient. Industrial tomato in the Prefecture of Serres is an illustrative example, as the concentration index was relatively high until 2003, while tomato processing units were operating in the Prefecture, and was considerably reduced thereafter.

Edible legumes exhibit high concentration coefficients during the period after 1991 (0.35-0.68), due their concentration in areas of Serres and Pieria. Crops of this category are typical examples of locally important crops, which use excessive farm family labor and are oriented to market demand.

Olive oil, although a typical Mediterranean Greek product, is of relatively low importance to RCM. The high concentration coefficient of this product (0.59-0.81) is interpreted in conjunction to its high concentration index for Chalkidiki. Olive oil is important for the rural economy of the Prefecture, as it constitutes a supplementary source of income for numerous families. The implementation of strategies aiming at the enhancement of quality and marketing conditions could improve its potential for RCM.

The concentration of wine production follows a decreasing pattern. The concentration index for wine, which reaches a minimum at 2003 (0.18), depicts the results of the CAP, as the restrictions introduced in 2000 brought about a significant decrease in the number and acreage of vineyards. Wine production, on the other hand, provides many areas of RCM with development opportunities, linked to the production of quality wines. The concentration coefficient is particularly low for 2003 and 2006, due to the emergence of such areas in all Prefectures, through wine tourism initiatives (e.g. “Wine Routes”).

Tree crops exhibit a high concentration coefficient (0.54-0.68), although declining during recent years. This is due to the intensive production of fruit, mainly in the Prefectures of Imathia and Pella. The predominance of tree crops in these Prefecture is due to favorable climate and soil conditions as well as to heavy

protectionism in the sector, mainly until 1992. These activities are vital to the economy of both Prefectures, as they provide income and employment to many farm families and they support considerable investments in processing and transportation.

Nuts are treated as a separate category within the analysis. Their high concentration coefficients are explained through their high concentration index in the Prefectures of Pieria, Kilkis and Chalkidiki, where they play an important role at the local level.

4.1.2 Livestock production

The dynamics of the livestock production sector in RCM are illustrated through the concentration indexes and coefficients for livestock products (Table 1). The production of cow milk exhibits an increasing concentration trend in the period under examination. During the first years, heavy protectionism resulted in the appearance of dairy farms in almost all areas of RCM. From 1991 and thereafter, increasing concentration coefficients (from 0.28 to 0.48) reflect the consequences of the quota regime. Production rights were gathered to fewer producers and large-scale dairy farms were formulated in some areas, mainly in the Prefecture of Thessaloniki. These farms undertook substantial investments in fixed capital and animal resources and pursued the amelioration of productivity.

Beef production is mainly concentrated in the Prefecture of Kilkis. However, the rearing of small, indigenous buffalos constitutes a typical activity for Kerkini area in the Prefecture of Serres. The economic performance of this production system is more than satisfactory, while it also contributes to the protection of indigenous genetic resources and biodiversity.

Pork production is mainly concentrated in the Prefecture of Pieria and in some areas of Imathia and Kilkis, which exhibit the highest indexes. Its importance for these regions is linked to the achievement of economies of scale by pork farms, which exhibit highly entrepreneurial characteristics. Poultry production also constitutes an intensive entrepreneurial activity, which cannot be undertaken by family farms typically operating in RCM. Considerable investments in the sector in the Prefecture of Thessaloniki result in a high concentration coefficient for RCM, mostly in recent years.

Sheep and goat farming is a typical activity for mountainous, less-favored and remote Greek areas. In RCM, the production of sheep and goat milk follows the same pattern; concentration coefficients are low during the whole 1982-2006 period, due to the existence of such areas in the whole acreage of RCM. The sector is of vital economic and social importance for these areas, because it uses land with no alternative uses for pastures and provides employment and income to farm families, where the rural economy is not diversified and alternative activities are not readily available. Meat production is even less concentrated, but a slightly increasing trend is observed for recent years, due to the operation of new processing centers in various areas. The substantial reduction of the concentration index for goat meat in Chalkidiki is counterbalanced by an increase in Pieria, which is indicative of the aforementioned developments.

It is worth to notice that concentration indexes for fodder crops and maize do not follow the same pattern with livestock production (not even dairy farming, which is heavily dependent on roughages), contrary to what was expected. Hence, these crops did not evolve in the centers of livestock production in RCM; on the contrary, they are scattered in all irrigated areas of the Region. This spatial organization of fodder production, reflected in the concentration indexes, implies inefficiencies in livestock production, as feeding costs are burdened with transportation costs, and potential market failures occur, given the distance between production cells of livestock products and fodder.

4.2 Specialization trends in the Prefectures of RCM

Table 2 presents the specialization coefficients of the Prefectures of RCM during the period under consideration. Imathia exhibits the highest coefficient among all seven Prefectures, as was expected, due to the predominance of tree crops. The common characteristic of the other six Prefectures is the relatively low specialization coefficient, which does not exceed 0.4 in most cases. This illustrates the structure of the agricultural sector in RCM, characterized by the large number of small family farms, which adopt a relatively large number of crops and livestock breeding activities. The broad range of farming types is typical for Greek Regions and for other Mediterranean countries.

Table 2. Specialization coefficients of the Prefectures of the Region of Central Macedonia (1982 – 2006)

Years	Prefectures						
	Imathia	Thessaloniki	Kilkis	Pella	Pieria	Serres	Chalkidiki
1982	0.451	0.313	0.269	0.258	0.330	0.207	0.354
1986	0.473	0.287	0.327	0.234	0.345	0.260	0.362
1991	0.448	0.279	0.291	0.330	0.364	0.212	0.391
1996	0.355	0.401	0.439	0.336	0.411	0.282	0.536
2003	0.669	0.127	0.358	0.372	0.334	0.256	0.440
2006	0.576	0.296	0.246	0.303	0.568	0.378	0.394

An examination of the specialization coefficients over time reveals increasing specialization trends for four (4) Prefectures in recent years. These trends are due to effects of the CAP, which favored the expansion of a small number of farming activities through the subsidization scheme, combined with the emergence of innovative crops at the local level. The Prefecture of Serres is an example of the former category, where arable crops prevail; nonetheless, these specialization trends do not conform with environmental policies, as the presence of protected areas (lake Kerkini, protected under the Ramsar Convention) calls for the adoption of activities with minimum agrochemical input requirements. In the latter category, the Prefecture of Imathia is further specialized in tree crops, feed crops and pork production, that is, in activities that develop its comparative advantages. In Pella, it is worth to notice the

increasing importance of tree crops and of certain industrial crops. The Prefecture of Pieria specializes in activities that are explicitly market-oriented, including poultry production, vineyards and vegetable production

The specialization coefficients of the remaining three Prefectures of RCM (Thessaloniki, Kilkis and Chalkidiki) remain relatively steady during the period under examination. In Thessaloniki, soil and climate conditions, existing infrastructures and the general economic context favor investments in a relatively broad range of production types. In Kilkis, the low specialization coefficient is due to the diversified livestock breeding sector and to the low percentage of irrigated land (21.1%, Hellenic Statistical Authority, 2005), which only permits a limited range of production activities and discourages the formulation of innovative production centers. Last but not least, the predominance of a relatively small number of traditional farming activities in Chalkidiki results in relatively high specialization coefficients for all years.

An interesting observation stems from the fact that specialization coefficients in 1996 are considerably higher for all Prefectures, except for Imathia. This demonstrates the effects of the 1992 CAP reform, which introduced subsidies per acre or per animal, rather than depending on the produced quantity, and established the milk quota regime. This shift in policy favored the expansion of heavily subsidized sectors, mainly dairy farming, maize and durum wheat, which substituted soft wheat in arid land.

5 Conclusions

The use of concentration and specialization indexes and coefficients constitutes a rather simple approach, aiming at the examination of concentration trends of crop and livestock production at the Regional level, while specialization coefficients permit comparisons among Prefectures. In this study, such indicators are the basis of a critical presentation of the crop and livestock breeding sectors of the Region of Central Macedonia, which aims at an interpretation of the factors that affected their structure. The empirical analysis revealed sectors which are common for all areas in the Region and others, which are typical of particular areas and Prefecture, thus increasing their corresponding concentration indexes.

The calculated indexes and coefficients yield valuable information concerning the prospects of the agricultural and livestock breeding sectors of RCM. The choice of the appropriate development strategy at the Regional and/or the Prefectural level should take into account the spatial distribution of each crop, along with its relative importance to specific areas and to the Region as a whole, in order to boost the efficiency of agriculture and to provide economic development opportunities.

Arable crops predominate in almost all areas, therefore presenting relatively low concentration coefficients. The perspectives of these crops, so far heavily protected by the CAP, are linked to the future of EU policies. Furthermore, low concentration coefficients indicate their geographical spread, therefore strategies concerning their continuation can be designed at the Regional level, as consequences of such strategies would affect producers in a similar way. On the other hand, sectors

exhibiting high concentration coefficients may formulate the axes on which to design targeted strategies in order to resolve endogenous problems of the Greek farming sector. Such activities can be incorporated into quality systems, which take into account comparative advantages and market demands, in order to mitigate the effects of high production costs of Greek farms. Strategies based on quality and alternative marketing approaches are also applicable to heavily subsidized concentrated crops, such as tobacco, given that their substitution in their production centers is difficult to achieve.

The proposed strategies for each product should, nonetheless, take into account the specialization at the Prefecture level and incorporate adjustments in order to accommodate differences. Prefectures with high specialization coefficients are characterized by the predominance of crops with particular contribution to incomes and employment at the local level; in this case, proposed strategies should focus on existing activities, emphasizing on marketing, quality and processing, thereby facilitating their access to markets. On the contrary, low specialization coefficients point out less opportunities for targeted measures for particular activities. This case calls for generalized strategies, aiming at the mitigation of structural deficiencies, the enhancement of basic infrastructure for all activities (for example transportation) and favorable economic conditions to induce investments.

The environmental impact of highly concentrated activities should also constitutes an important element in policy design. The presence of concentrated production centers in environmentally sensitive areas calls for the introduction of special initiatives, in accordance with the environmental policy in force (Dir. (EC) 60/2000 and (EC) 43/92). Farm education in environmental issues, agrochemical input control and the introduction of alternative farming practices (integrated crop management and organic farming) constitute examples of potential relevant actions. Environmental awareness is nowadays well-established in the design and implementation of agricultural policy measures. The methodological framework presented in this paper provides additional possibilities of further incorporation of environmental issues in decision-making.

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Appendix 1. Concentration indexes for each Prefecture in RCM (1982 - 2006)

PRODUCTS	THESSALONIKI						CHALKIDIKI					
	1982	**1986**	**1991**	**1996**	**2003**	**2006**	**1982**	**1986**	**1991**	**1996**	**2003**	**2006**
Cereals	143.8	125.1	117.6	202.0	131.5	128.9	145.6	129.5	93.0	38.5	92.2	70.7
Durum wheat	189.5	108.9	49.2	168.2	154.2	126.5	426.4	279.1	739.9	0.0	293.8	214.7
Maize	121.8	78.6	91.4	100.5	51.9	65.1	5.7	10.3	14.8	28.0	8.3	10.1
Rice	499.6	333.3	268.4	140.5	204.3	204.3	0.0	0.0	0.0	0.0	0.0	0.0
Edible legumes	67.3	40.6	21.5	7.2	42.3	75.8	118.2	86.2	4.0	19.6	34.9	250.3
Industrial and aromatic plants	58.5	62.8	72.8	47.0	59.1	25.5	16.2	32.5	26.1	21.4	38.3	20.4
Tobacco	50.8	37.9	53.6	36.8	45.9	67.9	14.3	11.1	16.1	4.1	4.3	8.9
Cotton	98.5	119.1	122.7	64.5	72.8	3.9	22.8	67.9	48.6	46.0	22.3	21.6
Sugar beet	33.5	14.2	26.1	22.3	41.3	39.5	0.0	0.0	0.0	0.0	0.0	0.0
Sunflower	0.0	82.9	363.5	449.1	103.4	87.9	0.0	137.8	32.7	15.9	1.5	1.2
Vegetables	159.0	158.3	130.7	133.0	89.3	115.5	121.2	146.2	83.9	156.5	293.4	196.1
Potatoes	63.6	72.5	36.7	68.6	37.3	66.3	31.3	103.9	129.0	122.3	114.3	51.5
Industrial tomato	77.6	92.4	84.5	100.5	107.4	136.9	0.0	0.0	0.0	0.0	49.7	229.6
Legumes for fodder	119.9	118.1	0.6	459.9	33.0	114.1	113.9	364.9	1.2	0.0	14.4	13.0
Fodder crops	105.6	84.3	127.2	169.5	175.1	154.6	47.6	51.1	117.4	34.2	13.1	58.4
Wine	19.2	93.4	139.6	132.7	108.2	88.9	77.8	208.9	231.7	187.8	194.0	295.4
Olive oil	10.4	64.5	25.4	49.2	30.5	47.9	1219.2	992.0	1165.6	1100.7	652.9	851.9
Fruit	7.1	8.3	7.2	5.1	8.4	9.8	32.1	27.4	37.1	24.3	41.5	58.7
Nuts	56.1	78.9	45.6	56.7	18.9	22.3	126.3	135.9	197.1	162.1	357.6	218.6
Beef cattle meat	77.5	115.3	111.3	140.5	126.1	101.5	38.1	36.8	26.6	24.6	26.2	29.3
Lamb meat	111.4	94.0	95.6	111.7	129.7	148.2	68.0	47.8	68.4	59.5	64.4	69.7
Goat meat	111.9	83.1	95.5	113.9	121.7	131.2	249.7	268.2	259.8	247.3	119.2	114.1
Pork meat	98.8	121.8	82.3	51.9	45.3	35.2	133.8	98.8	76.7	78.6	79.5	92.2
Poultry meat	196.4	277.4	190.9	165.8	186.8	173.8	78.3	54.9	31.8	78.2	92.6	73.4
Cow milk	176.0	170.3	187.4	206.8	264.3	322.4	27.2	19.1	21.9	18.7	1.6	1.6
Sheep milk	101.7	118.5	113.8	106.4	117.8	142.6	65.1	59.2	68.0	71.3	73.8	78.1
Goat milk	82.4	116.7	111.0	99.9	82.2	100.1	306.5	247.8	234.8	218.8	275.4	284.1
Eggs	164.8	276.1	210.4	253.7	278.6	254.4	92.4	79.0	64.4	56.8	32.7	90.2

PRODUCTS	PIERIA						IMATHIA					
	1982	**1986**	**1991**	**1996**	**2003**	**2006**	**1982**	**1986**	**1991**	**1996**	**2003**	**2006**
Cereals	24.6	61.8	70.1	68.7	79.1	64.6	32.9	39.2	53.3	81.0	110.0	110.4
Durum wheat	5.0	33.8	32.5	95.2	68.5	105.7	1.5	15.2	11.9	27.9	21.0	13.5
Maize	60.1	59.8	52.0	95.8	82.3	45.5	68.5	90.1	119.6	146.2	73.1	79.2
Rice	0.0	0.0	28.3	9.0	69.1	40.1	0.0	6.7	0.9	372.3	273.0	266.6
Edible legumes	255.8	418.8	592.0	369.6	945.9	324.5	49.3	53.2	4.9	43.2	10.5	12.4
Industrial and aromatic plants	221.7	190.6	245.7	220.3	80.8	51.4	134.0	103.4	62.9	70.5	82.3	102.0
Tobacco	287.4	299.3	369.5	399.3	117.6	46.2	58.0	36.9	33.8	44.9	18.8	5.3
Cotton	59.2	44.6	53.0	34.5	60.3	54.9	306.9	205.0	90.2	91.8	116.6	133.1
Sugar beet	165.2	112.2	121.3	55.1	63.3	47.2	239.7	200.7	156.2	151.5	127.0	117.4
Sunflower	0.0	3.3	0.1	0.5	33.4	38.5	253.5	4.8	2.7	0.0	455.7	439.7

Vegetables	73.6	70.9	41.5	50.2	107.2	101.8	53.4	65.4	49.1	56.5	98.6	90.6
Potatoes	65.3	38.0	30.9	16.6	16.8	28.3	30.0	19.5	2.0	13.2	51.9	22.4
Industrial tomato	4.7	45.8	49.8	41.4	56.0	41.4	100.1	202.9	38.4	76.5	129.2	62.2
Legumes for fodder	199.0	0.0	0.0	0.0	6.2	0.0	0.0	0.0	0.0	0.0	198.9	207.5
Fodder crops	75.8	58.2	59.6	79.3	107.4	132.5	38.0	24.0	43.2	71.3	53.7	53.6
Wine	128.8	33.2	10.0	11.2	189.3	135.7	359.0	238.7	230.5	194.0	112.2	131.2
Olive oil	41.0	67.2	44.9	58.4	299.6	56.9	0.0	9.2	0.0	0.8	0.4	5.3
Fruit	48.4	57.0	47.9	34.4	67.9	99.4	337.9	331.8	334.2	259.2	243.3	236.2
Nuts	401.1	248.1	231.0	127.3	276.7	137.5	34.6	36.8	62.8	36.9	19.1	13.8
Beef cattle meat	45.4	15.0	22.3	10.8	19.2	18.4	131.5	110.4	167.0	135.8	86.8	67.1
Lamb meat	138.6	106.9	114.0	78.4	124.9	103.5	65.9	56.8	77.1	73.0	15.7	10.8
Goat meat	107.7	156.3	91.6	128.4	201.5	164.8	51.5	39.3	39.5	39.8	10.4	9.6
Pork meat	182.2	236.6	209.4	177.4	193.5	199.0	104.8	112.8	176.3	152.5	258.9	225.7
Poultry meat	100.9	58.7	140.6	168.2	241.6	428.5	17.5	18.0	23.4	26.3	10.0	7.0
Cow milk	60.2	24.0	32.2	13.8	25.9	17.6	52.5	42.2	47.2	27.2	25.7	16.5
Sheep milk	149.8	93.8	114.7	77.5	97.8	73.6	57.1	48.7	56.9	48.4	75.3	69.4
Goat milk	158.2	129.5	150.5	152.6	171.4	130.1	46.7	40.6	39.4	51.4	56.2	54.7
Eggs	78.7	60.5	67.7	46.9	104.6	164.0	70.5	57.2	66.4	55.2	25.7	22.7

PRODUCTS	**KILKIS**						**SERRES**					
	1982	**1986**	**1991**	**1996**	**2003**	**2006**	**1982**	**1986**	**1991**	**1996**	**2003**	**2006**
Cereals	156.1	133.1	175.6	120.3	112.5	92.6	128.1	148.5	141.2	105.2	112.6	141.9
Durum wheat	198.3	182.2	134.3	334.6	272.5	213.2	13.3	164.9	64.1	102.0	20.0	108.6
Maize	9.9	21.2	38.1	92.4	76.1	73.2	200.4	221.1	202.5	126.6	242.7	236.9
Rice	0.0	0.0	0.0	0.0	0.0	0.0	0.0	133.7	188.3	41.2	32.5	58.2
Edible legumes	26.1	44.1	2.9	9.8	16.6	17.9	127.3	65.5	103.7	264.7	30.1	94.8
Industrial and aromatic plants	53.1	72.7	85.5	43.4	31.0	41.2	103.5	121.7	128.0	173.2	213.1	224.2
Tobacco	63.7	78.8	100.4	30.0	26.1	54.0	115.9	140.0	115.2	104.9	271.8	245.8
Cotton	24.9	22.7	74.6	6.9	37.5	41.2	39.4	69.0	112.5	246.2	179.9	215.7
Sugar beet	46.2	56.4	38.9	16.2	21.3	15.6	139.7	197.7	242.3	292.5	230.2	258.4
Sunflower	207.3	567.2	0.0	5.7	5.3	3.5	27.6	27.1	86.9	4.9	0.2	0.3
Vegetables	75.8	55.5	57.2	55.0	49.4	42.2	96.5	69.0	98.0	117.4	78.7	88.8
Potatoes	137.0	123.6	81.8	204.9	160.3	72.1	167.3	173.5	263.2	306.8	165.1	233.7
Industrial tomato	45.1	0.0	81.8	79.9	73.8	92.3	190.6	122.6	239.4	237.8	151.2	87.7
Legumes for fodder	0.0	0.0	0.0	0.0	351.8	32.2	170.9	0.0	179.8	0.0	20.5	41.3
Fodder crops	126.2	236.0	121.5	100.4	69.5	130.2	171.0	172.1	147.5	153.8	133.6	139.5
Wine	104.4	71.4	73.1	201.7	86.5	90.3	7.8	54.0	53.7	52.4	82.6	51.1
Olive oil	0.0	0.0	0.0	4.0	4.5	7.8	40.5	51.1	17.0	78.3	103.6	97.3
Fruit	10.7	8.6	7.8	2.6	9.7	4.1	6.3	6.5	11.7	5.8	2.7	7.0
Nuts	168.2	88.0	127.4	214.1	203.6	135.5	85.6	159.1	139.5	200.3	92.6	242.2
Beef cattle meat	170.6	191.1	168.9	245.1	307.1	366.3	117.9	99.5	102.9	72.7	83.9	100.1
Lamb meat	113.7	172.4	169.6	203.5	87.6	100.1	97.4	122.2	116.3	110.1	149.6	140.6
Goat meat	79.3	96.0	168.2	106.0	64.6	83.2	103.2	102.6	91.5	109.4	162.5	164.5
Pork meat	88.8	101.9	59.2	338.6	205.7	184.2	54.8	52.7	107.5	53.7	10.0	10.2
Poultry meat	71.5	34.3	36.4	52.8	80.2	26.8	106.9	81.3	124.2	116.8	63.5	44.9

Cow milk	151.3	195.5	184.8	343.0	160.8	143.0	105.3	111.1	101.5	77.2	26.6	26.2
Sheep milk	165.9	219.0	178.7	284.8	182.5	201.6	78.6	92.3	100.6	85.7	73.3	65.3
Goat milk	99.4	107.8	131.3	198.0	120.3	121.6	69.8	87.8	76.3	64.1	49.8	47.7
Eggs	110.9	101.7	115.3	45.1	54.0	92.2	88.8	7.6	92.4	89.3	79.7	67.6

PRODUCTS	**PELLA**					
	1982	**1986**	**1991**	**1996**	**2003**	**2006**
Cereals	51.1	56.1	48.0	25.7	44.3	53.0
Durum wheat	40.7	7.0	22.8	30.2	19.8	29.4
Maize	84.3	95.7	68.0	63.0	94.1	103.3
Rice	0.0	8.3	0.6	1.4	0.8	0.2
Edible legumes	109.1	106.7	114.9	1.0	18.1	70.8
Industrial and aromatic plants	121.7	107.3	97.1	92.4	123.1	146.2
Tobacco	138.9	115.0	94.3	101.4	136.8	181.3
Cotton	109.1	112.4	122.8	94.1	122.1	142.6
Sugar beet	58.6	64.0	45.0	46.4	115.2	106.1
Sunflower	201.5	64.8	0.1	0.0	0.0	0.0
Vegetables	92.8	116.8	161.4	109.2	80.7	96.3
Potatoes	131.9	135.1	97.9	9.9	147.7	158.1
Industrial tomato	127.1	122.8	83.0	58.5	67.0	95.5
Legumes for fodder	77.7	283.2	345.8	0.0	102.1	175.3
Fodder crops	69.9	66.4	59.2	26.3	68.6	29.7
Wine	96.3	57.6	5.9	14.1	23.8	26.5
Olive oil	0.0	0.4	0.1	0.0	1.0	0.7
Fruit	237.1	229.0	226.1	260.8	275.5	228.6
Nuts	32.1	19.3	32.8	27.9	27.5	24.0
Beef cattle meat	85.0	95.6	64.1	71.4	42.1	50.9
Lamb meat	104.1	93.7	76.1	86.7	101.2	111.7
Goat meat	70.9	72.5	66.4	60.6	57.2	58.8
Pork meat	110.2	40.5	30.5	30.2	16.2	22.8
Poultry meat	73.3	52.9	63.3	57.7	67.3	37.2
Cow milk	61.4	72.0	56.9	48.0	87.4	99.1
Sheep milk	110.0	82.6	83.1	104.0	92.4	87.6
Goat milk	92.1	64.6	65.5	72.1	95.2	88.7
Eggs	70.7	59.3	24.8	38.6	28.2	23.0