ANALYSIS AND COMPARISON OF GREEK PARLIAMENTARY ELECTORAL SYSTEMS OF THE PERIOD 1974-1999

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Abstract

An important topic, in electoral studies, is the choice of the electoral system, which will be applied in parliamentary elections, because parliamentary seats distributed to political parties differ when a different system is applied. In this paper we focus on the five latest electoral systems applied in Greek Parliamentary Elections. Each one of them is described and analysed, in detail. Different measures of disproportionality are used in order to evaluate and compare these systems. We provide implementation details and illustrations using the data set of the latest parliamentary elections of 1996 and various data sets generated by introducing noise to the initial data set.

Keywords: Electoral system, measures of disproportionality, sensitivity analysis.

1. Introduction

In all communities, democracy necessarily means representative democracy in which elected officials make decisions on behalf of the people. People express their will and chose their leaders or representatives by voting. The indispensable task of the election of the representatives, in democracies is performed by the electoral system. The electoral system is the set of methods that are used in the elections, for the translation of vote totals into representative seats in the Parliament. Because of the central role elections play in so many modern states, the influence of electoral systems on politics, and vice versa, has long been a justifiable concern of the discipline of political science. Taagepera and Shughart (1989) give a general statement of the role elections and electoral systems play in political life. They describe the electoral systems and their characteristics and present an empirical analysis of the electoral systems. Also, Lijphart (1994) analyse the operation and the political consequences of electoral systems, particularly the degree of proportionality of their translation of votes into seats and their effects on party systems. The emphasis is given to the electoral systems that have been used in the European democracies.

The study of electoral systems and their links to political issues and regime stability leads itself to quantitative analysis. Unlike many areas of social sciences, our data are already provided in a 'hard' quantitative form: numbers of votes and numbers of seats. Systematic quantitative studies of electoral systems have been relatively rare. The studies in the field have been limited to particular countries, promoting particular types of systems.

The aim of this study is to describe and analyse the operation of Greek Parliamentary Electoral systems. In particular **we provide a quantitative study** of Greek systems of the period 1974-1999. We compare these systems, with respect to the proportionality of their translation of votes into seats.

Reviewing the electoral systems literature, Lijphart and Gibberd (1985) noted the absence of one serious attempt to solve the problem of how to measure proportionality or disproportionality. There are many ways to measure inequality, see for example Allison (1978), but because they exceed a certain level of complexity, the results they provide became difficult to interpret. Gallagher (1991), presents and reviews the main Proportional Representation methods and discuses the principles

underlying each of them. He also presents measures of disproportionality, suggests some new indices and applies these measures to competitive elections of the period 1979-1989. Lijphart (1994) has also applied some indices of disproportionality in a study of twenty-seven democracies of the period 1945-1990.

Electoral systems are creatures of politics and can be altered for political reasons. Even when an electoral system is stable, it is affected by a large number of issues such as socio-economic, religious, political and ethnic factors. In Greece the last 25 years five different electoral systems have been applied. Our purpose is to describe and analyse these electoral systems in detail. We present the rules of the allocation of the seats, for all the systems under consideration. We comment the rules, the characteristics and differences between the electoral systems.

The most important point is the comparison and the evaluation of the Greek Electoral Systems [1974, 1977 (1981), 1985, 1989, 1993 (1996)] using some measures of disproportionality. Disproportionality is the deviation of the parties' seat shares from their vote shares. In the category of Proportional Representation systems (PR systems), where the Greek electoral systems we analyse, can be thought of, there are two broad categories of measures of disproportionality. The first concentrates on the absolute difference between parties' seats and votes, and the second focuses on the ratio between the party's seats and votes. For the evaluation of the Greek systems we apply the Rae's, Loosmore-Hanby, Least Square, Adjusted Loosmore-Hanby, Lijpart indices, which belong to he first category, and the Sainte-Langue and d'Hondt indices, which belong to the second category. We also apply the Regression index, which is a satisfactory measure of big-parties' bias. We implement the Greek systems using the data set of the parliamentary elections of 1996. In order to achieve more accurate results we use a large number of data sets generated by introducing noise (error) to the initial data set.

The paper is organised as follows. Electoral systems and their categories are presented in section two. Greek electoral systems are described and their characteristics and properties are presented in section three. In section four the measures of disproportionality are described, and the dataset we use together with the various generated datasets are described in section five. In section six we apply the Greek electoral Systems and the measures of disproportionality in the parliamentary elections of 1996 and also in the generated datasets. We also present the results of the elections for the European Parliament of 1999, in Greece, under the current system. Finally, we conclude in section seven with a brief discuss of the main results of this study.

2. Electoral Systems

The foremost purpose of this study is to analyse and evaluate the Greek electoral systems. The first step that needs to be taken towards this purpose is the description and classification of the electoral systems. We present the main categories of systems that have been used in Parliamentary Elections, in different countries all over the world. Almost all electoral system experts agree that the two most important features of the electoral systems are a) the electoral formula, which is the method that is used for the translation of vote totals into representative seats and b) the district magnitude, which is the total number of seats given to each district (the geographical regions that are used for the distribution of the seats). According to these features the electoral systems can be distinguished into three main categories, and, of course, a large number of subtypes.

2.1 Majoritarian Systems

The rule is the majority of votes, in some cases absolute majority is used in some other relative majority. The district magnitude is usually one or closes to one. The main types of the majoriarian systems are a) *Plurality (First Past The Post or relative majority)*: the rule is the relative majority. b) *Two ballot majority plurality:* the rule is the absolute majority in the first ballot. If this is not achieved, relative majority is applied in a second ballot and c) *Alternative vote:* the rule is the absolute majority of the first preferences. If this is not achieved, the weakest candidate is eliminated.

The most striking characteristic of all these systems is that they usually use single member districts or districts with magnitude close to one. Now, in most countries, which use majoritarian systems, only single-member districts have survived.

2.2 Proportional Representation systems

The purpose of these systems is to give 'proportional' results, which means that they distribute seats to parties according to the total number of votes that they have received. Thus, the way that seats are distributed to parties is based on its total number of votes and also on the number of the available seats. This type of systems can be distinguished in two categories.

- *Largest remainders (Quota systems)*: Each party is awarded as many seats as it has full quotas. The quota is based on the available number of seats (s) and the number of votes each party casts (v). The main quota that are used are:

  a. Hare or Natural quota, which divides the total votes by the available seats in the district, that is, Hare quota = v/s,

  b. Droop quota or Hagenbach-Bischoff, which divides the total votes by the available seats in the district plus one, that is Droop quota = v/(s+1),

  c. Imperiali quota, where total votes are divided by s+2, that is Imperiali quota = v/(s+2).

- *Highest Averages methods*: They are based on the number of votes each party casts (v_i) and the number of seats it has already won (s_i). The main rules are:

  a. Sainte Lague, where each seat is given to the party with the highest value of $v_i/(2s_i+1)$,

  b. d' Hondt, where each seat is given to the party with the highest value of $v_i/(s_i+1)$.I

  In fact, each time a party receives a seat, progressively larger numbers divide its original vote total. Seats are, successively, allocated to the party with the 'highest average' at each step. The variation between the methods lies in the sequence of numbers employed as divisors. Sainte Lague uses the sequence 1, 3, 5, ..., 2n-1, while d' Hondt uses the sequence 1, 2, 3, ...

2.3 Intermediate types

These are systems that do not fit either the majoritarian or the PR categories. In this category belongs the *Limited Vote* (LV) system. The rule is the plurality with the exception that voters vote for fewer candidates than there are seats to be filled in the district. In this category, are included the *Reinforced PR systems*, which also do not fit either the majoritarian or the PR categories perfectly. In some countries we meet a *mixture* of the majoritarian and the PR categories, like the French system of 1951 and 1956.

3. Greek Electoral systems

3.1. Introduction

Greek Electoral systems do not fit either the majoritarian or the PR categories and most of the analysed systems (1974, 1981, 1985) are referred to as Reinforced PR. However, these systems can be regarded as sufficiently similar to PR and for this reason Lijphart (1994) includes them in his comparative analysis of all PR systems. All of them are list systems. In 'list PR' systems voters may or may not be allowed to express a preference to a particular candidate or candidates within the list. In Greece, in some cases, a purest form of list PR, which is the 'closed list', is used. It is pure because voters choose only the party they prefer, making no choice to individual candidates. In that case, each party submits a list of candidates prior to the election. The seats the party wins are distributed in rank of the fixed list. Thus, if there are seven seats to be filled, each party will ordinarily submit a list of 7 candidates. If one party wins three seats, it elects the top three candidates of the list. In case of an 'open list' system, voters select a party and then, if they desire, they express a preference for a particular candidate, or candidates, within the list. Vote totals are translated into parliamentary seats occupied by the deputies. The parliament, in all cases, studied, consists of 300 deputies. The distribution of the 288 seats takes place in three steps: the primary, secondary, and tertiary distribution of seats, with the only exception of the 1989 system. A last step followed for the allocation of 12 additional seats occupied by the State Deputies.

The primary distribution is done in 56 lower districts, the secondary in 9 up to 1985 and 13 after then. The major districts and both the tertiary and the distribution of state deputies, are carried out throughout the state. For more details, see Pantellis and Triantafyllou (1985), Dretakis (1989), Dimitras (1991), and Nikolakopoulos (1989)..

A brief description of each electoral formula is given below. Before the description of the systems some terms must be defined. *Lower districts* ('nomoi', or 'elassones eklogikes periferies'): the geographical regions in which the state is divided, for the primary distribution of the seats. *Major districts* ('meizones eklogikes periferies'): the geographical regions in which the state is divided, for the secondary distribution of the seats. *Higher districts*: the geographical regions in which the state is divided, for the tertiary distribution of the seats. *District magnitude*: it is the number of the available seats in the corresponding district. *Quota*: in Greece the term 'electoral measure' is used. As it has already been mentioned, in the case of the Largest Remainders PR systems, the quota is the ratio in which the distribution of the seats is based. This ratio involves the number of the seats and the number of the votes, and it depends on the method that is used (e.g. Hare, Droop) and on the district where it is applied (e.g. Lower, Major, Higher).

3.2. Description of the Greek Electoral systems:

1974 system (Reinforced PR system)

Primary Distribution of Seats: The state is divided in 56 lower districts which are almost the same as 52 geographical-administrative districts ('nomoi') of the country. In fact only the prefecture of Attica is divided in 5 districts and the prefecture of Thessaloniki in two districts, due to overpopulation, while the other remain the same. The seats are distributed, in each lower district, among all alternatives: independent candidates, single parties and cartels of two or more than two parties. The distribution is done according to the total number of votes. For this purpose, the total number of the valid votes, in each district, is divided by the district magnitude. The integer part of this ratio is known as **Hare** Quota. The Hare quota is applied in each district. The total number of valid votes is divided by the quota, for each alternative. Parties are given as many seats as they have won quotas. In case of an

independent candidate, he takes one seat only if his total number of valid votes is greater or equal to the quota. In districts with magnitude equal to one the **relative majority** rule is applied: the seat is given to the party with the highest total of votes, in this district. Any remaining available seats are distributed in the following step.

Secondary Distribution of Seats: The distribution is carried out in 9 Major Districts. Each one of them consists of four five or even ten lower districts. The parties take part in the allocation of the seats only if they satisfy the following conditions:

- Single parties with a percentage of total votes greater or equal to 17%.
- Cartels of two parties with a percentage of total votes greater or equal to 25%.
- Cartels of more than two parties with a percentage of total votes greater or equal to 30%.
- Independent candidates are not included.

The remaining available seats, after the primary distribution, are aggregated, in each respective major district. The distribution of the remaining seats, in the major districts, is done according to a new quota. It is defined as the ratio of the total votes for the parties taking place in this distribution, in each major district, divided by the respective remaining seats. Then the integer part of this ratio is taken. Thus, the **Hare** quota is used adjusted to the major districts and to the available seats. Parties are given as many seats as they have won quotas.

Tertiary Distribution of Seats The parties which participate in this distribution are those who took part in the secondary distribution. The distribution of the seats is done throughout state. The quota is defined as the ratio of the total votes, in the nation, of the parties participating in this distribution divided by the number of the available seats. Then, the integer part of the ratio is taken. Thus, the **Hare** quota is used, adjusted to the entire state and to the available seats. Parties are given as many seats as the have won quotas. If there are still undisposed seats they are given to the party with the highest percentage of votes in the nation.

Distribution of Seats of State Deputies: In this distribution of the 12 seats, all parties that participated in the secondary and the tertiary distribution are allowed to participate. The quota is defined as the ratio of the total votes, in the nation, of the parties participating in this distribution divided by 12. (**Hare**) Parties are given as many seats as the have won quotas. Any remaining seats are given to the parties with the largest remainders of votes. The remainder is the total number of votes that have not been used for the allocation of the seats when the quota is used.

1977, 1981 systems (Reinforced PR system)

The national elections of 1977 and 1981 were carried out with the exact same system. The distribution of the seats is exactly the same with the 1974 system except for the primary distribution. The Droop quota is used for the allocation of the seat in the lower districts, in the primary distribution, instead of the Hare quota.

1985 system (Reinforced PR system)

Primary Distribution of Seats: Again the state is divided in 56 lower districts which are almost the same as the previous systems. Seats are distributed, in each lower district, among all alternatives: independent candidates, single parties and cartels of two or more parties. The distribution is done according to the total number of votes. For this purpose, the distribution of seats for single parties and cartels of more than two parties is done in the following way: In districts with magnitude equal to one, the **relative majority** rule is applied. In districts with magnitude greater or equal to two, and those are the multi-member districts, seats are given according to the **Droop** quota. In each lower district Droop quota is computed. That is, the total number of the valid votes, in each district, divided by the district magnitude increased by one ('sin ena'). The total number of valid votes, for each party, and for each

district, is divided by the Quota of the district. Each party occupies as many seats, in a district, as many times the quota is contained in the party's total valid votes of this district. Simply, parties are given as many seats as they have won quotas. The distribution of the seats for the independent candidates is done in the following way: An independent candidate takes one seat in a lower district only if its total valid votes in this district is greater or equal to the droop quota. If the previous procedure gives in some districts more seats than available, the seats that are in excess are subtracted. In a district the 'surplus' seat is subtracted from the party with the smallest remainders. The remainders are the seats that have not been used for the allocation of the seats. In case two or more parties have the same remainder, the selection of the party is done randomly. Any remaining seats are distributed in the following step.

Secondary Distribution of Seats: The distribution is carried out in 9 Major Districts. Each one of them comes from the aggregation of four, five or even ten lower districts. Single parties and cartels of more than two parties take part in the allocation of the seats, while independent candidates are excluded.

The distribution of the remaining seats of the primary distribution is done, in each major district, in the following way: The available seats from the primary distribution are aggregated in each major district. A new quota is defined in each major district. It is the ratio of the total votes, for the parties taking place in this distribution, divided by the respective remaining seats in each major district (**Hare**). Each party takes as many seats in a district as the times the quota is contained in the party's total valid votes of this district. Simply, parties are given as many seats as they have won quotas.

Tertiary Distribution of Seats: The parties, which participate in this distribution, are also those who took part in the secondary distribution. Thus independent candidates are excluded. This distribution is done throughout the state. The remaining undisposed seats from the primary and the secondary distribution is computed in each lower district. The remaining seats, in each lower district, are given to the party that has also the plurality of total votes, in this lower district, only if this party has achieved the plurality of total valid votes throughout the state. For the remaining seats, the ratio of the total votes divided by the remaining number of seats, is computed Parties are given as many seats as the have won quotas (**Hare**). Any remaining seats are given to the party with the highest percentage of votes in the nation.

Distribution of Seats of State Deputies: The parties, which participate in this distribution, are those who took part in the secondary distribution, and also the tertiary distribution. Thus, independent candidates are excluded. The quota is defined as the ratio of the total votes in the nation of the parties participating in this distribution divided by 12 (**Hare** quota). Parties are given as many seats as they have won quotas. For the remaining seats the d' Hondt rule, is applied

1989 system (PR system)

Primary Distribution of Seats: It is exactly the same as the primary distribution of the 1985 system.

Secondary Distribution of Seats: The distribution is carried out in 13 Major Districts. Each one of them consists of two, three or even six lower districts. Single parties and cartels of more than two parties are allowed to take part in the allocation of the seats, in this stage, while independent candidates are excluded.

The distribution of the seats is done, in each major district, in the following way: **The remaining valid votes** for single parties and cartels of more than two parties, are aggregated, in each major district. The remaining votes, for each party, are its votes that have not been accounted for the seats allocation in the primary distribution. The sum of the remaining votes is divided by the respective available seats, in each major district. Then the integer part of the ratio is taken. Each party occupies, in a district, as

many seats as the times the ratio is contained in the party's total remaining valid votes of this district. The available seats are given to parties (single parties and cartels of more than two parties) according to their remaining valid votes from the above allocation of seats and the one of the primary distribution. This means that the party with the highest value of the remaining votes takes the first seat. The party with the second highest value takes the second seat, and so on.

If there are single parties or cartels of more than two parties with total percentage of valid votes greater or equal to 2%, they obtain at least 3 seats. In case of parties with a total percentage of valid votes smaller or equal to 2%, but not smaller than 1%, they obtain at least one seat. For that purpose, if there are single parties or cartels of more than two parties that have the right to obtain 3 seats and have not reached this number, the next procedure follows. The distribution of seats to these parties is done according to the total percentages of votes, in major districts, such as: the party with the highest percentage of valid votes, in the district, obtains the first seat, the party with the second highest percentage of valid votes takes the second seat and so on. The procedure continues until they reach the number of three seats. If there are single parties or cartels of more than two parties that have the right to obtain 1 seat and they have not obtain it yet, they take the seat in the major district where they have gained the highest number of valid votes. If, there is a major district in which there are more parties that they have the right to obtain a seat, than seats, the available seats are given to the parties according to highest percentages of valid votes.

If there are still available seats, they are distributed to the rest of the parties (single parties or cartels of more than two parties). The same procedure is followed as the one used for the allocation of the seats in the secondary distribution. Thus, the sum of the remaining votes is divided by the number of the respective available seats, in each major district. The seats that have already been awarded to parties in the primary and the secondary distribution, so far, are not taken into account. Then the integer part of the ratio is taken. Each party occupies, in a district, as many seats as the times the ratio is contained in the party's total remaining valid votes of this district. The remaining seats are given to parties (single parties and cartels of more than two parties) according to their remainding of valid votes.

Distribution of Seats of State Deputies: The parties, which participate in this distribution, are those who took part in the secondary distribution. Thus, independent candidates are excluded. The quota is defined as the ratio of the total votes in the nation of the parties participating in this distribution divided by 12 (**Hare**). Parties are given as many seats as the havey won quotas. For the remaining seats the **d'Hondt** formula is applied

1993, 1996 systems (Reinforced PR system)

In this system only single parties, cartels of parties and independent candidates with total percentage of votes greater or equal to 3% compete. Parties with percentage of valid votes greater or equal to 3% of the total valid votes obtain a minimum number of seats. This number is equal to the integer part of the 70% of the seats that correspond to the percentage of party's valid votes, multiplied by 300.

Primary distribution: It is exactly the same with 1985 system.

Secondary distribution: The **Hare** quota is applied in the major districts. For that purpose, the available seats from the primary distribution are aggregated in each major district. The quota is defined in each major district. It is the ratio of the total votes for the parties taking place in this distribution divided by the respective remaining seats in each major district. Each party takes as many seats in a district as the times the quota is contained in the party's total valid votes of this district. Simply, parties are given as many seats as they have won quotas.

Tertiary distribution: The **Hare** quota is applied throughout the state, while the remaining seats are given to the single party with the highest value of total valid votes in the entire state.

Distribution of State Deputies: The **Hare** quota is applied throughout the state. The remaining seats are given to the parties according to the **d' Hondt** rule.

Table 1: The main rules, for all systems, for each one of the Primary (A), Secondary (B), Tertiary (C) and State Deputies (S. D.) distribution.

	A		B	C	S. D.
	Magn.=1	**Magn≠1**			
1974	Relative Majority (d'Hondt)	Hare Quota	Hare Quota (17%)	Hare Quota Remaining: 1st party	Hare Largest Remainders
1977-1981	Relative Majority (d'Hondt)	Droop Quota	Hare Quota (17%)	Hare Quota Remaining: 1st party	Hare Largest Remainders
1985	Relative Majority (d'Hondt)	Droop Quota Clause for 'surplus' seats	Hare Quota (17%)	Rel. Majority (Lower+State) Remaining: 1st party	Hare Quota d'Hondt.
1989	Relative Majority (d'Hondt)	Droop Quota Clause for 'surplus' seats	Based on Remainder of votes		Hare Quota d'Hondt.
1993	Relative Majority (d'Hondt)	Droop Quota Clause for 'surplus' seats	Hare Quota (3%, 70%)	Hare Quota Remaining: 1st party	Hare d'Hondt.

3.3 Some comments on the systems

We present in Table 1, the rules for all systems, for each one of the Primary (A), Secondary (B), Tertiary (C) and State Deputies (S. D.) distribution. Some comments on these rules follow. The 1974 system uses the Hare quota in the primary distribution while the other use the Droop quota ('plus one'). Given that the Hare is greater than the Droop quota, more seats are allocated in the primary distribution when the Droop is applied. Thus, the Droop favour more the small parties and especially those that do not take place in the secondary distribution. The systems applied in 1974, 1981 and 1985 include thresholds for the participation in the secondary distribution. They are not very important as in most cases only the two largest parties participate in the second distribution. The secondary distribution of the 1989 system is dramatically different from the others. It uses the remainders of votes, and not the total votes. Thus, proportional results are favoured.

Small parties are enforced in the 1989 system because parties with at least 1 per cent of votes take at least one seat and parties with at least 2% of votes take at least three seats. The 1993 system imposes an important threshold for small parties. All parties with total percentage of votes smaller than 3% are not allowed to obtain

seats. On the other hand, the parties with percentage of votes greater or equal to 3% in the entire state, obtain a minimum number of seats which depends on their votes (70% × 300 of votes). Thus, middle parties are favoured. Seats given to small parties are reduced from the second party, which loses a lot of its power.

4. Measures of disproportionality

In order to evaluate the Greek electoral systems, we use measures of disproportionality. **Disproportionality** means the deviation of the parties' seats shares from their votes shares, while perfect proportionality is the situation in which every party receives exactly the same share of seats with the share of the votes it receives. Some systems achieve more proportional results, some other less. We want to find out which system belong to each category. For this purpose we use the measures of disproportionality. When we use these measures we seek for small values of the index, in order to obtain the fairest system.

In the case of PR systems there are two broad categories of measures, corresponding to the two main types of allocation methods. The first category of measures concentrates on the *absolute difference* between a parties' seats and votes as the Largest Remainders methods do. The methods in the second category focus on the *ratio* between a parties' seats and votes, just as the Highest Averages methods do. We also present a satisfactory measure of big-parties bias that completes the measures of disproportionality. We present the measures of disproportionality we use according the category they belong.

Absolute difference based measures

- **Rae's index** [Rae (1967)]: it sums the absolute differences between vote percentages (v_i) and seat percentages (s_i) and the outcome is divided by the number of the political parties (n_i) : $I = \dfrac{1}{ni}\Sigma\left|v_i - s_i\right|$.

- **Loosemore-Hanby's Index** [Loosemore and Hanby (1971)]: it sums the absolute differences between vote percentages (v_i) and seat percentages (s_i) and the outcome is divided by two : $D = \dfrac{1}{2}\Sigma\left|v_i - s_i\right|$.

- **Least Square Index** [Gallager (1991, 1993)]: the least square index entail squaring the vote-seat difference for each party, adding these values, dividing the sum by two and taking its square root: $LSq = \sqrt{\dfrac{1}{2}\Sigma\left(v_i - s_i\right)^2}$

- **Adjusted Loosemore-Hanby** [Grofman and Lijphart (1986)]: it differs from Rae's index in that it divides the total amount of disproportionality by the effective number of parties's N, see, for example Laakso and Taagepera (1979), rather than the real number of parties n. N can be calculated either on bases of vote share's: $N = \dfrac{1}{\Sigma\left(v_i\right)^2}$ or seats share's: $N = \dfrac{1}{\Sigma\left(s_i\right)^2}$. Thus, the index is given by $N\Sigma\left|v_i - s_i\right|$.

- **Lijphart index** [Lijphart (1994)]: He simply uses the largest deviation in an election result as an overall index of disproportionality: $Lijph = \max\left|v_i - s_i\right|$

Ratio based measures

- **Sainte-Lague index,** for more details see Gallagher (1991). It is given by

$$\sum \left[\frac{(v_i - s_i)^2}{v_i} \right]$$

- **D' Hondt index,** for more details see Gallagher (1991), It is given by the seats' percentages to the votes' percentages ratio of the most over-represented party:

D' Hondt= $\max \dfrac{S_i}{v_i}$

Big parties bias measure
- **Regression index:** We apply the index proposed by Cox and Shugart (1991). They regress the parties' seat percentages on vote percentages. The slope of the regression line provides a simple index of big-parties bias.

5. Data generation method

In this study, we compare the latest five Greek electoral systems using the measures of disproportionality. If we want to find a 'good' estimate for a particular measure, we must use a large number of election results. Thus, in order to take accurate results, it would be better to use a large number of data sets. We applied some methods for the generation of voter preferences on different alternatives, found in the literature. These methods are the Impartial culture-Uniform assumption, see, Merill (1984, 1988), the Normal assumption, see, Bordley (1983), and the Spatial model, see, Champerlin and Cohen (1978). After their implementation we concluded that these methods are not suitable for our study. For this reason, we used the data set taken from the latest Greek Parliamentary elections of 1996, and we generated a large number of other dataset by introducing noise (error) in the initial dataset.

It is very well known that the political party which governs, for a period of time, losses some voters. These voters are disperted to other political parties or independent candidates. The second most powerful political party usually increases its total number of votes. The above phenomenon characterises the Greek Electorate. Therefore, it is reasonable to examine the possibility of generating data sets according to the characteristic described above. We generate a large number of data sets with the use of the real data set of total votes, of each political party, in each Lower District, and by using the following procedure.

The total number of votes for the first political party, in each district, is eliminated according to a value, which is taken from a Normal distribution with mean zero, and variance which is related to the real number of votes of this party, in each district. The total number of votes, for the second political party, in each district, is increased according to a value which is taken from a Normal distribution with mean zero and variance which is related to the real number of votes of this party, in each district. For the rest of the political parties we change the total number of votes, in each district, by introducing noise in the initial number of votes. The votes are generated from a Normal distribution with mean value equal to the real number of votes and variance based on the votes, of each political party, in each district. Therefore, the algorithm that we use is the following. Let n be the real number of districts and m the real number of political parties. For each district i, i=1,...,n do
step one:

For the first political party, m=1
- take a value ε_i from the normal distribution $N(0, c_1 Y_{1,i})$

- calculate the absolute value of ε_i
- the number of votes for the first political party, m=1, for the i-th district is given by $Y_{new,1,i} = Y_{1,i} - abs(\varepsilon_i)$, where $Y_{1,i}$ is the real number of votes of the first political party for the i-th district, c_1 is a number which changes the number of votes for the first political party in each district by the percentage we want (2%-5%), and $Y_{new,1,i}$ is the generated number of votes for the first political party for the i-th district.

step two:

For the first political party, m=2
- take a value ε_i from the normal distribution $N(0, c_2 Y_{2,i})$
- calculate the absolute value of ε_i
- the number of votes for the first political party, m=2, for the i-th district is given by $Y_{new,2,i} = Y_{2,i} + abs(\varepsilon_i)$, where $Y_{2,i}$ is the real number of votes of the second political party for the i-th district, c_2 is a number which changes the number of votes for the second political party in each district by the percentage we want (2%-5%), and $Y_{new,2,i}$ is the generated number of votes for the second political party for the i-th district.

Step three:

For the rest of the political parties, m≠1,2
- take a value ε_i from the normal distribution $N(Y_{m,i}, c_3 Y_{m,i})$
- the number of votes for the rest political parties, m≠1,2, for the i-th district is given by $Y_{new,m,i} = \varepsilon_I$, where $Y_{m,i}$ is the real number of votes of the rest political parties for the i-th district, c_3 is a number which changes the number of votes for the rest political parties in each district by the percentage we want, and $Y_{new,m,i}$ is the generated number of votes for the second political party for the i-th district.

6. Application
6.1. Application with real data set

We used the data-set of the Greek Parliamentary elections of the 22nd of September of 1996 taken from the Ministry of Interior. Although 32 parties (single, cartels and independent candidates) competed, we took into account only the six largest of them. The other 26 obtained total percentage of valid votes less than 1% each. We found impractical to study each one of them separately, as such a small percentage does not allow to the small parties to obtain seats in the parliament. So we treated them as 'other' party which is like one party with total votes the sum of the votes of the 26 parties. The 'other' party was not permitted to obtain seats.

Each one of the five latest Greek electoral systems was applied using the 1996 data-set. The number of parties was 6 and each one of them was treated as a single party. The number of the lower districts was 56, while 9 and 13 major districts were used. The results are summarised in the following tables.

Table 2a: Seats that would have been distributed to parties, for each system, and for 13 major districts, for the 1996 election results.

System	Party					
	1st	2nd	3rd	4th	5th	6th
1974	152	137	1	4	4	2
1977 (1981)	156	133	1	4	4	2
1985	164	125	1	4	4	2
1989	136	118	11	12	12	11
1993 (1996)	164	106	0	11	10	9

Table 2b: The measures of disproportionality evaluated for the seats obtained by each party, according to the analysed systems (13 major districts), for the 1996 election results.

	1974	1977	1985	1989	1993
Rae index	0,0519	0,0519	0,0519	0,0154	0,0401
LH	0,1557	0,1557	0,1557	0,0463	0,1203
LSq	0,0986	0,1006	0,1094	0,0325	0,0997
LH-adjusted	0,3115	0,3115	0,3115	0,0926	0,1873
Lijphart	0,0917	0,1050	0,1317	0,0383	0,1317
Sainte-Lague	0,1509	0,1524	0,1608	0,0140	0,0908
D'Hondt	0,2210	1,2531	1,3174	1,2455	0,1317
Regression	1,1841	1,1855	1,1882	1,0580	1,1242

The allocation of the seats to the parties differs a lot when the different systems are applied. We can notice from Table 2a that the first party receives the majority of the parliamentary seats (more than 150) when the different Reinforced PR systems are applied, while the 1989 system does not provide to the first party the majority of the seats. The determination of the majority of the seats is one important topic in the analysis of Electoral systems.

The results of the measures which are presented in Table 2b permit us to present some interesting observations: a) all indices, except d' Hondt give almost the same result. The 1989 system seems to be the most proportional. It gives significant smallest values of these indices when it is compared with the other systems. b) The d' Hondt index shows that the 1993 system is the system which provides the smallest overrepresentation of the most overrepresented party. In other words, the values of the d' Hondt index correspond the most overrepresented party, and the smallest overrepresentation appears in case of 1993. c) After 1989 the most proportional is the 1993 system. The Lijphart index gives the 1993 system as proportional as the 1985 system. d) The other three seems to give more similar results, while 1985 seems less fair when Lsq, Lijphart, Sainte-Lague, d'Hondt, and Regression are examined. e) a regression coefficient greater than 1 shows that all systems favor the big parties. Less biased in favor of big parties is given by the 1989 system, and the next less biased in favour of large parties is the 1993 system. The other three systems do not differ with respect to the regression index. However, as we move from older to newer systems (1974, 1981, 1985) more bias is given in favor of big parties.

Table 3a: Seats that would have been distributed to parties, for each system and for 9 major districts

System	Parties					
	1	2	3	4	5	6
1974	154	135	1	4	4	2
1977 (1981)	153	136	1	4	4	2
1985	161	127	1	4	5	2
1989	136	117	11	13	12	11
1993 (1996)	160	110	0	11	10	9

Table 3b: The measures of disproportionality evaluated for the seats distributed to each party according to the analysed systems (9 major districts), for the 1996 election results.

	1974	1977	1985	1989	1993
Rae index	0,0519	0,0519	0,0508	0,0143	0,0356
LH	0,1557	0,1557	0,1524	0,0429	0,1069
LSq	0,0994	0,0989	0,1041	0,0312	0,0894
LH-adjusted	0,3115	0,3115	0,3048	0,0859	0,2139
Lijphart	0,0983	0,0950	0,1217	0,0383	0,1138
Sainte-Lague	0,1514	0,1511	0,1513	0,0121	0,0813
D'Hondt	0,2371	1,2290	1,2933	1,2455	0,2853
Regression	1,1848	1,1844	1,1838	1,0547	1,1228

We notice that in both cases (9 major districts, 13 major districts), all systems provide an absolute majority of seats (more than 150 seats for the first party), except the case of 1989 system even though the same data set is used (see tables 2a and 3a.) We also notice no significant differences in the results with respect to seat shares as well as the indices, when 9 major districts are applied.

6.2. Application with the generated data set

We applied the proposed data generation method for $c_1=c_2=350$. It is a value that permits different election results, without producing significant differences in the total number of the valid votes, in each lower district, in the generated datasets. This permits us to use the same values for the lower districts magnitude, with the real data set. Furthermore, it is a value that produces datasets that sometimes permit absolute majority of seats, for the first party, and some times not. A smaller variation in vote totals was selected for the small parties, $c_3=100$. The number of parties is 6, of the lower districts is 56, while again 9 and 13 major districts are considered. 10 data-sets have been created and the measures of disproportionality have been computed for each of the generated data sets. We apply this analysis because we want to confirm the previous results taken from only one data set, with the results of the generated data sets. In this way, we find the allocation of the seats according to each system, when other possible data sets have been considered from the elections. We also can see the sensitivity of the analysed systems by noticing the seats allocated to each party and the sensitivity of the measures of disproportionality we use. In order to find the fairest system, we can use the mean values of the measures of disproportionality we analyse. The results (mean values and standard deviations of measures of disproportionality) are illustrated in Table 4.

Table 4: Mean values and standard deviations (in parenthesis) of the indices for each system, when 13 major districts are used.

	1974	1977	1985	1989	1993
Rae index	0,0524 (0,0010)	0,0515 (0,0012)	0,0502 (0,0008)	0,0149 (0,0033)	0,0359 (0,0027)
LH	0,1521 (0,0180)	0,1548 (0,0035)	0,1507 (0,0026)	0,0450 (0,0101)	0,1173 (0,0254)
LSq	0,1008 (0,0017)	0,0983 (0,0024)	0,1023 0,0039	0,0301 0,0057	0,0903 (0,0064)
LH-adjusted	0,3163 (0,0047)	0,3096 0,0071	0,3016 (0,0052)	0,0895 (0,0205)	0,2159 (0,0168)

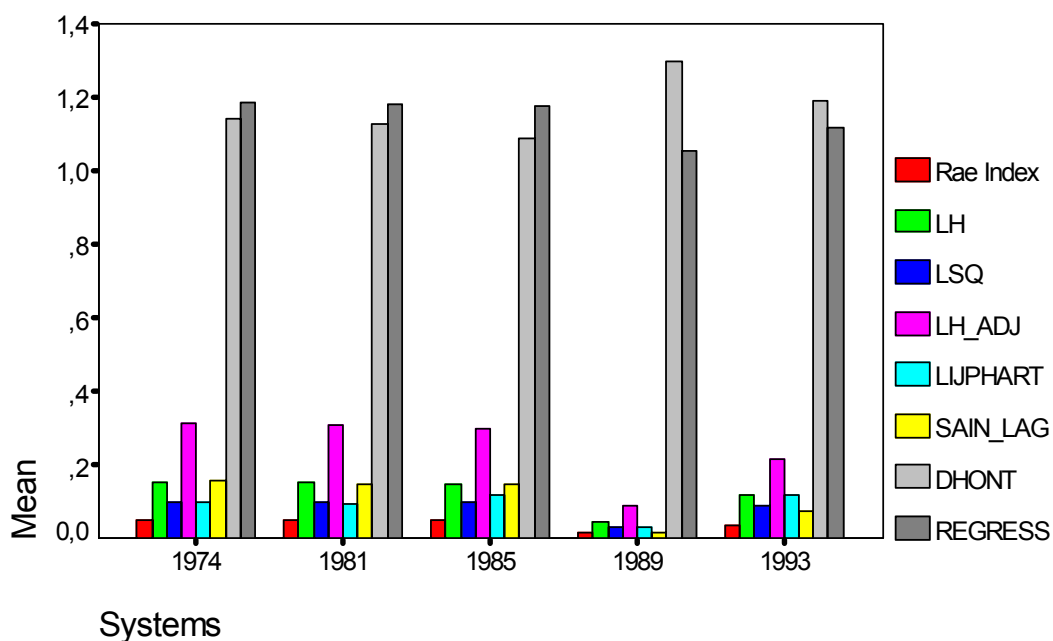|					
Lijphart	0,0992 (0,0056)	0,0929 (0,0065)	0,1182 (0,0085)	0,0308 (0,0068)	0,1192 (0,0084)
Sainte-Lague	0,1564 (0,0048)	0,1495 (0,0075)	0,1482 (0,0075)	0,0154 (0,0058)	0,0780 (0,0112)
D'Hondt	1,1447 (0,3168)	1,1296 (0,3239)	1,0916 (0,4151)	1,3016 (0,1454)	1,1940 (0,3083)
Regression	1,1866 (0,0028)	1,1832 (0,0044)	1,1799 (0,0033)	1,0537 (0,0122)	1,1214 (0,0253)

From the analysis of the above results we can arrive at the following conclusions: a) One way analysis of variance indicated no significant differences between the results for 9 and 13 major districts, when each one of the measures under consideration is used. b) all indices except d' Hondt show that the 1989 system give the most proportional results. c) the d' Hondt index shows that the 1985 is the system which provides the smallest overrepresentation of the most overrepresented party. d) all indices except d' Hondt give almost the same results. The high correlation between the other 7 indices is shown in table 5.

Table 5. The correlation between the 8 measures.

	Rae	LH	LSq	LH-adj	Lijphart	S-L	d'Hondt
Rae	1						
LH	0,9354	1					
LSq	0,9554	0,9196	1				
LH-adj	0,9996	0,9360	0,9552	1			
Lijpart	0,7682	0,7704	0,9177	0,7668	1		
S-L	0,9860	0,9220	0,9135	0,9865	0,7027	1	
d'Hondt	-0,2317	-0,2211	-0,2347	-0,2299	-0,2053	-0,2201	1
regress	0,9741	0,9178	0,9154	0,9743	0,7208	0,9776	-0,2227

e) after 1989 the most fair system is the 1993 system, except for the d'Hondt index which gives second the 1985 system, f) the other three seems to give more similar results, while 1985 seems the fairest when Rae Lh, Lh-adjusted, d' Hondt, and Regression are examined, g) the regression index shows that all systems favor the big parties. Less biased in favor of big parties is the 1989 system. Next is the 1993 system, while, as we move from older to newest (1974, 1981, 1985) less bias is given in favor of larger parties.

The results taken from the indices are illustrated in **Graph 1**

Graph 1. The mean values for each one of the 8 indices, for each one of the 5 systems under consideration.

Application with the data of the 1999 Elections for the European Parliament

In this section, we present the results of the 1993 (1996) electoral system when the dataset of the 1999 elections for the European Parliament is used.

The latest elections for the European Parliament took place on the 13th of June of 1999 in all the counties of the European Community. For this reason Greek voters voted for their 25 representatives in the European Parliament. Each one of these representatives belongs to a Greek political party. We suppose that, the Greek citizens vote for the same political parties (representatives) for the election of their representatives in the Greek Parliament (not for the European Parliament). We want to find out the results of this **hypothetical** election, when the current electoral system (for the Greek Parliamentary Elections) is used.

The number of the votes and the respective percentages for the six large parties is given in the following table

Party	Votes	% votes
Pasok	2090762	32,69
New Democracy	2301866	35,99
Political Spring	146039	2,28
K.K.K	554915	8,67
Synaspismos	330589	5,16
DH.K.KI	439712	6,87

Table 16: The total number of votes and the percentages of votes used in the analysis, taken from the 1999 elections for the European Parliament in Greece. The last column gives the real percentages of votes

Party	Seats	% seats	% seats/% votes
Pasok	93	31	0,94

New Democracy	165	55	1,52
Political Spring	0	0	-
K.K.K	18	6	0,69
Synaspismos	10	3,33	0,63
DH.K.KI	14	4,66	0,66

Table 17: The seats that would have been distributed to parties, using the 1993 (1996) electoral system, for the 1999 election results. It also includes the ratio of the percentage of seats divided by the percentage of votes.

Table 17 confirms all the comments and the results that we have presented for the 1993 (1996) system. We note that the first party is overrepresented a lot while this does not happen for the second party: PASOK which obtained the 32,69\% of the total votes, would have obtained the 31\% of the total seats, if National Parliamentary Elections would have been applied. On the other hand the first party, NEW DEMOCRACY, which obtained the 35,99\% of the total votes, would have obtained the 55\% of the total seats, if National Parliamentary Elections would have been applied. This fact consists the most important disadvantage of this system. Middle parties like K.K.E., SYNASPISMOS and DH.K.KI. are enforced by taking seats from the second party. Finally the party POLITICAL SPRING takes no seats

8. Discussion

In this study, we described and analysed the Greek Electoral systems of the period 1974-1999. We also, provided a systematic quantitative analysis in order to compare and evaluate these electoral systems. The comparison of electoral systems by using quantitative measures is not broadly used in the literature, and has not been applied in Greek Parliamentary Elections before.

The analysis of the Electoral systems led to some important conclusions. The system of 1989, in contrast to the other systems, does not provide to the first party the majority of the parliamentary. This system seems to be the fairest according to the most measures of disproportionality that we analysed. The second fairest system is the one used in 1993, while the other three seem to give similar results.

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