Need for Diversity in Elected Decision-Making Bodies: Economics-Related Analysis

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1. Need for Elected Bodies

- In a small community or a small company, decisions can be made by all people getting together.
- This is how decisions are usually made in a university's department:
  - by having a faculty meeting, so that each faculty member has a chance to express his or her opinion,
  - and these opinions are taken into account when making a decision.
- However, for a larger group – e.g., for all the university's faculty:
  - there are already so many folks
  - that it is not possible to give everyone a chance to talk.

2. Need for Elected Bodies (cont-d)

- In such situations, a usual idea is to elect a decision-making body:
  - cities elect city councils,
  - countries elect parliaments,
  - shareholders elect a company's board,
  - university faculty elect a faculty senate, etc.

3. Diversity in Elected Bodies Is Important

- Populations are diverse, we have people of different ethnicity, different gender, different ages, etc.
- These people have somewhat different agenda, somewhat different preferences.
- It is desirable that the opinions of each group are taken into account when decisions are made.
- For this purposes, it is desirable that all these groups are properly represented in the elected body.
- Even with the most democratic election procedures, however, some groups are under-represented.
- For example, women are under-represented on the boards of most companies and in most countries' parliaments.
- How can improve this situation?

4. Usual Approach: Enforce Diversity by Limiting Democracy

- Some groups are under-represented in democratically elected decision-making bodies.
- This is usually interpreted as the need to enforce diversity by limiting democracy.
- For example, some countries and some companies have a quota:
  - on female representation, and
  - on representation on other under-represented groups.

5. The Problem With the Usual Approach

- In many cases, elections are based on economics-related criteria; for example:
  - when shareholders elect board members,
  - their main objective is to maintain the economic prosperity of the company.
- So, naturally, they elect candidates who have shown to be successful in economic leadership.
- For cities and countries, this is also largely true; usually:
  - leaders who lead to economic prosperity are re-elected, while
  - leaders under whom economy tanked are not re-elected.

6. Problem With the Usual Approach (cont-d)

- From this viewpoint, it seems clear what we want from an elected body.
- There are economic criteria that we want to impose.
- The need to enforce diversity disrupts this straightforward idea; it is no longer clear:
  - what should we optimize,
  - how should we combine traditional economic criteria with this new diversity requirements.

7. But Is Diversity Indeed Inconsistent with Economics?

- Many folks argue – in our opinion, convincingly – that diversity actually helps economy.
- Their arguments are very straightforward: economics is complicated and very competitive.
- To make economy successful, we need to use all the talent we have.
- If in some country, citizens, e.g.,
  - consistently ignore females and only elect male board members and male CEOs,
  - they are not using half of the country's talent.
- As a result, this country will eventually lose competition with countries that utilize all their talent.

8. But Is Diversity Indeed Inconsistent with Economics (cont-d)

- From this viewpoint:
  - diversity is not only consistent with economics,
  - it should follow from the economic considerations.

9. How Can We Translate This Informal Argument into a Precise Model?

- Informally, the above argument makes sense.
- However, the existing economic considerations still lead to under-representation of different groups.
- How can we translate the above informal argument into a precise model?
- This is what we attempt to do in this paper.

10. Individual Decision Making According to Decision Theory

- The traditional decision theory describes how a rational person should make decisions.
- Reasonable rationality criteria lead to the following conclusions.
- Preferences of a rational decision maker can be described by a function $u(x)$ called *utility* function.
- A rational decision maker should select the one with the largest value of expected utility

$$\overline{u}(a) = E_a[u(x)] \stackrel{\text{def}}{=} \sum p_j(a) \cdot u(x_j).$$

- Here, x_j are possible consequences of making the decision a and $p_j(a)$ is the probability of x_j.

11. Utility Is Defined Modulo a Linear Transformation

- Utilities are determined modulo a linear transformation $u \to a \cdot u + b$.
- Usually, when we make a decision, there is a status quo situation whose utility can be taken as 0.
  - if we use this status quo situation as a starting point,
  - then the only remaining transformations are transformations of the type $u \to a \cdot u$.

12. Group Decision Making

- What if a group of n people needs to make a decision?
- For each participant i, and for each alternative a, we can determine i's expected utility $\overline{u}_i(a)$.
- So, each alternative is characterized by a tuple

$$U(a) = (\overline{u}_1(a), \ldots, \overline{u}_n(a)).$$

- Based on these tuples, we need to decide which alternative is better for the group.
- Utility of each participant i is defined modulo a linear transformation $\overline{u}_i \to a_i \cdot \overline{u}_i$.
- It is thus reasonable to require that:
  - if we apply such transformations,
  - the comparison between two tuples $U(a)$ and $U(b)$ should not change.

13. Group Decision Making (cont-d)

- It turns out that this natural requirement uniquely determines group decision making.
- Namely, we should select an alternative for which the product $\prod_{i=1}^{n} \overline{u}_i(a)$ of expected utilities is the largest.
- This criterion was first formulated by the Nobelist John Nash.
- It is therefore known as *Nash's bargaining solution.*

14. Analysis of the Situation

- There is a computational problem related to the direct use of the above formula.
- Indeed, the population size n is usually large.
- Reason: as we have mentioned, the very need for a elected body only appears when n is large.
- In the computer, a product of the large number of values very fast leads:
  - either to a number which is too small to be represented in a computer,
  - or to a number which is too large.

15. Analysis of the Situation (cont-d)

- For example, in a city of 1 million people:
  - if $\overline{u}_i = 2$, we get the value $2^{1000000}$ which is too large, and
  - if $\underline{u}_i = 1/2$, we get the value $2^{-1000000}$ which is too small.
- The usual way to avoid this computational problem is to use logarithms, since $\ln(a \cdot b) = \ln(a) + \ln(b)$.
- Maximizing the above expression is equivalent to maximizing its logarithm $\sum\limits_{i=1}^{n} \ln\left(\overline{u}_i(a)\right)$.
- Adding millions of numbers may also lead to computational problems.

16. Analysis of the Situation (cont-d)

- So an even better idea is to divide this expression by n and thus, to maximize the average instead of the sum:

$$\frac{1}{n} \cdot \sum_{i=1}^{n} \ln\left(\overline{u}_i(a)\right).$$

- So, each person i is characterized by a tuple L_i formed by values $L_i(a) \stackrel{\text{def}}{=} \ln\left(\overline{u}_i(a)\right)$ corr. to different a.
- The population size n is large:
  - so, we can say that we have a probability distribution $\rho(L)$ on the set of all such tuples L,
  - just like we can say that there is a probability distribution of people by age, by height, or by weight.

17. Analysis of the Situation (cont-d)

- In terms of the probability distribution, the average value can be described as the expected value

$$\ell(a) = \int \rho(L) \cdot L(a)\, dL.$$

18. What if We Select a Decision-Making Body

- The above formula describes the ideal decision making, when the opinion of each person is taken into account.
- As we have mentioned, for large n, this is not realistically possible.
- Instead, we elect a decision-making body, and this body makes decisions.
- In the ideal world, decisions of this body also follow Nash's bargaining solution.
- So, this body selects an alternative that maximizes the expected value

$$\ell_B(a) = \int \rho_B(L) \cdot L(a)\, dL.$$

- Here, $\rho_B(L)$ describes the distribution of tuples L among the members of the elected body.

19. What We Want

- We want to make sure that the decisions of the elected body reflect the opinions of the people.
- In other words, we want to make sure that:
  - the decisions based on the considering everyone
  - coincide (or at least are close) to decisions based on elected body.
- Thus, for every alternative a, the values of the corresponding criteria must:
  - coincide,
  - or at least be close to each other.

20. This Leads to Diversity

- How can we guarantee that the values of the criteria always coincide (or are close)?
- We must make sure that the corresponding probability measures $\rho(L)$ and $\rho_B(L)$ coincide (or are close).
- So, for each group of people characterized by special values of the tuple L:
  - the proportion of this group's representatives in the elected board (described by $\rho_B(L)$)
  - should be close to the proportion of this group in the population as a whole (described by $\rho(L)$).
- This is exactly what perfect diversity looks like.
- So indeed, for an accurate economics-related description of decision making, optimization leads to diversity.

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