

Comparison between Agrifood and Other Priority Sectors in N. Greece and S. Bulgaria towards Their Environmental and Sustainability Improvement

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Abstract For the comparable valuation of the manufacturing activities between regions and sectors, methods of statistical analysis are used to define significant differences in terms of competitiveness, environmental load, sustainability and eco-productivity. The data was obtained from manufacturing industries (Small and Medium Enterprises) operating in Northern Greece and South Bulgaria. The statistical analysis is based on available energy indices produced with emergy analysis. The results of the statistical analysis show that: (a) no significant differences were found between the manufacturing sectors examined, (b) the competitiveness of the manufacturing sector in S. Bulgaria significantly surpass that of N. Greece, under the current conditions in terms of labor and services compensation, (c) an elasticity of the environmental consciousness exists in S. Bulgaria in contrast to that of N. Greece, (d) the low labor compensation does not lend any significant superiority to S. Bulgaria in terms of the sustainability of its manufacturing industry, (e) from the eco-productivity statistical analysis becomes clear that the three main production factors, the labor, capital and energy, are better exploited in N. Greece than in S. Bulgaria.

Keywords Emergy Indices, Competitiveness, Environmental Load, Sustainability, Eco-productivity

1. Introduction

In European Union, the globalization was accompanied by a reinstallation of many productive and innovative activities in countries of low labor cost [1]. This research work was inspired by the abovementioned fact since a serious movement of several industrial and enterprising activities in the Greek borderlands, such as Central

Macedonia and East Macedonia – Thrace, in Greece as well as the nearby regions of neighboring countries, such as Bulgaria was observed. Usually, this kind of reinstallation of many financial activities is followed by a great impact on regional, national and sectoral indices. For example, the presence of the secondary sector of production in the region of Central Macedonia and especially in Thessaloniki it appears to be very beneficial, since it contributes to about 30% of the GNP (Gross National Product) and 20% of the Gross Added Value of Greece.

The choice of the neighboring regions of Greece and Bulgaria appears to have a special interest for the comparable evaluation of agri-food and other manufacturing activities, due to many similarities and differences, which characterize them. A similarity that characterizes the neighboring regions of Greece and Bulgaria is the homogeneity of the demographic profile; the aging of the population resulting in the reduced workforce as well as the abandonment of the rural areas to the big cities. Also, homogeneity is observed in terms of environmental characteristics. The area is rich in natural resources, including rivers, forests, protected areas, and is considered one of the most ecologically sensitive areas of the Mediterranean. As regards economic data, the sector that appears to play a significant role in these areas and in terms of contributing to GDP is tertiary, while the secondary is also considered to be developed.

However, great differences are found in the economic structure between Greece and Bulgaria. One of the main reason is due to the fact that both countries are in transition for economic, fiscal and institutional reform but for different causes. The distance in time of the two countries in the European Union has resulted in a delay from the Bulgarian side to conform with the directives and regulations adding a further advantage to the Bulgarian companies. The low production costs due to the low wages of the workforce, as well as the favorable tax and

bureaucratic regime, are considered as the most important incentives for the movement of many Greek enterprises from Drama, Serres and Thessaloniki to the area of Blagoevgrad.

The investigated industries are SMEs (Small and Medium Enterprises), which operate in two regions of Northern Greece as well as in two regions of South Bulgaria, during the year 2011. These regions are:

- a Northern Greece: i. The region of Central Macedonia: including the areas of Thessaloniki, Pieria, Kilkis and Serres. ii. The region of Eastern Macedonia-Thrace: including the areas of Drama, Kavala, Xanthi, Rodopi and Evros.
- b South Bulgaria: i. The region of Blagoevgrad. ii The region of Kardjali. These two regions are examined as one, due to the common characteristics they appear.

The above regions are characterized by the fact that they include a complicated network of energy, materials and information and they depend upon the sources and services, which are offered by their biosphere similarly to natural ecosystems. For these reasons the emergy analysis produce a proper way to evaluate the total eco-productivity of each one of the regions examined [2]. The raw data referred to the examined manufacturing industries was collected from several manufacturing industries from Northern Greece and Bulgaria. This data is actually the product of an investigation and detailed audits analysis for the needs of a project entitled "Cross Border Implementation of Innovative Cost Cutting Technologies-CROSSINNO CUT", as a part of which the present work can be considered. The examined manufacturing industries are mainly activated in the following sectors: Food/Drinks, Metals/Wood, Chemical/Plastics, Fabric/Clothing, Electric/Electronics, Building materials & machinery. A percentage of about 90% of the total number of those industries belong to very small industries with a number of personnel below 10 persons. From the above industries, 30 belong to the region of C. Macedonia, 20 to E. Macedonia-Thrace and 16 to the regions of S. Bulgaria.

2. Materials and Methods

Emergy analysis was introduced by H. T. Odum [3] and it is used in this investigation as a modern and holistic method (Figure 1), to investigate the effect of renewable, non-renewable and financial inputs as well as the waste financial output produced on the sustainability of manufacturing industries. Emergy analysis offers the possibility of linking the utility that can occur in an industrial activity, since energy and environmental management are applied, in a way, which can make clear the advantage gained by "environmentally conscious enterprises", such as the food industries because these

industries have interesting similarities with the natural ecosystems [4]. This is due to the fact, that both systems make use of energy and raw materials and they transform them into products and wastes [5].

The quantitative primary data was collected and classified in two ways: a. according to the region and b. according to the sector of activity, under the condition that the number of enterprises in any case is above five. The primary data used in the emergy analysis of the examined and compared industries are related to:

- The renewable inputs (R)
- The non-renewable inputs (N), (electricity (N1), Oil (N2), LPG (N3) and Natural Gas (N4))
- Financial inputs (F), (labor cost (F1), service and maintenance cost (F2), cost of market inputs (F3) and waste treatment cost (F4))
- Polluting gas emissions (W1) and waste production (W2)
- Annual turnover (T)

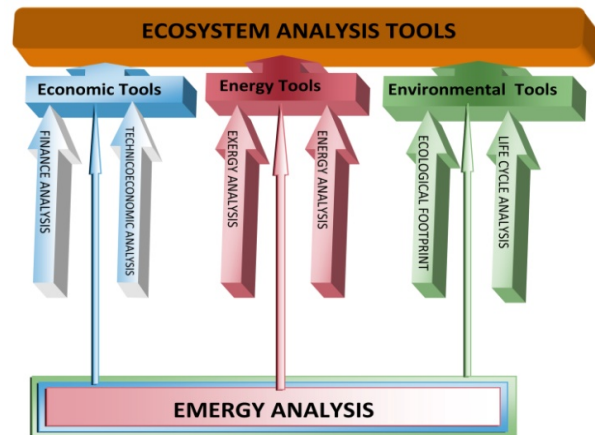


Figure 1. Schematic diagram of the main ecosystems' analysis diagnostic tools [6]

The emergy analysis is based on the calculation of the emergy indices: (a) EYR: Emergy Yield Ratio which expresses the competitiveness, (b) ELR: Environmental Load Ratio which expresses the environmental impact, (c) EIS: Emergy Index of Sustainability which expresses the average degree of sustainability and (d) the Emergy eco-Productivity Index (EPI), which expresses the influence of the monetary, non-monetary and renewable inputs, in the final economic product. The results of the above indices calculations are used as the data in this work. The values of these emergy indices, as given by a research work of Martzopoulou [4], are shown in Tables 1, 2 and 3. The comparable evaluation and the finding of significant differences of the examined sectors between and within the regions were based on the following statistical analyses:

1. Calculation of the regression equation and the coefficient of determination of the emergy indices

versus the annual turnover for the industrial sectors activated in each of the regions examined.

2. Analyses of Variance (ANOVA) to define significant differences between the main five manufacturing sectors examined, in terms of competitiveness, environmental distress, Sustainability and eco-productivity, for probability value $p < 0,05$.
3. Analysis of Variance (ANOVA) to define significant differences between the three regions examined, in terms of competitiveness, environmental distress, sustainability and eco-productivity, value $p < 0,05$.

4. All the above Analyses of Variance are also repeated without the influence of the services (maintenance and marketing expenses) and labor costs.

The afore-mentioned statistical analyses are used to derive conclusions referring to (a) the diversification between the regions as well the industrial sectors of the SMEs examined, and (b) the influence of the geographical regions, according to their local financial policies exercised.

Table 1. Emergy indices of Central Macedonia calculated with and without the cost of labor and services [4].

	SMEs categories	EYR	EYR-LS	ELR	ELR-LS	EIS	EIS-LS	EPI	EPI-LS
1	Food/drinks1	1,193	1,553	1,233	1,691	0,918	0,918	0,784	1,732
2	Food/drinks 2	1,178	2,238	1,206	2,550	0,878	0,977	1,393	5,115
3	Food/drinks3	1,022	1,045	1,027	1,054	0,991	0,996	1,266	2,490
4	Food/drinks4	1,086	1,187	1,101	1,221	0,972	0,987	1,037	2,068
5	Food/drinks5	1,025	1,044	1,031	1,052	0,995	0,992	0,845	1,422
6	Food/drinks 6	1,057	1,074	1,064	1,084	0,993	0,991	0,953	1,225
7	Food/drinks7	1,063	1,118	1,075	1,142	0,988	0,979	1,362	2,434
8	Food/drinks 8	1,150	1,225	1,182	1,275	0,973	0,961	1,214	1,722
9	Fabric/Clothing 1	1,158	1,437	1,148	1,408	1,008	1,020	1,307	2,961
10	Fabric/Clothing 2	1,076	1,171	1,086	1,195	0,991	0,980	1,681	3,483
11	Metals/Wood 1	1,032	1,039	1,039	1,048	0,993	0,992	0,990	1,198
12	Metals/Wood 2	1,223	1,454	1,276	1,574	0,959	0,923	1,115	1,912
13	Metals/Wood 3	1,028	1,075	1,034	1,092	0,994	0,985	1,225	3,113
14	Metals/Wood 4	1,017	1,042	1,024	1,059	0,993	0,984	0,962	2,306
15	Metals/Wood 5	1,106	1,280	1,121	1,322	0,987	0,968	2,148	4,935
16	Metals/Wood 6	0,912	0,841	1,898	3,800	0,481	0,221	0,871	1,721
17	Metals/Wood 7	1,090	1,134	1,109	1,421	0,983	0,943	0,563	1,728
18	Metals/Wood 8	1,024	1,032	1,030	1,040	0,995	0,993	0,979	1,304
19	Metals/Wood 9	1,129	1,176	1,160	1,219	0,974	0,965	0,991	1,297
20	Metals/Wood 10	1,014	1,020	1,031	1,046	0,983	0,976	1,086	1,599
21	Electric/Electronic 1	1,020	1,030	1,023	1,035	0,997	0,995	0,960	1,405
22	Electric/Electronic 2	1,091	1,753	1,110	1,985	0,982	0,883	1,323	6,845
23	Chemical/Plastics 1	1,030	1,042	1,036	1,050	0,994	0,992	0,943	1,316
24	Chemical/Plastics 2	1,473	2,129	1,542	2,345	0,995	0,908	0,780	1,322
25	Chemical/Plastics 3	1,003	1,005	1,003	1,005	1,000	1,000	1,219	1,898
26	Chemical/Plastics 4	1,003	1,003	1,003	1,004	1,000	0,999	1,123	1,253
27	Chemical/Plastics 5	1,004	1,005	1,035	1,041	0,970	0,965	1,159	1,366
28	Chemical/Plastics 6	1,022	1,079	1,010	1,034	1,012	1,043	0,883	3,076
29	Chemical/Plastics 7	1,013	1,017	1,014	1,019	0,998	0,998	1,261	1,662
30	Creative/Printing	1,141	1,468	1,174	1,598	0,972	0,918	0,809	2,083

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Table 2. Emery indices of East Macedonia-Thrace calculated with and without the cost of labor and services [4].

	SMEs categories	EYR	EYR _{LS}	ELR	ELR _{LS}	EIS	EIS _{LS}	EPI	EPI _{LS}
1	Food/drinks 9	1,078	1,098	1,093	1,117	0,986	0,983	1,121	1,382
2	Food/drinks 10	1,009	1,012	1,036	1,047	0,974	0,966	0,914	1,187
3	Food/drinks 11	1,146	1,179	1,145	1,177	1,001	1,001	0,967	1,153
4	Food/drinks 12	1,081	1,118	1,096	1,139	0,981	0,981	0,881	1,233
5	Food/drinks 13	1,474	1,668	1,599	1,864	0,972	0,895	0,563	0,701
6	Food/drinks 14	1,205	1,362	1,253	1,454	0,962	0,936	1,831	2,857
7	Food/drinks 15	1,036	1,053	1,037	1,054	0,999	0,999	1,707	2,451
8	Food/drinks 16	1,045	1,073	1,047	1,077	0,998	0,997	0,748	1,180
9	Metals/Wood 11	1,132	1,438	1,152	1,514	0,983	0,950	1,069	2,874
10	Metals/Wood 12	1,062	1,092	1,076	1,113	0,987	0,981	1,049	1,515
11	Metals/Wood 13	1,001	1,001	1,424	1,514	0,703	0,661	1,265	1,478
12	Metals/Wood 14	1,038	1,068	1,042	1,076	0,996	0,993	1,031	1,809
13	Metals/Wood 15	0,972	0,947	1,104	1,214	0,881	0,780	0,777	1,542
14	Metals/Wood 16	1,528	2,045	1,622	2,279	0,942	0,897	1,784	2,639
15	Electric/Electronic 3	1,035	1,176	1,043	1,220	0,992	0,964	1,252	5,584
16	Electric/Electronic 4	1,088	1,094	1,107	1,114	0,983	0,982	0,800	0,848
17	Chemical/Plastics 8	1,897	2,971	1,923	3,050	0,987	0,974	1,625	2,281
18	Building materials	1,847	2,915	2,021	3,499	0,914	0,833	0,294	0,422
19	Car repair	0,996	0,994	1,027	1,045	0,970	0,951	0,887	1,441
20	Tire retreading	1,464	1,956	1,598	2,306	0,916	0,848	0,455	0,701

Table 3. Emery indices of South Bulgaria calculated with and without the cost of labor and services [4].

	SMEs categories	EYR	EYR _{LS}	ELR	ELR _{LS}	EIS	EIS _{LS}	EPI	EPI _{LS}
1	Food/drinks 17	1,338	1,516	1,424	1,659	0,940	0,913	0,936	1,261
2	Food/drinks 18	1,671	1,769	1,845	1,978	0,906	0,894	0,738	0,799
3	Food/drinks 19	1,163	1,227	1,196	1,277	0,972	0,961	0,966	1,280
4	Fabric/Clothing 3	1,446	1,522	1,567	1,668	0,923	0,912	0,646	0,718
5	Fabric/Clothing 4	1,151	1,163	1,186	1,201	0,971	0,968	0,837	0,897
6	Fabric/Clothing 5	1,175	1,205	1,193	1,226	0,985	0,983	0,883	1,006
7	Fabric/Clothing 6	1,149	1,299	1,169	1,346	0,983	0,965	0,806	1,432
8	Fabric/Clothing 7	1,123	1,247	1,142	1,289	0,983	0,967	0,832	1,501
9	Fabric/Clothing 8	1,207	1,409	1,240	1,486	0,973	0,948	0,774	1,312
10	Fabric/Clothing 9	1,121	1,645	1,144	1,818	0,979	0,905	0,654	2,383
11	Metal/timber 17	1,050	1,108	1,054	1,117	0,996	0,992	0,985	2,008
12	Metal/timber 18	1,122	1,202	1,149	1,249	0,976	0,962	0,860	1,328
13	Metal/timber 19	1,029	1,058	1,342	1,795	0,767	0,589	0,838	1,603
14	Electric/Electronic 5	1,252	1,572	1,307	1,717	0,958	0,916	0,747	1,349
15	Building materials 2	3,280	3,596	4,721	5,446	0,695	0,660	0,364	0,378
16	Mushrooms	1,322	1,531	2,759	5,859	0,479	0,261	0,371	0,528

3. Results and Discussion

3.1. The Influence of the Total Inputs to the Annual Turnover of the SMEs in Each Region

The measurements of the non-renewable and renewable energy, labor, services, market, waste management energy flows were compared with the gross annual income of the SMEs, separately for each region. The

assessments after the regressions show a very close linear relation between the energy flows and the gross annual turnover, for the three regions. The calculated high values of the coefficient of determination conclude this relation. The regression equations and the corresponding coefficients of determination are shown in Figures 2, 3 and 4. The three regressions, found to have almost same slopes, which means that inputs are almost equally exploited in the three regions.

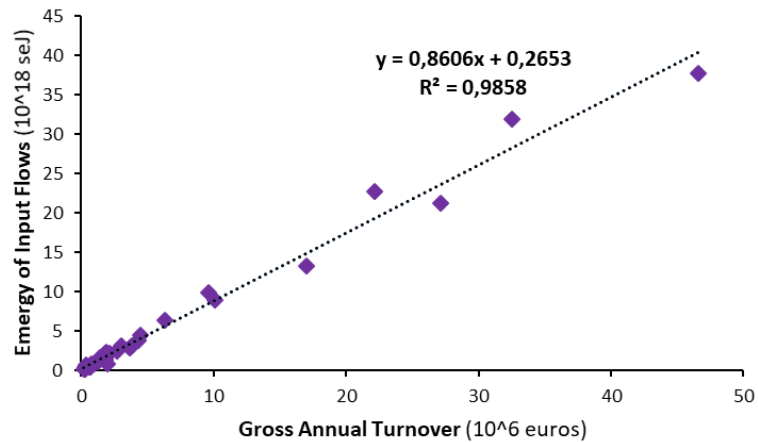


Figure 2. Annual turnover vs. Energy flows in the region of Central Macedonia

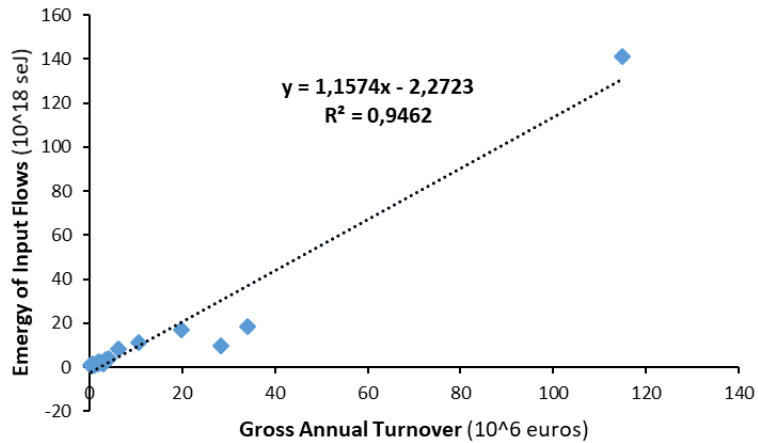


Figure 3. Annual turnover vs. Energy flows in the region of East Macedonia-Thrace

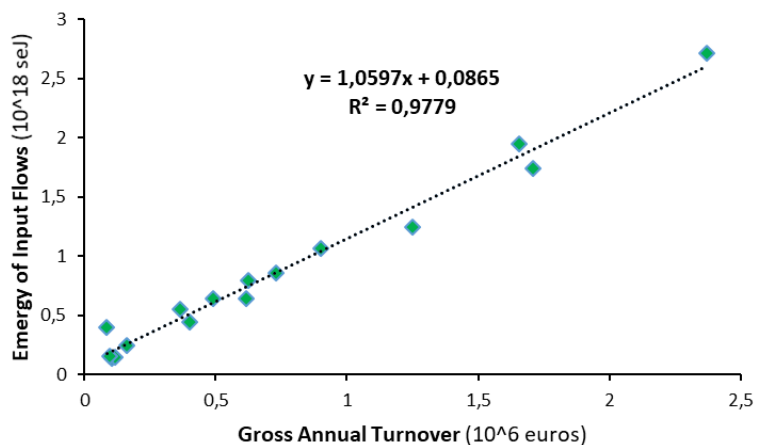


Figure 4. Annual turnover vs. Energy flows in the region of South Bulgaria

3.2. Comparable Evaluation of the Industrial Groups by Sector

The five more important out of the six manufacturing sectors, mentioned in the introduction and operating within the three regions, are evaluated and compared. These five sectors are the Food/Drinks, Metals/Wood, Chemical/Plastics, Fabric/Clothing, Electric/Electronics. For this reason, the ANOVA executed to find significant differences between the sectors shows the absence of any significant difference, either taking into account labor and services costs or not. However, energy indices mean

values of each for the five sectors with and without accounting the afore-mentioned costs are used for a simple comparison of the industrial groups by sector.

(a) Competitiveness: The diagrams in Figure 5 appear a relative superiority of the chemical/plastics sector over the other four sectors, especially when labor and services cost are not accounted, and relative deficient of the metal/wood sector, in terms of competitiveness. In the case of accounting labor costs and services, fabric/clothes sector looks to surpass chemical/plastics but this can be explained by the fact that the latter sector spends more for expertise in staff and services.

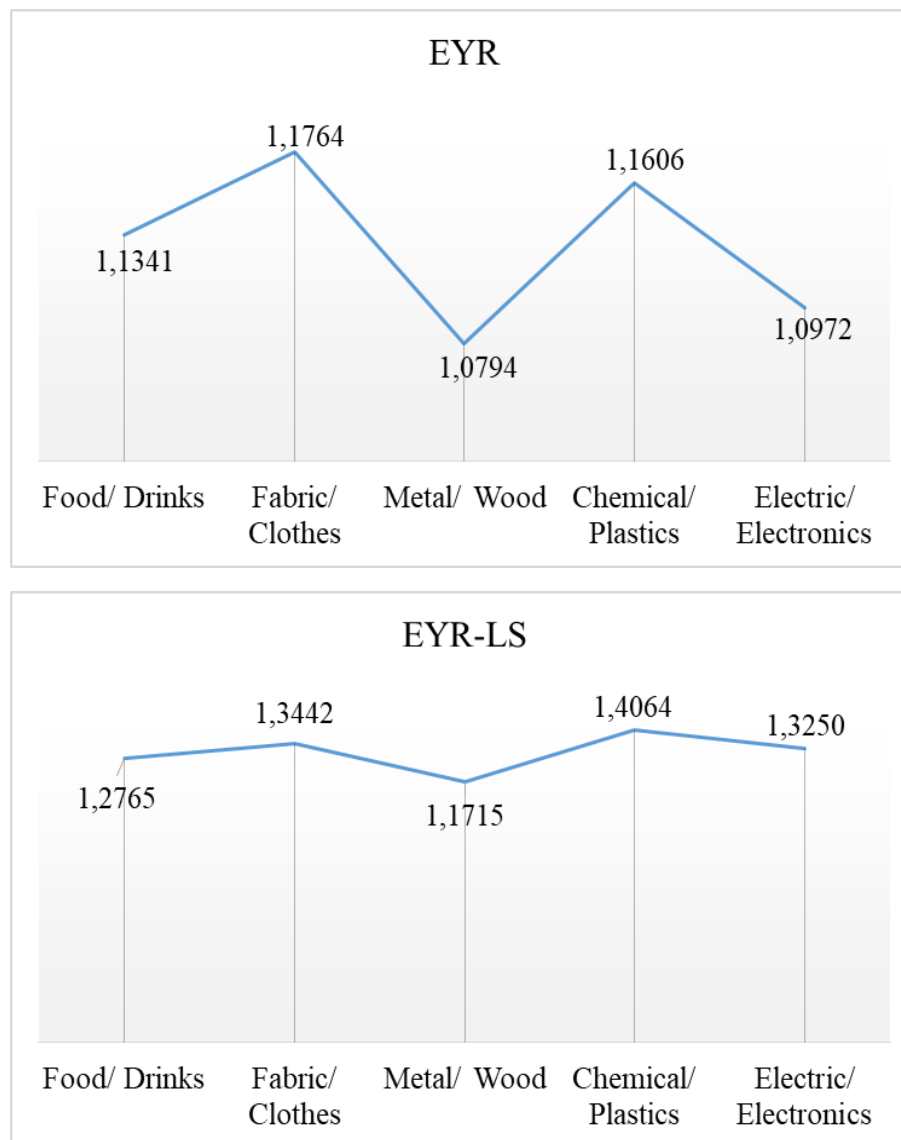


Figure 5. Diagrams of the mean energy index values of competitiveness with (EYR) and without the services and labor costs (EYR-SL)

(b) Environmental impact: The diagrams of environmental load indices (Figure 6) present a settled high environmental pollution impact of the chemical/plastics and metal/wood sectors. In contrast, the sector of Electric/Electronics appears as the most environmentally clean sector.

(c) Sustainability: The Figure 7 of the sustainability index diagrams shows the sector of electric/electronics in a steadily high position and the sector of metal/wood in a relatively low position. The other three sectors appear to

be affected by local conditions of labor and services costs.

(d) Eco-productivity: The comparison of the eco-productivity indices of the sectors examined is illustrated in the diagrams of the Figure 8. According to these diagrams the sectors of metals/wood and electric/electronics are appeared in a steadily middle to high position, in terms of eco-productivity, while the sector of fabric/clothing appears a steadily low position. The other two sectors seem to be affected by local conditions of labor and services costs.

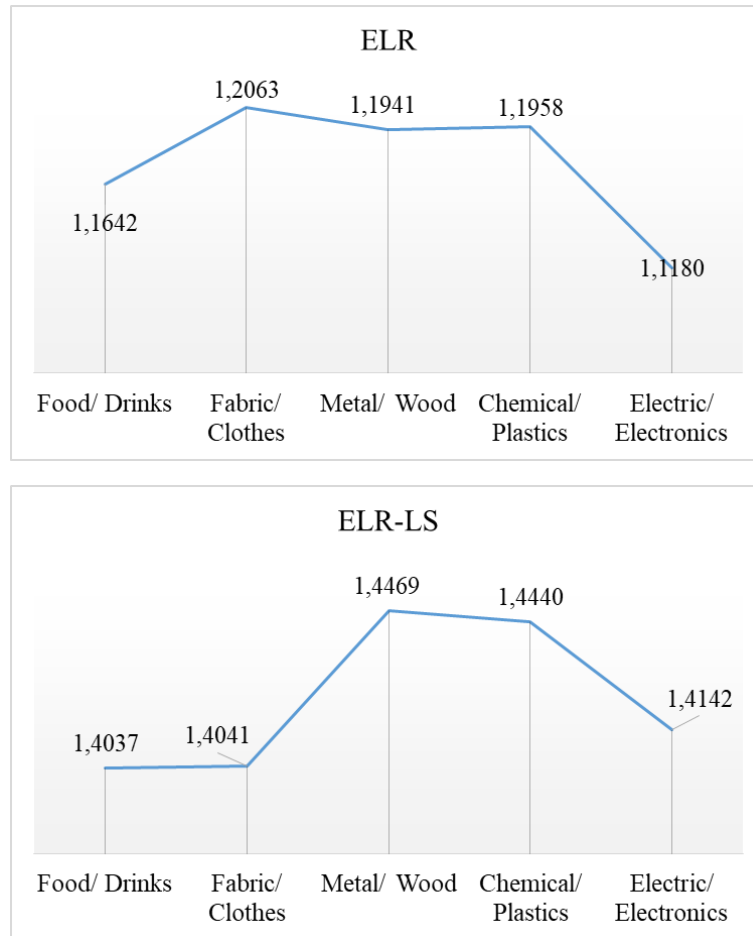
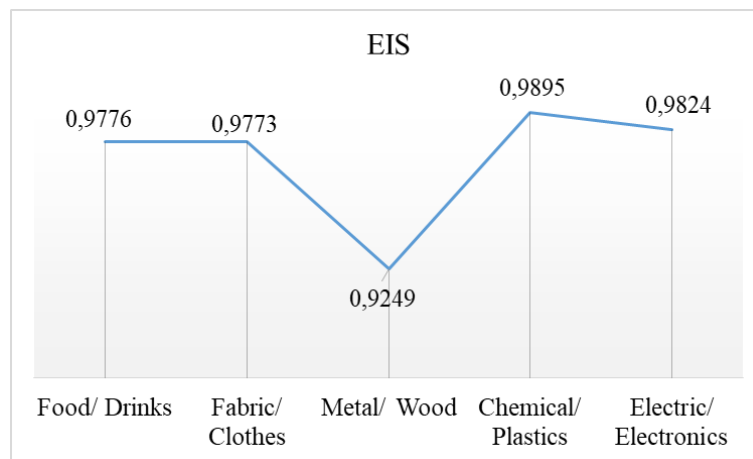


Figure 6. Diagrams of the mean energy index values of environmental load with (ELR) and without the labor and services costs (ELR-LS)



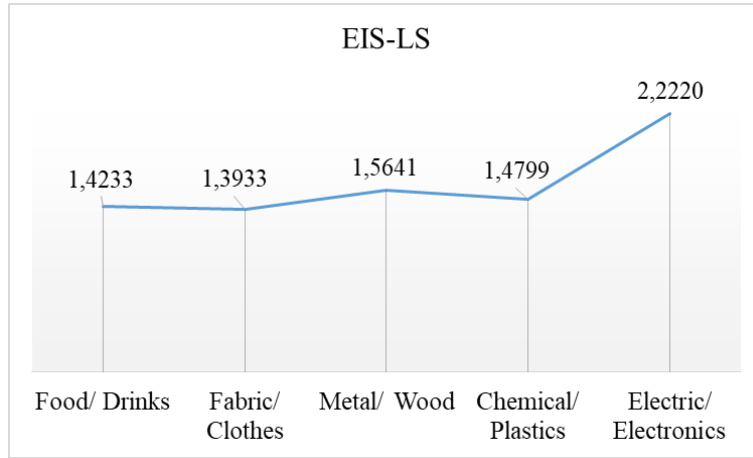


Figure 7. Diagrams of the mean energy index values of sustainability with (EIS) and without the labor and services costs (EIS-LS)

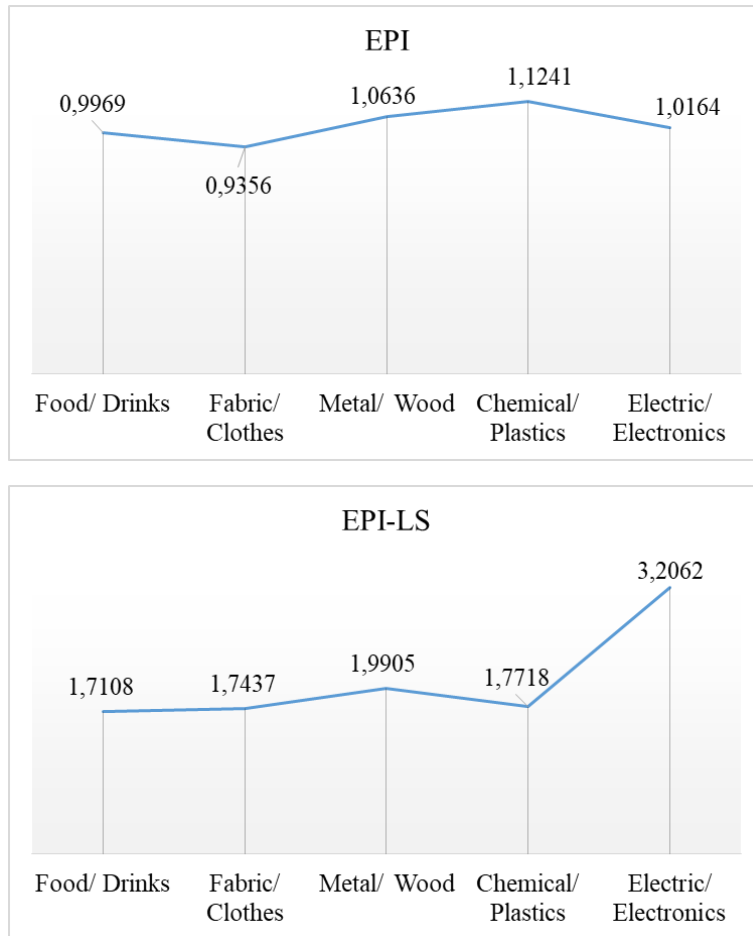


Figure 8. Diagrams of the mean energy index values of eco-productivity with (EPI) and without the labor and services costs (EPI-LS)

3.3. Comparable Evaluation of the Industrial Groups by Region

The following statistical analyses lead to the comparable evaluation of the influence of the region to the competitiveness, the environmental impact, sustainability and the eco- productivity of the manufacturing enterprises (SMEs) installed in each of the three regions, in two ways,

(a) with the entry of labor, services, marketing and maintenance costs and (b) without them. The statistical analysis includes (i) an analysis of variance (ANOVA) to find out significant differences (Table 4), (ii) the means diagram of the variables (EYR, ELR, EIS and EPI) of the SMEs groups in each region and (iii) a post hoc analysis with use of least significant differences for 95% probability value, to specify the significant differences

(Table 5) of each variable between the regions.

(a) Competitiveness (EYR). The ANOVA shows significant differences (Table 4) between the regions with reference to competitiveness. The mean values of EYR and EYR-SL in each region is illustrated in Figure 9. The post hoc analysis shows that the significant differences exist only between the manufacturing industries of Central Macedonia and South Bulgaria.

However, the ANOVA in Table 5 shows no significant difference in competitiveness between the regions, when the cost of labor (L) and services (S) is not accounted. The above statistical analyses show that the South Bulgarian region gains a supremacy over the Greek regions, in terms of competitiveness. Nevertheless, post hoc analysis showed significant difference only between S. Bulgaria (lowest labor-services cost) and Central Macedonia, (highest costs). On the other hand, no significant differences appear when the cost of labor (L) and services (S) is not taken into account.

(b) Environmental impact (ELR). The ANOVA shows significant differences (Table 4) between the regions with reference to environmental impact. The post hoc analysis shows that the significant differences exist between the manufacturing industries of Central Macedonia and South Bulgaria (Table 5), while a marginal existence of statistical difference appears between the S. Bulgaria and East Macedonia-Thrace, with reference to environmental impact, when labor and services are included. Also, in the ANOVA of Table 4 no significant differences appear, in the absence of services and labor costs. The mean values diagram of ELR and ELR-SL, in each region, are illustrated in Figure 10, where it can be seen a lower environmental distress in the N. Greek regions compared with the S. Bulgaria. The above statistical analyses of ELR may conclude that a more elastic environmental consciousness exists in Bulgaria compared to Greece.

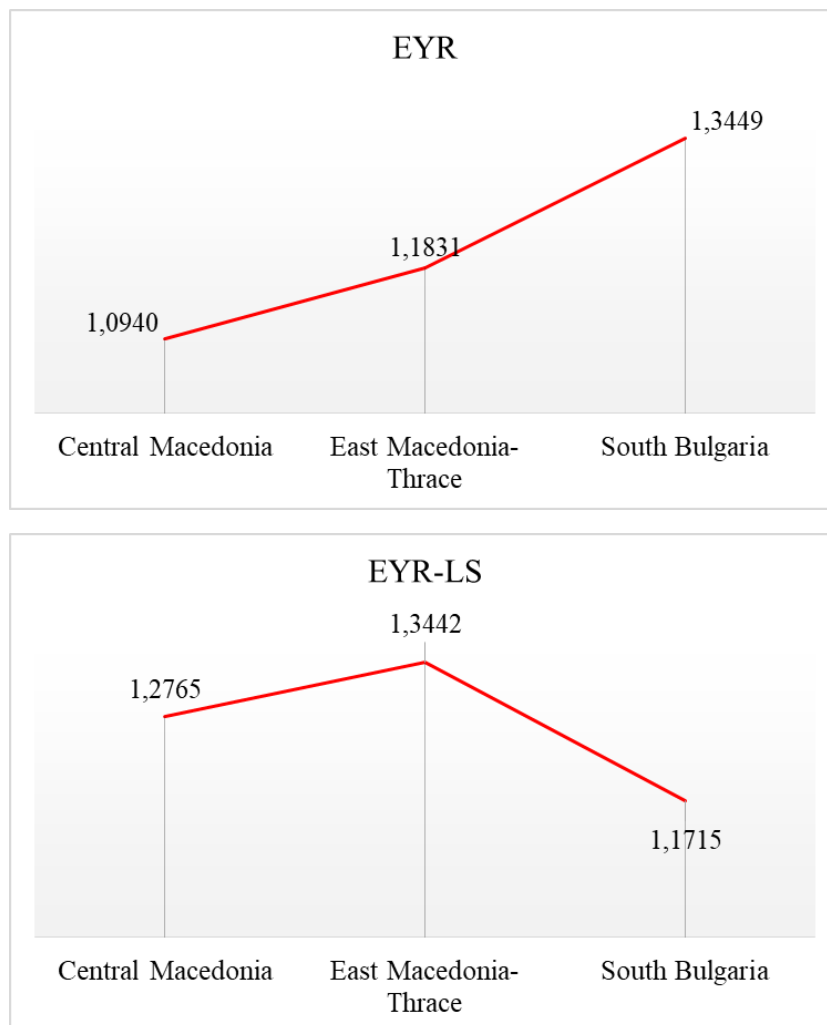


Figure 9. Competitiveness diagrams of SMEs per region with (EYR) and without the services and labor costs (EYR-SL)

Table 4. ANOVA table of the significant differences of the SMEs variables between the three regions.

Depended Variable Between Regions	Sum of Squares(ss)	Degree of freedom (df)	Mean Square	F	Significance P
EYR	0,765	2	0,382	3,937	0,024
ELR	2,259	2	1,129	4,495	0,015
EPI	1,227	2	0,614	5,609	0,006
EPI-LS	11,672	2	5,836	4,611	0,014

Table 5. The post hoc analysis table to point out the significant differences of each variable between the regions.

Depended Variable	(I) Region	(II) Region	Mean differences (I-II)	Std. Error	Sig.	Probability value P<0,05	
						Lower Bound	Upper Bound
EYR LSD	Central Macedonia	South Bulgaria	-0,2705	0,0965	0,007	-0,4633	-0,0777
ELR LSD	South Bulgaria	Central Macedonia	0,4624	0,1552	0,004	0,1523	0,7725
		East Macedonia & Thrace	0,3461	0,1681	0,044	0,0102	0,6821
EPI LSD	South Bulgaria	Central Macedonia	-0,3429	0,1024	0,001	-0,5475	-0,1383
EPI-LS LSD	Central Macedonia	South Bulgaria	1,0299	0,3483	0,004	0,3339	1,7259

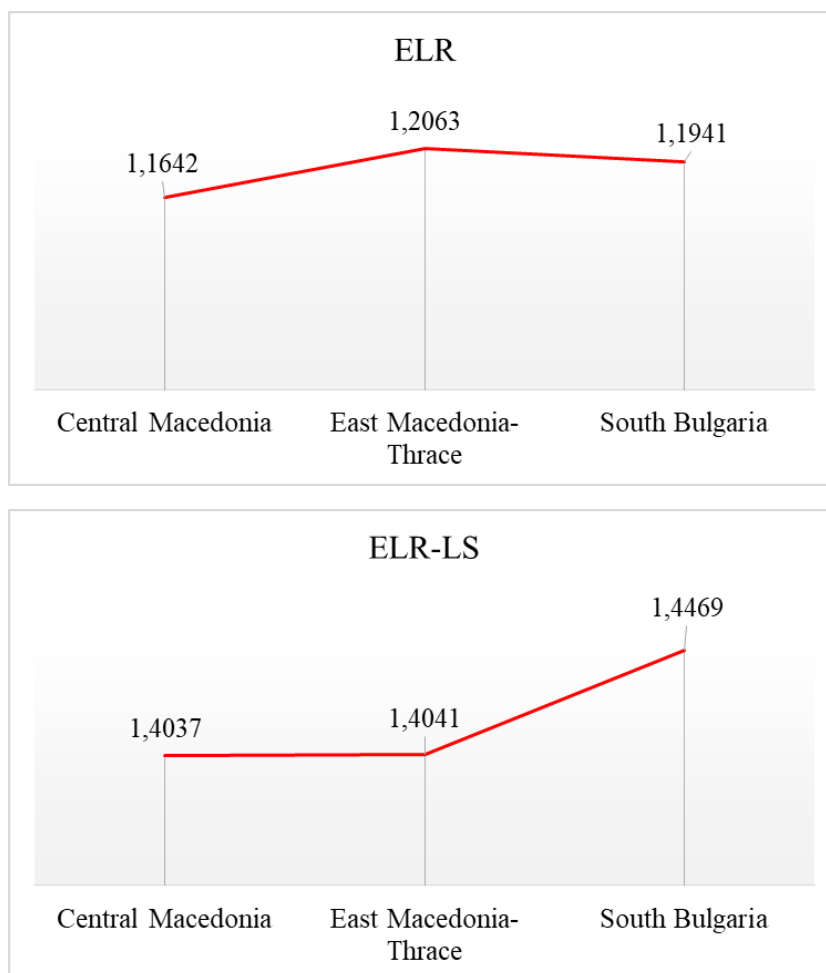


Figure 10. Environmental load diagrams of SMEs per region with (ELR) and without the services and labor costs (ELR-SL)

(c) Sustainability (EIS). The emergy index of sustainability (EIS) is a division product of the emergy index of competitiveness (EYR) by the emergy index of environmental load (ELR). The ANOVA of the sustainability index of the three industrial groups by region examined, showed that no significant differences of the sustainability among the three regions exist, either accounting or not the services and labor costs (Table 4) and they are illustrated in Figure 11.

(d) Eco-productivity (EPI). The ANOVA of the emergy eco-productivity indices of the examined SMEs

shows significant differences between the groups (Table 4), with and without the services and labor costs. The post hoc analysis (Table 5) resulted that significant differences exist between the regions of S. Bulgaria and C. Macedonia with reference to eco-productivity, when labor and services are included. In addition, significant differences were found in index EIS-LS, when services and labor are not accounted, only between the region of S. Bulgaria and C. Macedonia. The above differences are illustrated in the diagrams of Figure 12.

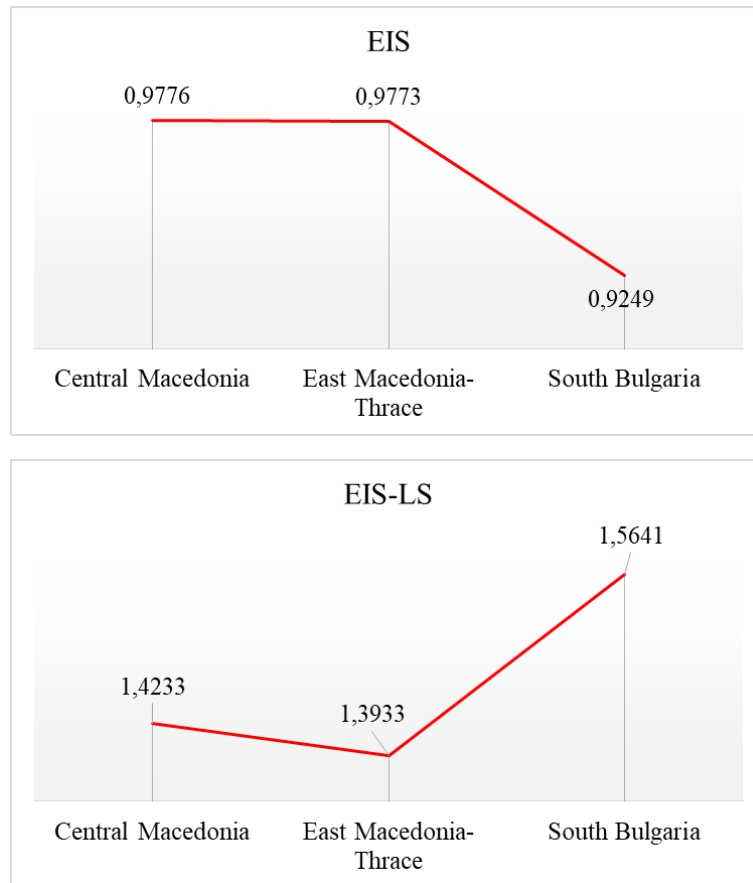
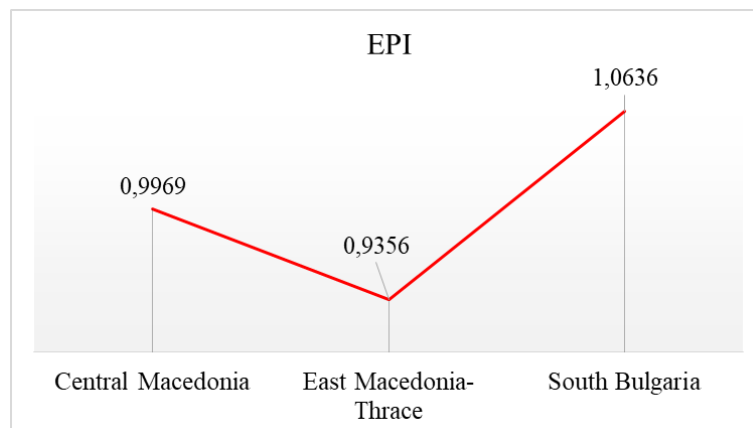


Figure 11. Sustainability diagram of SMEs per region with (EIS) and without the services and labor costs (EIS-SL)



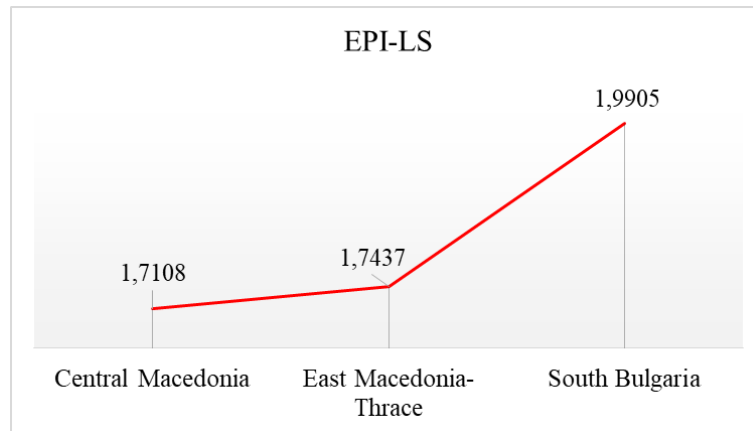


Figure 12. Eco-productivity diagrams of SMEs per region with (EPI) and without the services and labor costs (EPI-SL).

4. Conclusions

The results of this investigation led to the following conclusions:

- a The regression analysis of the emergy index data for all the regions examined showed a similar slope and a very high coefficient of determination. These results draw the conclusion that the data used can be considered of high reliability, since the input flows proportionally affect the annual turnover.
- b The results concerning the comparison between the regions lead to the conclusion that competitiveness of Bulgaria exceeds this one of Greece, mainly due to the low labor and services costs. Nevertheless, some other factors, mainly financial, related with policies exercised by each country for strengthening the industrial production, affects, also, competitiveness. For example, the percentage of the total surcharge, including taxes, fees, etc., of the operational profit in Bulgaria at 2011 was 28,10%, while in Greece was 46,80% [7] and this practice inversely affects the Greek competitiveness. On the other hand, the increasing exploitation of renewable energy sources in Greece is expected to improve the emergy index of competitiveness (EYR). The conclusion derived from this ANOVA is absolutely aligned with the results of another investigation, according to which, a similar index of competitiveness for Bulgaria was 4,16 and for Greece 3,92 at the same year 2011 [8].
- c The results referred to the environmental distress caused by the industrial activities in the examined regions showed a significant negative picture in Bulgaria, compared with the neighboring Greek regions examined. These results were mainly due to the fact that Bulgaria, as a new member of the EU, may not fully adopted the European directives and rules for the environment. In contrast, the low environmental distress in Greece is probably due to the severe and frequent inspections, as well as the increasing use of alternative energy sources, which

contribute to the decrease of emission and environmental pollution.

- d The South Bulgarian manufacturing industries found to have no significant superiority in sustainability over the Greek ones, although the first appears with a lower labor and service cost. In contrast, the Central Macedonian manufacturing industries have the higher emergy index of sustainability, although they have the higher labor and service costs.
- e The eco-productivity statistical analysis makes clear that the three basic factors of production (labor, capital and energy) are better exploited in the two Greek regions, than in the regions of S. Bulgaria. The result of this is the achievement of higher emergy efficiency, which means higher annual turnover per emergy unit of the energy, capital and labor input, in the Greek regions, despite the Bulgarian advantage in the lower labor and services costs.
- f The comparison of the sectors examined did not show any significant difference between them in terms of competitiveness, environmental distress, sustainability and eco-productivity. However, the mean value diagrams showed a dependency of the food/drink, the fabric/cloths and the chemical/plastics sectors on local conditions, in terms of labor and services. The chemical/plastics and metal/woods are the most pollutant sector, while the sector of electric/electronics appeared to be the most environmentally clean sector.

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