Accidental Politicians: How Randomly Selected Legislators Can Improve Parliament Efficiency

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Abstract. - We study the prototypical model of a Parliament with two Parties or two Political Coalitions and we show how the introduction of a variable percentage of randomly selected independent legislators can increase the global efficiency of a Legislature, in terms of both number of laws passed and average social welfare obtained. We also analytically find an "efficiency golden rule" which allows to fix the optimal number of legislators to be selected at random after that regular elections have established the relative proportion of the two Parties or Coalitions. These results are in line with both the ancient Greek democratic system and the recent discovery that the adoption of random strategies can improve the efficiency of hierarchical organizations.

Introduction. – In ancient Greece, the cradle of democracy, governing bodies were largely selected by lot [1–6]. The aim of this device was to avoid typical degenerations of any representative institution [7]. In modern democracies, however, the standard is choosing representatives by vote through the Party system. Debate over efficiency of Parliament has therefore been centred on voting systems, on their impact on parliamentary performances and, ultimately, on the efficiency of economic system [8–12]. In this paper, rediscovering the old Greek wisdom and recalling a famous diagram about human nature by C.M.Cipolla [13], we show how the injection of a measure of randomness improves the efficiency of a parliamentary institution. In particular, we develop an agent based model [14] of a prototypical Parliament and find an analytical expression, whose predictions are confirmed by the simulations, that determines the exact number of randomly selected legislators, in an otherwise elected parliament, required to optimize its aggregate performance (number of approved acts times average social gain). This result is also in line with the recent discovery [15,16] that, under certain conditions, the adoption of random promotion strategies improves the efficiency of a human hierarchical organization.
The paper is organized as follows. In the first section we describe the Parliament model and its dynamics. In the second section we present the main numerical and analytical results. Then we discuss several historical examples in order to give an empirical support to our findings. Finally, conclusions and remarks are drawn.

The Parliament Model. – Human societies need institutions [17–19], since they set the context for individuals to trade among themselves. They are expected, therefore, to have an impact on the final outcome of those trading relations [20,21]. This paper looks at a specific institution, the Parliament, designed to hold the legislative power and to fix the fundamental rules of society.

The Cipolla Diagram. A Parliament can be modeled as resulting from the aggregate behavior of a number of legislators, who are expected to make proposals and vote. In so doing they are pictured as moved by personal interests, like re-election or other benefits, and by a general interest. Taking both motivations into account, it is possible to represent individual legislators as points $l_i(x,y)$ (with $i = 1, ..., N$) in a diagram (see Fig.1), where we fix arbitrarily the range of both axes in the interval $[-1, 1]$, with personal gain on the x-axis and social gain on the y-axis. Each legislator will be therefore described through his/her attitude to promote personal and general interest. This diagram takes after a very famous one proposed in 1976 by the economic historian Carlo M. Cipolla [13], who represented human population according to its ability to promote personal or social interests, coming up with four different categories of people: *Intelligent* people (points in the top right quadrant, i.e. individuals whose actions produce a gain for both themselves and other people), *Helpless/Naive* people (points in the top left quadrant, i.e. individuals whose actions produce a loss for themselves but a gain for other people), *Bandits* (points in the bottom right quadrant, i.e. individuals whose actions produce a gain for themselves but a loss for other people) and *Stupid* people (points in the bottom left quadrant, i.e. individuals whose actions produce a loss for themselves and also for other people). Of course people do not always act consistently: for example, under certain circumstances a given person acts intelligently and under different circumstances helplessly. Therefore each point in the Cipolla diagram represents the weighted average position of the actions of the correspondent person.

The basic idea of this study is to use the Cipolla classification in order to elaborate a prototypical agent based model [14] of a Parliament with only one Chamber, consisting of $N = 500$ members and $K = 2$ Parties or Coalitions, and to evaluate its efficiency in terms of both approved acts and average social gain ensured. In particular, all the points representing members of a Party will lie inside a circle with a given radius r_i and with a center $P_i(x, y)$ falling in one of the four quadrants. Of course we are not interested here in classifying individuals or Parties (considered as a whole) as intelligent, bandits, helpless or stupid, but only in representing them according to their attitude to promote personal or social interest. The center of each Party is fixed by the average collective behavior of all its members, while the size of the respective circle indicates the extent to which the Party tolerates dissent within it: the larger the radius, the greater the degree of tolerance within the Party. Therefore, we call the circle associated to each Party *circle of tolerance*.

It is clear that, in real Parliaments, the fact of belonging to a Party increases, for a legislator, the likelihood that his/her proposals are approved. But it is also quite likely that the social gain resulting from a set of approved proposals will be on average reduced if all the legislators fall within the influence of some Party (more or less authoritarian). In fact, even proposals with little contribution to social welfare will be approved if Party discipline prevails, while, if legislators were allowed to act according to their judgement, bad proposals would not receive a large approval. Therefore, the main goal of this paper is to explore how the global efficiency of a Parliament may be affected by the introduction of a given number N_{ind} of independent members, i.e. randomly elected legislators free

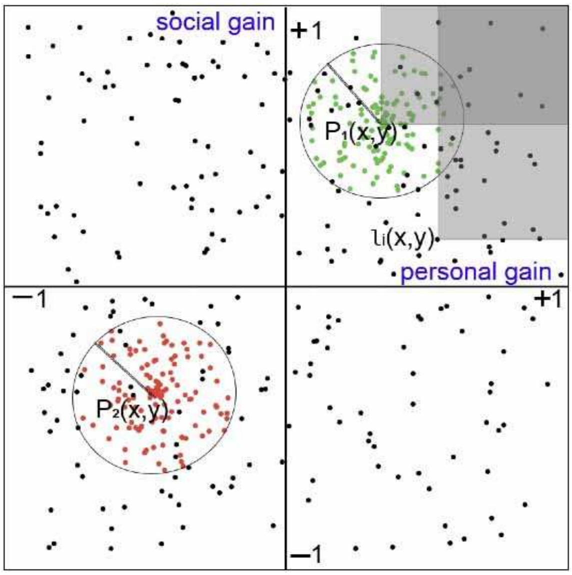

Fig. 1: *Cipolla Diagram.* Each point in this diagram, with coordinates in the intervals $[-1, 1]$, represents a member of a given realization of our Parliament model, according to his/her attitude to promote personal or social interests. The Parliament consists of $N = 500$ members: black points represent $N_{ind} = 250$ independent legislators, while green and red points refer to the remaining members, belonging to the majority (51%) and minority (49%) Parties respectively. The *circles of tolerance* of the two Parties, with equal radius r=0.3, are explicitly drawn (notice that some free points could apparently fall within the circle of tolerance of some Party, but of course the correspondent legislators will remain independent). Finally, the two grey areas indicate the acceptance windows of the independent legislator $l_i(x, y)$ and of the Party P_1.

from the influence of any Party, which will be represented as free points on the Cipolla diagram.

Dynamics of the Model. The dynamics of the model is the following. During a Legislature L each legislator (agent) l_i can perform only two simple actions: (i) proposing an act and (ii) voting (for or against) a proposal.

The first action does not depend on the membership of the agent: each legislator proposes one or more acts of Parliament (a_n, with $n = 1, ..., N_a$, being N_a the total number of acts proposed by all the legislators during the Legislature L), with a given personal and social advantage depending on his/her position on the diagram (i.e. $a_n(x, y) \equiv l_i(x, y)$ for every act proposed). It follows that legislators belonging to a Party can propose acts which are not perfectly in agreement with the Party's common position, as function of their distance from the center $P_i(x, y)$ of the correspondent circle of tolerance.

The action of voting for, or against, a proposal is more complex and strictly depends on the membership of the voter and on his/her *acceptance window*. The acceptance window is a rectangular window on the Cipolla diagram into which a proposed act $a_n(x, y)$ has to fall in order to

be accepted by the voter, whose position fixes the lower left corner of the window (see Fig.1). This follows from the assumption that legislators are able to recognize better and worst proposals than their ones, but only accept proposals better (or equal) than their ones.
The main point is that, while each free legislator has his/her own acceptance window, so that his/her vote is independent from the others vote, all the legislators belonging to a Party always vote by using *the same* acceptance window, whose lower left corner corresponds to the center of the circle of tolerance of their Party. Furthermore, any member of a Party accepts *all* the proposals coming from any another member of the same Party. But, while the perception of the social advantage $y(a_n)$ (i.e. the y-coordinate) of a given act a_n can be likely considered as unambiguously determined for each legislator or Party, the perception of the personal advantage $x(a_n)$ (i.e. the x-coordinate of a_n) cannot. Indeed, the fact that a certain a_n would be favorable for a given legislator, does not imply that it should be favorable for another legislator or for a Party. Therefore, the coordinate $x(a_n)$ of any proposed act has to be different for any legislator or Party and will be expressed by a random number x^*, called *voting point*, uniformly extracted in the interval $[-1, 1]$.
Finally, calling N_{acc} the number of the accepted acts, the efficiency $Eff(L)$ of a Legislature is calculated as:

$$Eff(L) = (\frac{N_{acc}}{N_a} \cdot 100) \cdot \frac{1}{N_{acc}} \sum_{m=1}^{N_{acc}} y(a_m) \qquad (1)$$

i.e. as the product of the percentage of accepted acts times the average social welfare $Y(L)$ ensured by these acts. Therefore it is a real number included in the interval [-100,100]. In order to obtain a global efficiency measure independent of the particular configuration of Parliament, simulation results for Eq.(1) has been further averaged over 100 Legislatures, each one with $N_a = 1000$ proposals and a different distribution of legislators and Parties on the Cipolla diagram.

Simulation Results. – In Fig.2 we plot the global efficiency of the Parliament for three different sizes of the two Parties (panel (a): 51%-49%; panel (b): 60%-40%; panel (c): 80%-20%), as function of an increasing number N_{ind} of independent legislators. In all the three panels the two extreme cases, corresponding to $N_{ind} = 0$ (only Parties) and $N_{ind} = N$ (no Parties), show a very small efficiency (close to zero). On the other hand, a pronounced peak in the global efficiency is always obtained between these extremes, thus identifying an optimal number N^*_{ind} of independent legislators (see vertical dashed lines). This peak, very sharp in panel (a) with $N^*_{ind} = 20$, becomes broader and shifts to the right in panels (b) and (c), with $N^*_{ind} = 140$ and $N^*_{ind} = 280$ respectively. Such an effect suggests that, if the two competing Parties have a similar size, even a small number of independent members present in the Parliament, playing a role of balance, can

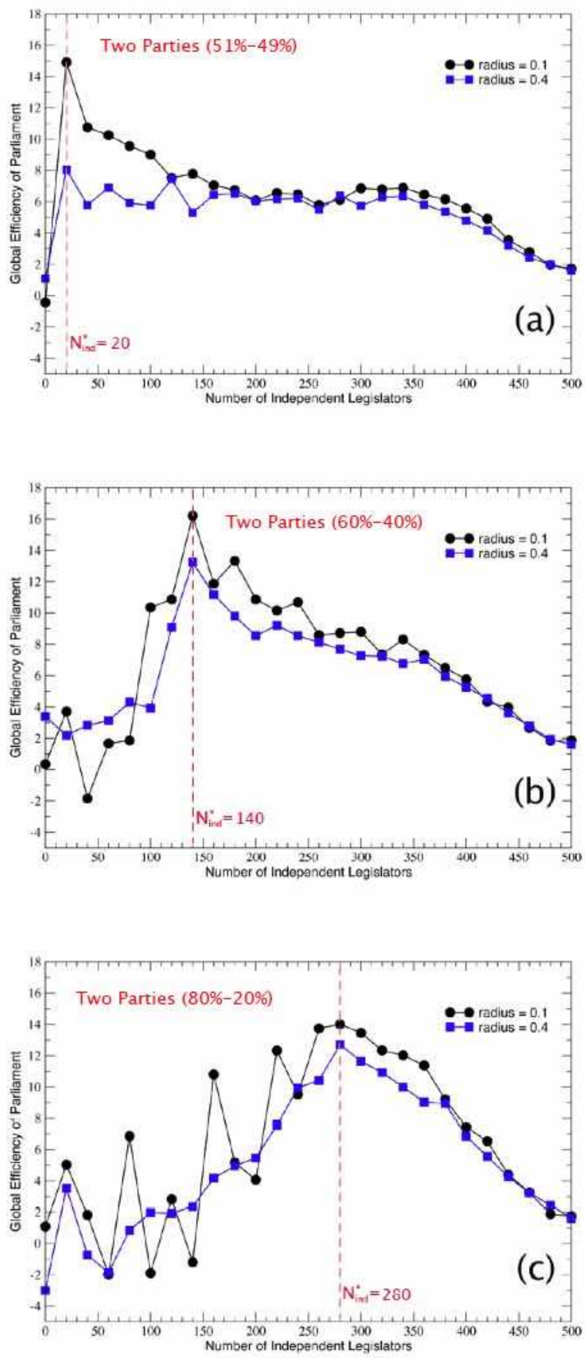

Fig. 2: *Simulation Results*. The global efficiency of a Parliament with $N = 500$ members and two Parties P_1 and P_2, with circles of tolerance of two sizes, $r = 0.1$ (circles) and $r = 0.4$ (squares), is plotted as function of an increasing number of independent legislators N_{ind}. Each point represents an average over 100 Legislatures, each one with 1000 proposals of acts of Parliament coming from randomly selected legislators. The three panels differ in the percentage of the $(N - N_{ind})$ members assigned to the two Parties. In Panel (a): 51%, 49%; Panel (b): 60%, 40%; Panel (c): 80%, 20%. In all the panels, for a specific N^*_{ind} (indicated by a red dashed line), it is visible a peak in efficiency which shifts from left to right going from the top to the bottom panel and whose value decreases increasing the radius of the Parties.

fairly improve the global efficiency. On the contrary, when one Party is quite bigger that the other one, the number of independent legislators required for enhancing the efficiency of the Parliament increases.
Let us discuss in detail, first, the results obtained in the two limiting cases of a Parliament with $N_{ind} = 0$ or $N_{ind} = N$.

Parliament with 2 Parties and $N_{ind} = 0$. The efficiency of a Parliament with N members in absence of independent legislators strictly depends, for a given Legislature L, on the random position of the centers of the two Parties, with coordinates, respectively, $x(P_1)$, $y(P_1)$ and $x(P_2)$, $y(P_2)$ over the Cipolla diagram (see Fig.1), but also on their size (in terms of percentage of members) and on the radius r of their circle of tolerance. Suppose to assign a percentage p of legislators to P_1 and the remaining $(100-p)$ to P_2. Let us to consider a sequence of $N_a = 1000$ acts of Parliament, proposed each time by a randomly chosen legislator. Actually, in the further limiting case of a radius $r = 0$, we have the following two possibilities:
(i) If $y(P_2) < y(P_1)$, only and all the acts of Parliament coming from Party P_1 will be accepted, since members of P_1 will never vote for any proposal coming from P_2, and the percentage of accepted proposal during the Legislature L will be equal to the percentage p of members of Party P_1; it follows that the average social welfare $Y(L)$ of the accepted acts will approximately coincide with the y-coordinate of P_1, i.e. $Y(L) \sim y(P_1)$.
(ii) If $y(P_2) > y(P_1)$, in addition to all the proposals of P_1, will be also accepted those proposals of P_2 which will randomly fall in the acceptance window of P_1. This will depend on the coordinate $x(P_1)$ and will occur with a probability $\frac{1-x(P_1)}{2}$ (such a probability is 1 for $x(P_1) = -1$ and 0 for $x(P_1) = 1$), thus yielding a correspondent increment in both the percentage of accepted proposals and the average social welfare with respect to the previous case. Of course non-null values of the radius r will produce slight modifications in these predictions.
Results of Fig.2 (where averages over 100 Legislatures, each one with a different position of P_1 and P_2 over the Cipolla diagram, have been considered) confirm the previous arguments. In all the three panels we observe, in correspondence of $N_{ind} = 0$, small values of the global efficiency, calculated by the expression of Eq.(1). These values derive from the product of the number of accepted proposals, which oscillates between the percentage p of members in the majority Party and 100%, and an almost null value of the average social welfare, due to the fact that, when one averages over the entire set of 100 Legislatures, the values of $y(P_1)$ result uniformly distributed along the y-axis. Therefore, *a Parliament with two Parties and without independent legislators free from the influence of Parties results to be not very efficient.*

Parliament with no Parties and $N_{ind} = N$. Let us consider, now, the opposite situation in which only independent legislators are present in the Parliament. In this case no Parties exist and the points $l_i(x, y)$, corresponding to the $N = 500$ members of Parliament, are uniformly distributed over the Cipolla diagram (see Fig.1). It is evident that now a given act of Parliament $a_n(x, y)$ will be accepted only if the majority $\frac{N}{2}+1$ of these points will fulfill the prescriptions $y(l_j) < y(a_n)$ and $x(l_j) < x^*(a_n)$, being $x^*(a_n)$ the x-coordinate of the voting point $a_n(x^*, y)$, randomly extracted with uniform distribution over the straight line of equation $y = y(a_n)$ for each legislator l_j which is requested to vote for a_n.
Being $l_i(x, y)$ uniformly distributed on the plane, for a given value of $y(a_n)$ only about 50% of the $\tilde{N}(a_n)$ legislators with $y(l_j) < y(a_n)$ will accept the proposal. But such a number will be clearly lower than $\frac{N}{2}$ unless $y(a_n) \sim 1$: in fact, only in this latter case the half-plane $y < y(a_n)$ will coincide with the entire Cipolla diagram and $\frac{\tilde{N}(a_n)}{2} \sim \frac{N}{2}$. Thus it follows that, during a Legislature L, only a very small number of proposals will be accepted, but with a very high social gain $y(a_n) \sim 1$. In conclusion, the product of these two quantities, further averaged over 100 Legislatures, each one with a different random distribution of legislators over the Cipolla diagram, will stay again near to zero, giving the small global efficiency observed for $N_{ind} = 500$ in all the three panels of Fig.2. This means that *it seems not to be advantageous to eliminate completely Parties from a Parliament.*

The Efficiency Golden Rule. At variance with the relatively simple behavior of the system in the two limiting

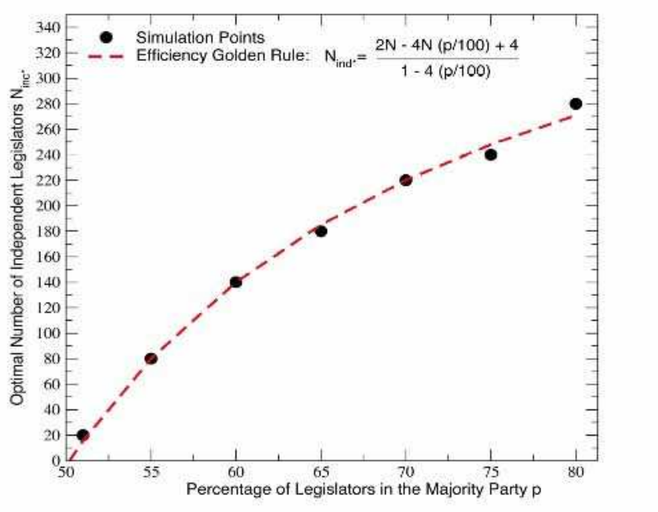

Fig. 3: *Efficiency Golden Rule.* The optimal number of independent legislators N^*_{ind} is plotted (full circles) as function of the size p (in percentage) of the majority Party P_1, for our Parliament with $N = 500$ members and two Parties. An average over 100 Legislatures, each one with 1000 proposals of acts of Parliament, has been performed for each point. This plot is invariant for values of the radius of the Parties in the range $[0.1, 0.5]$. The dashed line represents the prediction of the efficiency golden rule (see text).

cases $N_{ind} = 0$ and $N_{ind} = N$, the general case with $0 < N_{ind} < N$ is much more complex to manage and it is absolutely not trivial to predict the efficiency value of the peaks shown in the three panels of Fig.2, which stays approximately constant although it depends on all the features that affect the voting process. However, quite surprisingly, a simple argument can be advanced in order to find the optimal number N^*_{ind} of independent legislators as function of the size p (in percentage) of the majority Party.

Actually, we can intuitively suppose that, in a given Legislature and in presence of two Parties with different sizes, none of which would have the absolute majority of the members in the Parliament (due to the presence of independent members), N^*_{ind} would be in some way correlated with the minimum number of independent legislators which, added to the majority Party P_1, allows to reach the threshold of $\frac{N}{2}+1$ members necessary to accept a given proposal a_n. But we know from the previous subsection that, being the independent legislators $l_j(x,y)$ uniformly distributed over the Cipolla diagram, for a given value of $y(a_n)$ only about 50% of all the independent members with $y(l_j) < y(a_n)$ will vote for the proposal, equivalent to the $\tilde{N}(a_n)$ points lying in the left half of the half-plane below the line of equation $y = y(a_n)$. Such a rule continues to apply also in the presence of Parties. In this case, being a generic $y(a_n)$ randomly distributed over the y-axis during many Legislatures, we can safely assume that, in average, the line $y = y(a_n)$ will coincide with the x-axis, therefore, for a given N_{ind}, only $\frac{N_{ind}}{4}$ independent members (i.e. those lying in the left half of the half-plane $y < 0$) will vote the proposal. Thus, in order to find N^*_{ind}, it is enough to add this number to the number of members of the majority Party P_1, i.e. $(N - N^*_{ind}) \cdot \frac{p}{100}$, and to impose the following equality:

$$(N - N^*_{ind}) \cdot \frac{p}{100} + \frac{N^*_{ind}}{4} = \frac{N}{2} + 1 \quad (2)$$

Finally, solving this equation with respect to N^*_{ind}, one easily obtains:

$$N^*_{ind} = \frac{2N - 4N \cdot (p/100) + 4}{1 - 4 \cdot (p/100)}. \quad (3)$$

This prediction closely matches the numerical results of simulations performed for several values of p, as shown in Fig.3. We checked that it is verified for several sizes N of the Parliament and that is independent of the number of Legislatures and of the number of proposals for each Legislature. Being also independent of the radius of the circles of tolerance of the Parties, we argue that Eq.(3) could be considered an universal *golden rule* for optimizing the efficiency of any social situation with two competing groups of elected people through the introduction of randomly selected independent voters. Thinking of a practical application for a real Parliament, the knowledge of the golden rule would allow to fix the optimal number of accidental politicians to be chosen at random, by picking them up from a given list of candidates (i.e. ordinary citizens fitting the requirements), after that regular elections have established the relative proportion of the two Parties or Coalitions.

Discussion and Historical Review. – Probably, for a modern political observer, our findings could sound very strange. In fact, today, most people think that democracy means elections, i.e. believe that only electoral mechanism could ensure representativeness in democracy. However, as already anticipated in the introduction, in the first significant democratic experience, namely the Athenian democracy, elections worked side by side with random selection (*sortition*) and direct participation. Actually, in that period Parties did not exist at all and random selection was the basic criterion when the task was impossible to be executed collectively in the Assembly, where usually Athenian citizens directly made the most important decisions. Of course only the names of those who wished to be considered were inserted into the lottery machines, the *kleroteria* [1–6].

Sortition was not used in Athens only. Probably, already others Greek city-states adopted the Athenian method, even if historical documentation is dubious. For sure, many others cities in the history used some kind of lot as rule, such as Bologna, Parma, Vicenza, San Marino, Barcelona and some parts of Switzerland. Lot was also used in Florence in the 13th and 14th century and in Venice from 1268 until the fall of the Venetian Republic in 1797, providing opportunities to minorities and resistance to corruption [22].

In the course of history, little by little, the concept of representativeness overlapped with that of democracy, until it became its synonymous. Consequently, today, in contemporary institutions, almost any random ingredient has been expunged. Among the few historical vestiges of sortition, there are the formation of juries in some judicial process and the selection by lot in some public policy [23]. Actually, even if nowadays the information and communication technology would revitalize the possibility of direct democracy, (the so-called *E-democracy*), this idea meets opposition as much as random selection, since the representative system, and his correlated Party system, is strongly believed to be the only way to make society a democratic place.

On the other hand, the drawbacks of Party system have been well documented. For example, the iron law of oligarchy of the sociologist Robert Michels [7], states that all forms of organization, democratic or not, inevitably develop into oligarchies. The indispensability of leadership, the tendency of all groups to defend their interests and the passivity of represented people, are only a few of the many reasons that deteriorate every democratic Party system. In the representative democracy this process is even institutionalized. Party elites act to serve the Party and themselves, often at the expenses of the public in-

terest. If some members of Parliament vote against the Party line on any issue, these are likely to be ostracized, expelled, or not endorsed at the next elections.
Of course free elections are an indubitable progress in comparison with authoritarian regimes, but today the electoral system tends to form a democratic aristocracy, where representatives are superior to the electorate. In particular, the representativeness is organized by ideas, or classes, which flow together into the Parties' programs. Unfortunately, this kind of organizations (in turn, institutions) very slowly accept social changes because of several incomes that they ensure [9]. Therefore, in the last decades, the idea of choosing representatives by random selection has been re-introduced in political reflections and gained a fair number of supporters. Demarchy, or statistical democracy, is the name proposed by someone [24–32]. According to these supporters there would be several advantages in the sortition method. For example, social and demographic features (income, race, religion, sex,) would get a fair distribution in the parliament, so the interest of the people would get a more effective representativeness and politically active groups in society, who tend to be those who join political Parties, would not be over-represented. On the other hand, representatives appointed by sortition do not owe anything to anyone for their position, so they would be loyal only to their conscience, not to political Party, also because they are not concerned in their reelection. Furthermore, sortition may be less corruptible than elections. It is easy to ensure a totally fair procedure by lot. On the contrary the process of elections by vote can be subject to manipulation by money and other powerful means.
In this context our results, on one hand, confirm the poor efficiency of a Parliament based only on Parties or Coalitions (see the case $N_{ind} = 0$) but, on the other hand, corroborate the constructive role of independent, randomly selected, legislators. In any case, it is worthwhile to stress that, in our proposal, the electoral system is not eliminated at all but only integrated with a given (exactly determined) percentage of randomness.
Before closing this section, let us remark that our findings are also perfectly in line with recent studies [15, 16] about the effectiveness of random promotion strategies in hierarchical organizations. In these studies, that one of promoting people at random has been shown to be, under certain conditions, a convenient way to circumvent the effects of the so-called "Peter Principle" [33] and to increase the efficiency of a given pyramidal or modular organization. We think that random selection could be of help in contrast Peter Principle effects also in the context of parliamentary institutions, which are exposed to analogous risks linked to the change of competences required to the elected people in their new political positions.

Conclusions and Remarks. – In this paper, by means of a prototypical Parliament model based on Cipolla classification, we demonstrated that the fact of introducing a well-defined number of random members into the Parliament improves the efficiency of this institution and the social overall welfare that depends on its acts. In this respect, the exact number of random members has to be established *after* the elections, on the basis of the electoral results and of our analytical "golden rule": the greater the size difference between the Parties, the greater the number of members that should be lotted to increase the efficiency of Parliament.
Of course our prototypical model of Parliament does not represent all the real parliamentary institutions around the world in their detailed variety, so there could be many possible way to extend it. For example it would be interesting to study the consequences of different electoral systems by introducing more than two Parties in the Parliament, with all the consequences deriving from it. Also the government form could be important: our simple model is directly compatible with a presidential system, where there is no relationship between Parliament and Government, whereas, in the case of a parliamentary system, also such a link should to be considered in order to evaluate the overall social welfare. For simplicity, we chose to study a unicameral Parliament, whereas several countries adopt bicameralism. So, the presence of another chamber could bring to subsequent interesting extensions of the model. Finally, we expect that there would be also several other social situations, beyond the Parliament, where the introduction of random members could be of help in improving the efficiency.
In conclusion, we think that the introduction of random selection systems, rediscovering the wisdom of ancient democracies, would be broadly beneficial for modern institutions.

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