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

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Abstract On a qualitative level, everyone understands the need to have diversity in elected decision-making bodies, so that the viewpoint of each group be properly taken into account. However, when only the usual economic criteria are used in this election – e.g., in the election of company's board – the resulting bodies often under-represent some groups (e.g., women). A frequent way to remedy this situation is to artificially enforce diversity instead of strictly following purely economic criteria. In this paper, we show the current seeming contradiction between economics and diversity is caused by the imperfection of the use economic models: in an accurate economics-related decision making model, optimization directly implies diversity.

1 Diversity and Economics-Related Decision Making: Formulation of the Problem

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. In such situations, a usual idea is to elect a decision-making body.

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Cities elect city councils, countries elect parliaments, shareholders elect a company's board, university faculty elect a faculty senate, etc.

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?

Usual approach: enforce diversity by limiting democracy. The fact that some groups are under-represented in democratically elected decision-making bodies 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.

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.

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.

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 make CEOs, they are not using half of the country's talent – and, as a result, this country will eventually lose competition with countries that utilize all their talent.

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

How can we translate this informal argument into a precise model? Informally, the above argument makes sense, but 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.

2 Accurate Economics-Related Decision Making Model and How Its Optimization Implies Diversity

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 conclusions:

- that preferences of a rational decision maker can be described by a special function $u(x)$ called *utility* function, and
- that out of several alternatives a, the rational decision maker should select the one with the largest value of expected utility

$$\overline{u}(a) = E_a[u(x)] \stackrel{\text{def}}{=} \sum p_j(a) \cdot u(x_j), \tag{1}$$

  where x_j are possible consequences of making the decision a and $p_j(a)$ is the probability of the consequence x_j;

see, e.g., [1, 2, 3, 6, 7, 8].

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 $u \to a \cdot u$.

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 the expected utility $\overline{u}_i(a)$ of this participant corresponding to the alternative 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.

Since utility of each participant i is defined modulo a linear transformation $\overline{u}_i \to a_i \cdot \overline{u}_i$, it is reasonable to require that the comparison between two tuples $U(a)$ and $U(b)$ not change if we apply such transformations. It turns out that this natural requirement uniquely determines group decision making – namely, we should select an alternative for which the product

$$\prod_{i=1}^{n} \overline{u}_i(a) \tag{2}$$

of expected utilities is the largest; see, e.g., [1, 2, 3, 4, 5, 6, 7, 8].

This criterion was first formulated by the Nobelist John Nash in [4]. It is therefore known as *Nash's bargaining solution*.

Analysis of the situation. Before we go into a more serious analysis, let us first mention that there is a computational problem related to the direct use of the formula (2). Indeed, the population size n is usually large – since, 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. 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 the logarithm of a product is equal to the sum of the logarithms. From this viewpoint, maximizing the expression (2) is equivalent to maximizing its logarithm

$$\sum_{i=1}^{n} \ln\left(\overline{u}_i(a)\right). \tag{3}$$

Adding millions of numbers may also lead to computational problems, so an even better idea is to divide the expression (3) by n and thus, to maximize the average instead of the sum:

$$\frac{1}{n} \cdot \sum_{i=1}^{n} \ln\left(\overline{u}_i(a)\right). \tag{4}$$

In these terms, each person i is characterized by a unique tuple L_i formed by the values

$$L_i(a) \stackrel{\text{def}}{=} \ln\left(\overline{u}_i(a)\right) \tag{5}$$

corresponding to different alternatives a.

Since the population size n is large, 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. In terms of the probability distribution, the average value (5) can be described as the expected value

$$\ell(a) = \int \rho(L) \cdot L(a)\, dL. \tag{6}$$

What happens if we select a decision-making body. The formula (6) describes the ideal decision making, when the opinion of each person is explicitly 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 – i.e., equivalently, this body selects an alternative that maximizes the expected value

$$\ell_B(a) = \int \rho_B(L) \cdot L(a)\, dL, \tag{7}$$

where the probability measure $\rho_B(L)$ describes the distribution of tuples L among the members of the elected body.

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 value (7) coincide (or at least are close) to decisions based on the value (6).

Thus, for every alternative a, the values (6) and (7) of the corresponding criteria must coincide – or at least be close to each other.

This leads to diversity. The only way to guarantee that the values (6) and (7) always coincide (or are close) is to make sure that the corresponding probability measures $\rho(L)$ and $\rho_B(L)$ coincide (or are close).

In other words, for each group of people characterized by special values of the tuple L, the proportion of this group's representatives in the elected board (as described by the probability measure $\rho_B(L)$) should be close to the proportion of this group in the population as a whole (as described by the probability measure $\rho(L)$).

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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