

DETERMINATION OF THE NATIONAL REGIONAL ORGANISATION USING ROAD TRANSPORT DATA

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ABSTRACT

The lack of an organised planning infrastructure (National Data Bank, National Land Registry, etc.) is a major problem in elaborating and exercising a coherent regional policy. The first Origin/Destination Survey for Road Transport conducted recently by the Ministry of Public Works (1980/81) permits the systematic search of the regional organisation of the national territory.

The flow of goods through out the national territory being the over - all result of the spatial structure of the production in our country, permits an objective/systematic determination of its regional organisation. The main conclusions—after the determination of the existing, today, regional organisation—is that this structure has been strongly differentiated from the traditional organisation into the national geographic regions. Being strongly stable and imbalanced it necessitates a restructuring based on a coherent and realistic regional policy.

1. INTRODUCTION

This paper is the first publication of an ongoing research project on the relations of transportation and the regional organization of the Hellenic space. It aims at the systematic — objective determination of the existing regional organization in Greece as the necessary basis for the elaboration of a coherent regional policy towards the restructuring of the national territory.

The term «regional organization» is used here as the simultaneous description of :

- the partition of the national space into regions,
- the relations of inter—dependence in the national space.

Production is considered here as the formative basis of the regional organi-

zation ; both the regional partition and the relations of dependence are determined after the analysis of the flows of production on the national territory (Road transport of goods).

2. THE DATA AND METHODOLOGY

The study is based on data coming from the first national Origin/Destination Survey carried out by the Ministry of Public Works—1980/81—see (9). Although our study was carried out on the eparchies level (132x132 matrix) as well as on the departments level (38x38 matrix), our results are presented on the level of the departments. So, the following 38 departments form the set of the study units :

- | | |
|----------------------|----------------|
| 1. AETOLIA/AKARNANIA | 20. LARISA |
| 2. ATTICA | 21. MAGNISIA |
| 3. BEOTIA | 22. TRIKALA |
| 4. EUBOEA | 23. YANINA |
| 5. EURITANIA | 24. DRAMA |
| 6. FTHIOTIS | 25. IMATHIA |
| 7. FOKIS | 26. SALONICA |
| 8. ARGOLIS | 27. KAVALA |
| 9. ARCADIA | 28. KASTORIA |
| 10. AKHAIA | 29. KILKIS |
| 11. ILIA | 30. KOZANI |
| 12. KORINTHIA | 31. PELLA |
| 13. LAKONIA | 32. PIERIA |
| 14. MESSINIA | 33. SERRES |
| 15. ARTA | 34. FLORINA |
| 16. CORFU | 35. KHALKIDIKI |
| 17. LEUKAS | 36. EUROS |
| 18. PREVEZA | 37. XANTHI |
| 19. KARDITSA | 38. RHODOPI |

It was observed that the department is an efficient unit of study since it proved to present a uniform transport behaviour in all cases, with the exception of AETOLIA/AKARNANIA, where a differentiated behaviour between its eparchies was found.

The transportation flows between departments were examined in the form of total volumes of goods as well as in the form of totals of 2—AXL, 3—AXL and Pick - up vehicles. The determined structures were found to be almost identical

for both matrices. The results presented here come from the analysis of flows in numbers of vehicles for reasons of comparison between the flows of goods and the relevant flows of passengers by car and by bus (see par. 4).

Mathematical Taxonomy which forms an almost autonomous branch in Data Analysis, today—see (2), (12)—was employed both for the analysis and the understating of the structure of flows between the departments. For the needs of the determination of the partitions of the national space into regions, Taxonomy was employed in the form of linkage analysis with a view to approaching a total structure of the relations between departments : the chain of partitions between departments—see Fig. 1. This chain is a structure giving in every horizontal level the best partition of the national territory into smaller spatial units (groups of departments).

The flows of goods between departments were cons'idered as the «similarities» (linkages) between departmaents, since they conform with the necessary properties of an index of similarity, S , between objects (départements a , b , here belonging to the set of départements E) :

We call similarity the application S of $E \times E$ in R^+ that associates every pair (a,b) to the real number $S(a, b)$ that satisfies the conditions :

- 1. $S(a,b) : \max \quad a \equiv b$
- 2. $S(a,b) = S(b,a)$

Single, complete and average linkage analysis algorithms—see (3), (4), (5)—have been used as grouping ealgorithms in an exploratory phase.

For the needs of the determination of the dependencies between departments, an hierarchic algorithm, based on the comparison of the main outflow of a department with its total outflows, has been used (see (6)).

3. THE APPLICATION AND THE OUTPUT

The results of the application of different algorithms for the determination of the regional partition were quite close. Mc Quitty's algorithm (Rank order typal analysis) and Kruskal's algorithm for the regrouping of the departments were found the most appropriate, giving the possibility of an easy manipulation of data at the same time.

Rank - order typal analysis is an agglomerative sequential clustering technique, employing complete linkage analysis in which the criterion for complete linka-

ge is not a threshold but consistency within the cluster with respect to the order of relationship (see (12), pages 223, 240).

Kruskal's algorithm is the maximum tree algorithm using ultrametric distances. This algorithm is based on the formation of the minimum tree of distances ; this tree is formed successively from the rank of distances between the pairs of objects (departments) which do not form a cycle in the similarity graph (see (12), pages 249, 255).

After a first transformation of the matrices of flows between the departments, aiming at their symmetrization (so as to conform with the 2nd condition of the similarity index), the regrouping algorithms were applied, giving the chains of partitions of the departments. On these chains the selection of the «best horizontal cut» conforming with the criterion of the maximization of the internal similarity within groups and external distance between groups and also with a criterion of form of the grouping, was defined. This cut gives what we call the «physical partition» of the set of departments into regions, or the physical groupings of the departments: the regions (see (11), page 81).

Figure 1 presents both the chain of the partitions and the level of the partition into regions of the national territory, for the matrix of flows in number of vehicles transporting goods (total of pick-ups, 2—AXL and 3—AXL vehicles), as was produced by the application of the McQuitty's algorithm. Figure 3 presents the boundaries of the regions produced. It was found that all groupings produced by the application of all the algorithms employed in all the matrices of flows (in volume of goods or number of vehicles) respect the spatial contiguity of the departments.

The determination of the relations of dependence was based on the well—known algorithms (see (10), page 35), used to determine nodality : transportational or regional. Conforming to the employed algorithm :

- a department is independent if its greater outflow is directed to a «smaller» department (= a department with a smaller total of directed flows). Conversely : a department is dependent on another department, a «bigger» one, to which its main outflow is directed.
- If a department «a» is dependent on a department «b», which is dependent on a department «c», the department «a» is dependent on department «c».
- No department is dependent on another department if the latter is dependent

Figure 2 presents the relations of dependence between departments all over the national territory. The same algorithm was applied on the level of regions : the relative relations of dependence are presented in Figure 3.

4. THE MAIN CONCLUSIONS

4.1. Concerning the determined regional partition :

4.1.1. It differs considerably from the traditional partition into the geographic regions of the national territory. Contrary to non-objective conclusions and to the conventional practice of regional planning in our country, the determined partition is strongly differentiated from the geographic regions—see Figure 3 : YANINA does not belong to IPIROS, where AETOLIA/AKARNANIA does belong, while KAVALA belongs to THRAKI and PELOPONISSOS and the rest of STEREA form a regional unity.

4.1.2. It differs strongly from all the planning regional partitions of the national territory, legislated in the process of time, and especially it differs from the existing legislated regional partition of the country (Compare Fig. 3 with Fig. 4).

4.1.3. It is stable. It is to be noted that the same partition is determined, using either the flows of volumes of goods or the number of vehicles transporting the goods. The same happens using the McQuitty's or the Kruskal's algorithms.

4.1.4. It is an imbalanced partition : With the exception of 4 small (in area and population) regions, the rest of the national territory is shared between two regions, 1 and 5.

4.1.5. Despite its imbalance it is much more balanced than the partition applied by the Administration in the national space. It was found that although the passengers' transport by private car follows generally the determined partition, the passengers' transport by bus gives a much more imbalanced regionalization of the national territory. (Compare Fig. 5 with 1). It is sad to note that the Bus Transport Organizations (KTEL) are local organizations, protected by legislation as de-centralised services.

4.2. Concerning the determined relations of the partitions :

4.2.1. They conform completely with the determined regional partition—compare Fig. 2 with Fig. 3 :

No arrow of dependence «cuts» the boundaries of the regions, in other words all the determined dependencies are exercised within the region ; this fact proves the stability of the determined regional partition (See conclusion 4 13)

4.2.2. The orientation of the dependence arrows does not conform always with the population relations between departments. Inversions are examined in the

cases of the arrows: 36 38, 38 37, 16 17, 1 15, 9 8, 14 9, where the population of the origin was found to be bigger than the population of the destination. From an exploratory examination of these cases, it was found that this phenomenon is related rather to locational or transportational factors than to the structure of the production in these departments.

- 4.2.3. In regions 4 and 5 the relations of the dependence are direct to their centers while in the other ones there exist many transitive relations (secondary centers). Furthermore, PATRA and ILIA form an independent subsystem in region 1. It is observed that the distribution of the public investments does not conform with the selection of the KEPA ; at the same time it conforms, in most of the cases, with the orientation of the determined arrows of dependence. (Smaller in the origin, bigger in the destination). So, investment policy is found to be controversial both in national and regional level.

5. TOWARDS A COHERENT REGIONAL POLICY.

With a view to restructuring the regional organization within the frame of our analysis, we introduce three indices/criteria of stability of this organization :

- the index of the regional integration of a department¹
- the index of the reversability of the dependence relation²
- the index of the regional value of the dependence relation³

Using these indices we can rank the possibilities of intervention to the regional organization with a view to optimizing it by restructuring it. Thus, though these indices do not refer directly to the restructuring of the production in the national space, they offer the systematic basis necessary for such a restructuring.

Figure 6 presents the departments with lower values for each of the selected criteria⁴. It is evident that any systematic - realistic (minimization of the cost of the restructuring) has to conform with these priorities.

1. The ratio of the volume of the flows of the department into its region to the total of its outflows.
2. The ratio of the total outflows of a dependent department to the same flows of the department on which it depends.
3. The ratio of volume of flows of an arrow of a dependent department to the total of flows of the region it belongs to.
4. The grouping of the departments for every index has been produced as a monothetic classification with the criterion of the physical grouping in every scale.

There follows an indicative list of propositions aiming at :

- balancing the size of the regions (consequently of the influence of their centers)
 - respecting the distribution of population (conclusion 4.2.2.),
 - respecting the forementioned criteria.
1. With the exception of KORINTHIA, the rest of PELOPONISSOS could form an independent region. The eparchy of MESSOLONGHI (see 1) differentiating its behaviour from the rest of AETOLIA/AKARNANIA, could belong to the new - formed region.
 2. FTHIOTIS, could form the center of a new region including EURITANIA and FOKIDA and later on BEOTIA and EUBOEA.
 3. DRAMA could be drawn out from region 5 to join region 6.
 4. It is rather difficult for IMATHIA to be drawn out from region 5 to join region 4.
 5. In region 6 the structure of the dependencies imposed by the geographic characteristics and the transportation network does not conform with the population distribution. It is judged that the restructuring of the relations of dependence necessitates that RHODOPI and EUROS should form a relatively independent sub - system with ALEXANDROUPOLIS as a regional sub - center to KAVALA.

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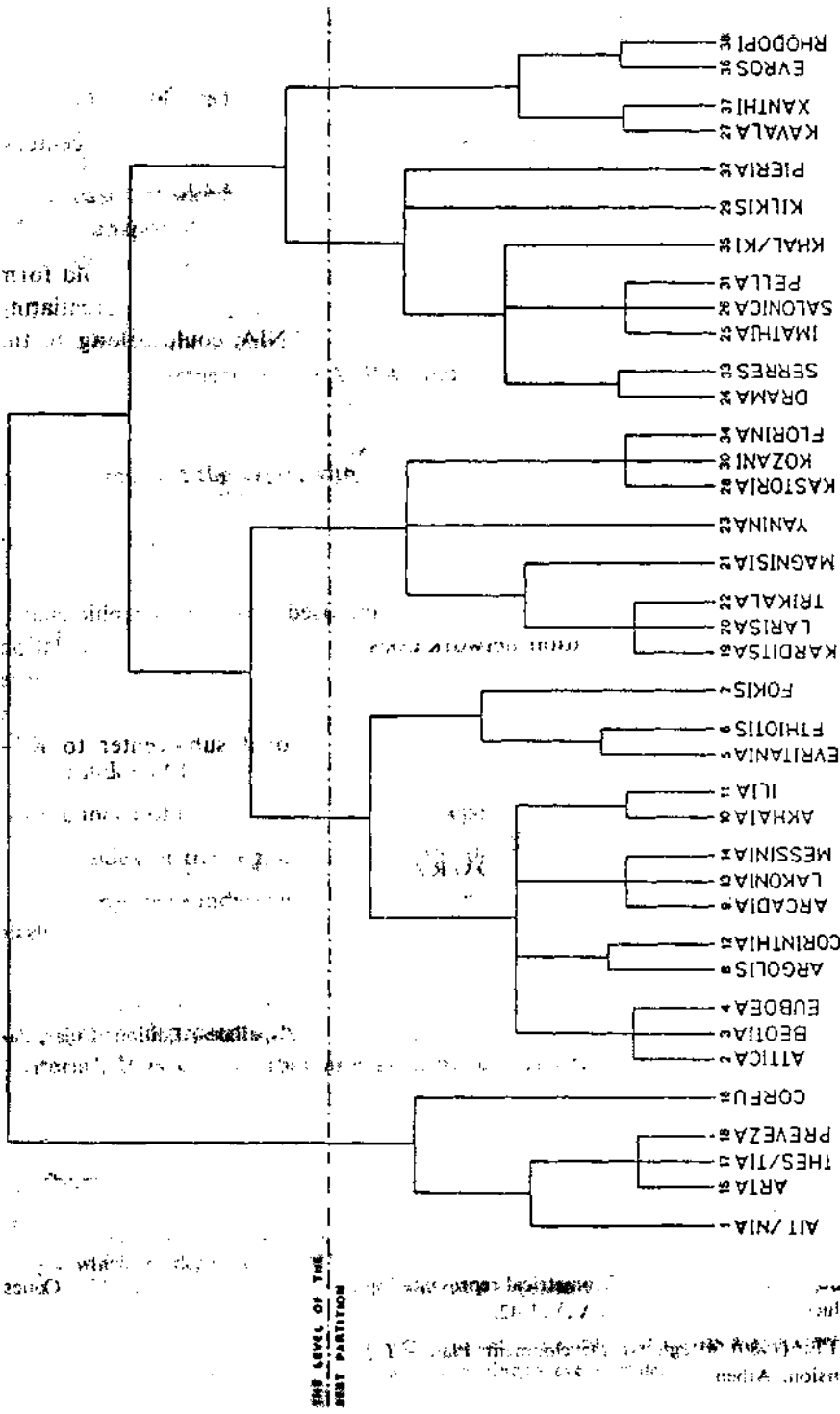


FIGURE 1. The chain of partitions of the departments (defined on the volume of vehicles transporting goods).

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FIGURE 2. The relations of dependence between the departments



- - - - - Region Boundaries
 ————> Relations of dependence between the regions.

FIGURE 3. The determined regionalisation of the the national territory.



FIGURE 4. The regional division of the country (see 7, 8).

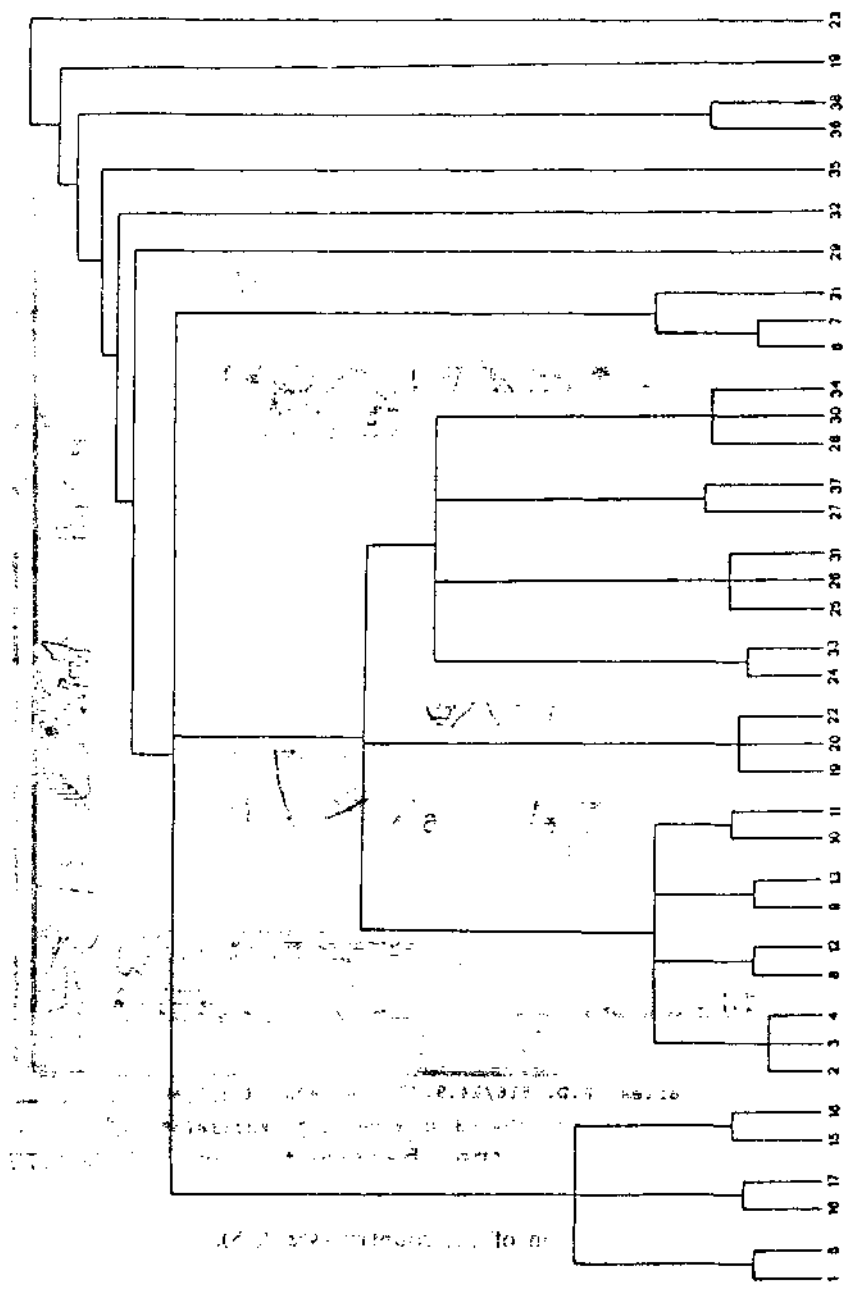


FIGURE 5. The chain of partitions of the departments (defined on passengers transport by bus).



FIGURE 6. The opportunities to intervene.