Sovereign Debt Assistance and Democratic Decision Making

by

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Abstract

Organizational reforms stimulating democratic decision making are crucial for the economic effectiveness of concessional debt and debt relief. This claim is supported by a theoretic model illustrating the role of democratic decision making in increasing lending as well as in determining the effectiveness of these types of debt assistance. The proposed model suggests a novel explanation to the advantage of conditioning debt assistance on organizational reforms.

Keywords: debt relief, concessional lending, reforms, democracy, autocracy.

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1. Introduction

Low income countries and heavily indebted countries receive debt assistance in the form of concessional debt and debt relief. Key debt assistance programs condition aid on organizational reforms in the economy including organizational decision-making reforms (henceforth organizational reforms). \(^1\) A reform in the structure of the economy and its organizations contributes to the local population's social welfare as well as to increased transparency in decision making, which improves information availability, protection of rights and also lowers corruption in the economy. Ideological and welfare goals and, in particular, the enhancement of economic growth are, therefore, among the reasons for conditioning assistance on such reforms. \(^2\) At the same time, growth is directly related to the flow of financial resources to projects in the country, leading to debt assistance for poor or highly indebted countries. We examine whether organizational reforms that require greater democratization in decision making support the enhancement of project financing as intended by debt assistance. Accordingly, we focus on the effect of such reforms on the flow of financial resources and introduce some novel insights to this relationship. A theoretic model is used to formalize the relationship between democratization of decision making and lending. Organizational reforms are shown to be crucial for the effectiveness of debt assistance because the structure of decision making in an economy's organizations affects the likelihood that projects will be approved. The theoretic model demonstrates the mechanism through which democracy affects lending and, in particular, the effectiveness of debt assistance.

In our framework growth is interpreted as the product of projects that are implemented after receiving approval for funding. Under the assumption that in poor countries the quality of projects is low, loan approval will be limited under normal circumstances. However, without loan approval that allows project implementation, growth opportunities will be missed. Moreover, in order to implement projects there is

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\(^1\) A prominent example of conditional debt relief is the HIPC (Heavily Indebted Poor Countries) initiative which gives eligible countries debt reduction under the condition that governance is decentralized and democratic decision processes are imposed. The international community commits to a level of debt relief, such that countries must have achieved certain reforms and taken concrete steps to reduce poverty in order to receive the full amount of pledged debt relief. (source: http://www.worldbank.org).

\(^2\) Burnside and Dollar (2000) show that aid increases growth in GDP per capita only when good economic policies exist in recipient countries. They also use institutional quality including property rights and the efficiency of government bureaucracy to explain growth in GDP per capita.
need for (international) funding that is at risk of declining following defaults on loans. Hence debt assistance in the form of concessional debt and debt relief is vital in order to guarantee the continual flow of funds necessary for economic growth. As demonstrated in Reinhart and Trebesch (2016), per capita GDP increases when debt relief involves face value reduction. Our focus is on the decision process of loan approval required for financing projects in the presence of debt assistance. The outcome of this process is compared under organizational regimes that vary in their level of democracy. In our theoretic model, we examine the effect of greater democratization on the effectiveness of debt assistance. This is done by comparing decision-making institutions in the countries receiving debt assistance under democratic and autocratic norms. Alternatively, the effectiveness of debt assistance is compared assuming that the decision-making institutions are democratic but with low and high degrees of participation in decision making.

In light of the significance of the decision process applied by organizations in the countries receiving debt assistance when making lending decisions, our theoretical framework is that of group decision making in a fixed size committee that is subject to human fallibility. This field of study has attracted a great deal of attention. Nitzan and Paroush (1982, 1985), Grofman et al. (1983) and Shapely and Grofman (1984) laid the theoretical foundations of the uncertain binary choice model. Following previous results, Ben-Yashar and Nitzan (1997) defined the optimal decision rule in an extended setting which allows asymmetric choice. In the debt assistance application of this model, a decision committee can be interpreted as a group of decision makers who vote on project approval. The task of the committee is to approve or reject a project while trying to reach the correct decision. Each committee member has expertise in determining whether or not a project should be approved. The decisions of the committee members are aggregated by using a decision rule that yields a final decision regarding the approval or rejection of the requested loan. In our setting we define autocracy as the rule where the decision is made by one decision maker. Democracy is

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3 Sah (1991) and Sah and Stiglitz (1986, 1988) applied the asymmetric model to study the architecture of economic systems and, in particular to compare the performance of hierarchies and polyarchies. Other studies analyzed the optimal decision rule under constraints, e.g., Ben-Yashar, Kraus and Khuller (2001) and Ben-Yashar and Kraus (2002), the optimal decision rule in polychotomous choice, Ben-Yashar and Paroush (2001), and the optimal allocation of committee members, Ben-Yashar and Danziger (2011). Since the seminal work of Austen-Smith and Banks (1996), much attention has been also devoted to the role of strategic decisions, see for example, Ben-Yashar and Milchtaich (2007). Also see Dietrich and List (2013).
defined as the application of the majority rule. Although our focus is on the majority rule, we also study the consensus rule, which requires an extreme majority that assigns ultimate significance to avoidance of failure in the collective decision, viz, approving a bad project. Note that under these democratic rules every decision maker has an equal chance to be pivotal or decisive.

The theoretic model provides sufficient conditions ensuring that more democratic decision making in organizations displays greater lending to the private sector. It is shown that an increase in debt assistance does indeed increase lending. We also compare the marginal effectiveness of increasing debt assistance under different levels of democracy. The results imply that if the aid organization can control both the debt assistance and the level of democratization in organizations, it can exploit its advantage and set the debt assistance that induces the maximal increase in project approval. Organizational reforms that impose democratic norms in decision making are important therefore not only for promoting social values, but also, as we show, for increasing the effectiveness of debt assistance. However, if the autocrat has sufficiently greater skills at making correct decisions than the remaining decision makers, debt assistance effectiveness may decline when imposing democracy and a trade-off exists between debt assistance and the organizational reform requirements.

2. The role of democratic decision making in lending and debt assistance

The amount of credit provided and its destination are the product of market forces and competition. The literature, however, has also linked private credit to institutional quality while institutional quality has been linked to political institutions, specifically democratization. The relationship between institutional quality and the financial sector has been demonstrated by Acemoglu and Johnson (2005), where property rights are shown to positively affect economic growth, investments and financial development. At the same time, there is a link between political institutions and economic institutions, as demonstrated by Kotschy and Sunde (2017) who show that institutional quality increases with democracy when equality in income is high. It is, however, difficult to establish a direct effect of political democratization on financial development due to

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omitted factors and causality. Thus, the question remains as to whether political democracy improves financial development. For example, Haber (2005) demonstrates for the US and Mexican banking systems that political competition determined the level of centralization in the banking system. However, the literature does not offer a large body of clear cut evidence on the nature of the relationship between political democracy and the financial market. Intuitively, in autocracies even if institutional quality is good in the sense of rule of law and property rights, markets will be centralized and controlled by the government. Moreover, political centralization relates to government control that extends to all parts of the economy and, in particular, to the financial sector. Apart from appropriation of resources in corrupt regimes, credit to government and state owned enterprises may have a crowding-out effect vs. private lending, since governments compete over the same limited resources (Anyanwu an, Gan and Hu, 2017). In addition, government credit affects interest rates in the economy, and may also suggest greater centralization in asset allocation in the economy. Conversely, in democracies there is greater freedom, political and otherwise including in financial markets. Yet China is a case where the political climate remained autocratic while economic markets were opened.

Hence, democratization can be viewed at two separate levels: First, political democratization that relates to the government and its institutions and second, organizational democratization that relates to organizations in the economy. While the question of whether democratization at the political level is related to democratization at the organizational level, and the direction of causality is worthy of research, it is not discussed within the framework of this paper. We focus on democratization of decision making at the organizational level. At the micro level of lending, the decision making structure – centralized or decentralized – affects credit decisions in banks (Stein, 2002). Hence, credit is affected by decision making norms in lending institutions. This has particular importance in the context of debt assistance programs that increase the amount of lending resources in the economy with the aim of creating growth in the economy.

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5 Stein (2002) discusses the effect of two specific (centralized vs. decentralized) such designs on the share of small business lending. Canales and Nanda (2012) studies the organizational structure that provides better lending terms for small businesses finding that decentralized banks provide larger loans to small businesses. These findings are further supported by Cotugno et al (2013) where hierarchical distance is shown to be negatively related to credit availability.
On the effectiveness of aid and debt relief, Burnside and Dollar (2000) show that aid increases growth in GDP per capita only when good economic policies exist in recipient countries. They also use institutional quality including property rights and the efficiency of government bureaucracy to explain growth in GDP per capita. Asiedu (2003) links institutional quality to the success of debt relief programs. For the effects of corruption on the efficiency of aid on growth, see Aidf (2003), Hillman and Krausz (2007) and Jalles (2011). In this paper we study whether debt assistance is more effective in economies that have greater democratization in decision making at the organizational level.

Debt assistance reduces the debt burden of low income countries that may also be highly indebted. Countries that are unable to repay debt may be eligible for concessional debt relief that allows them to borrow fresh funds at reduced interest rates. The World Bank gives the following definitions of concessional debt "Concessional debt is defined as loans with an original grant element of 25 percent or more "Concessionality". The degree of concessionality of a loan is measured by its “grant element”. The grant element is defined as the difference between the loan’s nominal value (face value) and the sum of the discounted future debt-service payments to be made by the borrower (present value), expressed as a percentage of the loan’s face value. Whenever the interest rate charged for a loan is lower than the discount rate, the present value of the debt is smaller than its face value, with the difference reflecting the (positive) grant element of the loan".

An additional form of debt assistance is debt relief. Some central debt relief programs such as the HIPC initiative, condition debt relief on reforms that include greater decentralization in the economy and improved decision processes. While this is important from the social welfare point of view, the theoretic model presented below, suggests a mechanism through which the level of democracy in decision making processes at the organizational level affects lending decisions and hence determines the effectiveness of debt assistance. For reasons of exposition the following model refers to concessional debt while the results also apply to debt relief.

3. The model
Local entrepreneurs in the receiving country have projects that they wish to carry out. Decisions are made by a credit disbursing organization (private or government owned)
that decides on allocation of resources between entrepreneurs on behalf of the economy. The entrepreneurs, who have no wealth, can apply for funding in the amount of 1 unit, which if granted, allows them to proceed with their project that requires 1 unit of investment. The funding can be used only for the purpose of investing in the project. A project returns either $Y$, which is fully observable, with probability $P_y > 0$ or zero with probability $(1 - P_y)$. The entrepreneur knows the characteristics of his project, so from his point of view, the expected return from his proposed project is $P_y Y$. The probability $P_y$ represents the project's risk level whereby a low risk project is associated with a high $P_y$.

The success of the projects (and hence of the economy) depends on the realization of the return $Y$ on the project, that is, on the probability $P_y$. However, a project's $P_y$ is unknown to the credit disbursing organization. For the organization it is a random variable that varies according to a commonly known distribution function.

Lending resources are obtained from either private or public external lenders, creating external debt. The credit disbursing organization must decide whether to approve or reject the entrepreneur's funding application, taking into account that the gross market cost of borrowing 1 unit from external lenders is equal to $R \geq 1$. Concessional debt is represented by $g$, where $R$ reflects the risk adjusted return and $g$ is the grant component of concessional debt reflecting its magnitude. It is set such that, $0 \leq g \leq R$. Consequently, the expected income from a project that has borrowed funds is: $P_y Y - (R - g)$. There are two types of projects, good projects (1) and bad projects (-1). From the perspective of the credit disbursing organization a correct decision is to approve (1) a good project and to reject (-1) a bad project where a good project has a probability of success $P_y > \tau$, where $\tau$ is the threshold probability of success that determines what is a correct decision from the credit disbursing organization's standpoint, i.e., there is a positive expected income from a project. The threshold probability $\tau$ is determined by the known parameters, $g$, and $R$, such that for cases where $P_y > \tau$, $\tau = \frac{R - g}{Y}$, a project provides positive expected income, $P_y Y - (R - g) > 0$. Hence, given the distribution function $f(P_y)$ of $P_y$, the a-priori probability of a good project, $\alpha$, is determined as follows: $\alpha = \int \frac{f(P_y)}{Y} dP_y$. Since
\( \frac{\partial \tau}{\partial g} < 0 \), it follows that \( \frac{\partial \alpha}{\partial g} > 0 \). That is, an increase in the size of \( g \) lowers the threshold for good projects resulting in a larger a-priori probability that the credit disbursing agency faces a good project. We assume that a candidate project that is presented for an approval decision has greater a-priori probability that it is good than bad. This is a plausible assumption since the credit disbursing agency can apply effective initial screening of projects so that valuable decision-making resources are not wasted on projects that are more likely to be bad than good.\(^6\) Alternatively, the existence of such favorable candidate projects can be justified by assuming that \( g \) is sufficiently high.

Since the probability \( P_y \) is unknown to the credit disbursing agency, it appoints a committee of \( n \) members whose task is to approve or reject a project application by assessing whether \( P_y > \tau \) or not. The common objective of all the committee members is to make the correct decision concerning project approval.\(^7\) Each member's decision regarding the type of project (good or bad) is based on his specific information, such as past experience in approving the entrepreneur's projects, the entrepreneur's leverage and other attributes of the entrepreneur and of the project application. The decisional skill of committee member \( i \), is better than a random decision and is represented by \( p_i \),

\[ \frac{1}{2} < p_i < 1 \], which represents his probability of approving a good project and rejecting a bad one. We assume that the committee members' decisional skills are statistically independent across committee members. Specifically, we refer to the homogeneity assumption when committee members' skills are identical, i.e., \( p_i = p_j \) for all \( i \neq j \).

A final decision is reached by applying a decisive decision rule, which is a function that assigns 1 (approval) or -1 (rejection) to any set of decisions made by the members of the committee. We focus on three organizational systems. First, democracy, which is represented by the majority rule; That is, the committee's decision is 1, if and only if the number of the credit committee members who support approval is larger than 50% of the committee members. Clearly, the larger the number of members in the committee, the more democratic the system is. Second, autocracy, where the decision is 1 if and only if the autocrat supports approval. The autocrat's skills

\(^6\) Formally, \( \alpha > (1 - \alpha) \).
\(^7\) In our setting, we can disregard the typical problems that arise in a classical social choice setting where preferences are heterogeneous (e.g., the difficulty of attaining a social compromise, (Young 1988, 1995) and the problem of majority tyranny, (Baharad and Nitzan, 2002).
are denoted by \( p_1 \), and we assume that \( p_i > p_s \) for all \( i \neq 1 \). Finally, we compare our results to those obtained under the consensus rule whereby the approval of all the committee members is required to approve a project.

In our setting, we compare the applied decision rule by the credit disbursing organization under varying levels of democratization: autocracy that acts according to the dictates of an autocratic decision maker, democratic decision making corresponding to the application of the majority rule, and low versus high degree of democratization represented by a small and large size of the decision committee. In our model the credit disbursing organization is the agent in the economy who implements democratization with respect to the decision making process. In the following results we examine the conditions under which greater democratization increases the efficiency of concessionary debt.

4. The effect of concessional debt on project approval

Let us denote the probabilities that the committee approves a good project and rejects a bad project by, \( T(1) \) and \( T(-1) \), respectively. Hence, the probability that a request is approved by the committee is denoted by \( \text{Pr}(1) \) where \( \text{Pr}(1) = \alpha T(1) + (1 - \alpha)(1 - T(-1)) \). Note that \( 1 - T(-1) \) is the probability that the approved decision is incorrect and that \( \alpha \), the a priori probability that a project is good depends on two factors, the distribution of good and bad projects in the population and the level of \( g \).

We consider two cases of organizational structure in receiving countries. One in which the country receiving concessionary debt is an autocracy where all decisions are dictated by a central authority. The second case is that of a country that applies democratic decision making in its economic organizations using the majority rule. The concessionary debt program requires increased democratization either by adopting the majority rule or by adding decision makers to the decision committee.

Under the homogeneity assumption, we can establish that increasing democratization results in an increase in the probability of loan approval. Let \( \text{Pr}(1: \text{democracy}) \) and \( \text{Pr}(1: \text{autocracy}) \) denote the probability of approval for democracy and autocracy, respectively.

**Proposition 1:**
Under the homogeneity assumption,

(a) \( \Pr(1: \text{democracy}) \geq \Pr(1: \text{autocracy}) \)

and

(b) \( \frac{\partial \Pr(1: \text{democracy})}{\partial n} > 0 \)

**Proof:**

(a) Under democracy and autocracy, \( T(1) = T(-1) \).\(^8\)

Hence, \( \Pr(1) = \alpha T(1) + (1 - \alpha)(1 - T(1)) = T(1)(2\alpha - 1) + (1 - \alpha) \).

The probability of approval therefore depends only on the probability of making a correct decision \( T(1) \) and on \( \alpha \). As is well known, under the homogeneity assumption, \( T(1) \) increases with the committee size (Condorcet, 1785). Since, by assumption, \( \alpha > \frac{1}{2} \), \((2\alpha - 1)\) is positive. It therefore follows that increased democratization, that is, a move from autocracy to the democracy increases the probability of approval, \( \Pr(1: \text{democracy}) \geq \Pr(1: \text{autocracy}) \). A similar argument can be used to prove (b).

Q.E.D.

We now establish that the concessional debt enables the receiving country to increase the probability that a loan is approved. Namely, the probability of approval increases with the magnitude of the concession, \( g \), that is: \( \frac{\partial \Pr(1)}{\partial g} > 0 \).

**Proposition 2:**

Under democracy and autocracy, \( \frac{\partial \Pr(1)}{\partial g} > 0 \).

**Proof:**

\(^8\) Under these two rules the requirements for decision 1(accept) are identical to the requirements for the decision -1(reject). That is, under democracy there is need for a majority vote to accept a project and a majority vote to reject a project. Similarly, under autocracy, the autocrat must be in favor of a project for it to be accepted and against a project for it to be rejected.
As already established in Proposition 1, \( \Pr(1) = \alpha T(1) + (1 - \alpha)(1 - T(1)) = T(1)(2\alpha - 1) + (1 - \alpha) \). Hence, \( \frac{\partial \Pr(1)}{\partial g} = \frac{\partial \alpha}{\partial g}(2T(1) - 1) \) which is positive since \( \frac{\partial \alpha}{\partial g} > 0 \) and \( T(1) > 0.5 \) under our assumption that for all \( p_i > \frac{1}{2} \).

\[ \text{Q.E.D.} \]

The probability of approving a project increases with the magnitude of concessionality as reflected in the grant component, \( g \), due to the fact that the a-priori probability that a project request is good increases when the threshold of good projects is reduced.\(^9\) The lower threshold is achieved by the grant component, \( g \), of concessional debt that reduces the cost of borrowing. The implication is that, from the point of view of the decision committee members in the credit disbursing organization, there is a larger proportion of good projects. Hence, some projects that would have been rejected before the introduction of concessional debt are now approved.

Notice that the marginal effectiveness of concessional debt on the probability of loan approval depends only on the probability of making a correct decision \( T(1) \) and on \( \frac{\partial \alpha}{\partial g} \). Note that \( T(1) \) is increasing with decision makers' skills and, under the homogeneity assumption, increases with the number of decision makers. When the autocracy is changed to democracy with homogeneous decision makers, the probability of making a correct decision is again increased. It is straightforward to obtain the following two corollaries.

**Corollary 1:**
Under the homogeneity assumption, increased democratization increases the marginal effect of \( g \) on the probability of approval.

**Corollary 2:**
The higher the skills of the committee members, the larger the marginal effect of the grant component of concessional debt on the probability of loan approval.

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\(^9\) This may give rise to moral hazard problem since the level of debt and of risk increases (see for example Kirsch and Rühmkorf (2017)).
Let \( \frac{\partial \Pr(1: \text{democracy})}{\partial g} \) and \( \frac{\partial \Pr(1: \text{autocracy})}{\partial g} \) denote the marginal change in the probability of approval following an increase in the magnitude of concessional debt for the democracy, and autocracy respectively. In the following proposition we compare the marginal effectiveness of \( g \) in increasing the probability of approval under democracy and autocracy.\(^\text{10}\)

**Proposition 3:**

\[
\frac{\partial \Pr(1: \text{democracy})}{\partial g} \geq \frac{\partial \Pr(1: \text{autocracy})}{\partial g} \text{ if and only if } \prod_{i=2}^{n} \frac{p_i}{1-p_i} \geq \frac{p_1}{1-p_1}.
\]

**Proof:**

\( \frac{\partial \Pr(1: \text{democracy})}{\partial g} \) and \( \frac{\partial \Pr(1: \text{autocracy})}{\partial g} \) depend only on \( T(1) \) (see proof of Proposition 2). However, \( T(1) \) under democracy is not less than \( T(1) \) under autocracy if and only if \( \prod_{i=2}^{n} \frac{p_i}{1-p_i} \geq \frac{p_1}{1-p_1} \) as shown by Nitzan and Proush (1982).

Q.E.D.

Proposition 3 shows the conditions concerning skills under which marginal effectiveness of concessional debt is greater under democracy. In particular, the following corollaries are obtained.

**Corollary 3:**

Under the homogeneity assumption, \( \frac{\partial \Pr(1: \text{democracy})}{\partial g} \geq \frac{\partial \Pr(1: \text{autocracy})}{\partial g} \).

**Corollary 4:**

If \( p_1 \) is sufficiently larger than the skills of all other committee members, then \( \frac{\partial \Pr(1: \text{democracy})}{\partial g} < \frac{\partial \Pr(1: \text{autocracy})}{\partial g} \).

\(^{10}\) In Ben-Yashar, Krausz and Nitzan (2018), the marginal effectiveness of a loan guarantee is analyzed in a different setting and a more simple framework where skills are homogenous and the discussion is confined to anonymous qualified majority rules.
These results reveal that there could be a trade-off between democratization and concessional debt whereby in certain cases, which are determined by the insufficient skills of the decision makers, forcing democratization reforms on the organizations in the country receiving concessional debt reduces the marginal effectiveness of this type of debt assistance.

We now turn to the marginal effectiveness of \( g \) in increasing the probability of approval under the consensus rule and to its comparison to the marginal effectiveness of \( g \) under autocracy and democracy. Let \( \frac{\partial \Pr(1: \text{consensus})}{\partial g} \) denote the marginal change in the probability of approval under the consensus rule following an increase in the grant component of concessional debt. Then

**Proposition 4**

\[ \frac{\partial \Pr(1: \text{consensus})}{\partial g} > 0. \]

**Proof:**

Under consensus, \( T(1) = \prod_{i=1}^{n} p_i \) and \( T(-1) = 1 - \prod_{i=1}^{n} (1 - p_i) \). Hence,

\[ \frac{\partial \Pr(1: \text{consensus})}{\partial g} = \frac{\partial \alpha}{\partial g} \left( \prod_{i=1}^{n} p_i - \prod_{i=1}^{n} (1 - p_i) \right). \]

This term is positive because \( \frac{\partial \alpha}{\partial g} > 0 \) and \( \prod_{i=1}^{n} p_i - \prod_{i=1}^{n} (1 - p_i) \) is positive, since according to our assumptions, \( p_i > \frac{1}{2} \), which is equivalent to \( p_i > 1 - p_i \) for all \( i \).

Q.E.D.

Proposition 4 shows that the grant component of concessional debt, \( g \), increases the probability of approval under consensus. However the marginal effectiveness of \( g \) might be less than in the case of autocracy.

**Proposition 5**

\[ \frac{\partial \Pr(1: \text{consensus})}{\partial g} \leq \frac{\partial \Pr(1: \text{autocracy})}{\partial g} \iff \frac{1 - \prod_{i=2}^{n} (1 - p_i)}{1 - \prod_{i=2}^{n} p_i} \leq \frac{p_i}{1 - p_i}. \]
Proof:

\[
\frac{\partial \Pr(1: \text{consensus})}{\partial g} = \frac{\partial \alpha}{\partial g} \left( \prod_{i=1}^{n} p_i - \prod_{i=1}^{n} (1 - p_i) \right).
\]

\[
\frac{\partial \Pr(1: \text{autocracy})}{\partial g} = \frac{\partial \alpha}{\partial g} (2p_1 - 1). \text{ Hence,}
\]

\[
\frac{\partial \Pr(1: \text{autocracy})}{\partial g} \geq \frac{\partial \Pr(1: \text{consensus})}{\partial g} \iff (2p_1 - 1) \geq \left( \prod_{i=1}^{n} p_i - \prod_{i=1}^{n} (1 - p_i) \right) \iff
\]

\[
(2p_1 - 1) \geq p_1 \prod_{i=2}^{n} p_i - (1 - p_1) \prod_{i=2}^{n} (1 - p_i) \iff
\]

\[
(1 - p_1) \left( \prod_{i=2}^{n} (1 - p_i) - 1 \right) \geq p_1 \left( \prod_{i=2}^{n} p_i - 1 \right) \iff \frac{p_1}{1 - p_1} \geq \frac{\prod_{i=2}^{n} (1 - p_i) - 1}{\prod_{i=2}^{n} p_i - 1} = \frac{1 - \prod_{i=2}^{n} p_i}{1 - \prod_{i=2}^{n} (1 - p_i)}.
\]

Q.E.D.

Proposition 5 shows that autocracy is more beneficial for concessional debt than consensus provided that the skills of the autocrat are sufficiently greater than those of the other decision makers. The reason is that in an autocracy, we assume that the autocrat has greater skills than the other decision makers and under the consensus rule, it is sufficient for any decision maker (who does not necessarily have greater skills than the others) to reject the project and impose his choice.

Corollary 5:

Under the homogeneity assumption, \( \frac{\partial \Pr(1: \text{autocracy})}{\partial g} \geq \frac{\partial \Pr(1: \text{consensus})}{\partial g} \).

Proof:

Under the homogeneity assumption,

\[
\frac{\partial \Pr(1: \text{autocracy})}{\partial g} \geq \frac{\partial \Pr(1: \text{consensus})}{\partial g} \iff \frac{p}{1 - p} \geq \frac{1 - (1 - p)^{n-1}}{1 - p^{n-1}}, \text{ which holds when}
\]

\[
p - p^n \geq 1 - p - (1 - p)^n \iff 2p - 1 \geq p^n - (1 - p)^n.
\]

This condition holds for \( n=1,2 \).
Let us assume that it holds for \( n \), that is, \( 2p - 1 \geq p^n - (1 - p)^n \), and show that it holds for \( n+1 \), i.e., that \( 2p - 1 \geq p^{n+1} - (1 - p)^{n+1} \). To complete the proof, we need to prove that \( p^n - (1 - p)^n \geq p^{n+1} - (1 - p)^{n+1} \). This inequality holds because it is equivalent to

\[
\left( \frac{p}{1-p} \right)^n \geq \frac{p}{1-p} ,
\]

which holds.

Q.E.D.

Corollary 3 and Corollary 5 show together that under the homogeneity assumption,

\[
\frac{\partial \Pr(1: \text{democracy})}{\partial g} \geq \frac{\partial \Pr(1: \text{autocracy})}{\partial g} \geq \frac{\partial \Pr(1: \text{consensus})}{\partial g} .
\]

Hence, in the case of homogeneous decisional skills, not all forms of democratization are beneficial for concessional debt programs. In particular, the form of democratization that requires a full consensus for approval of projects and hence extreme caution in loan approval is the least beneficial in terms of the effectiveness of concessional debt in increasing loan approval.

5. Conclusions

Our theoretic model combines decision-making aspects of democracy and debt assistance to expose the mechanism by which these two factors are related demonstrating conditions ensuring that democratization in decision making increases lending. In the model, democratization is discussed in two cases. In one case, the receiving country is an autocracy that must adopt the majority rule in its organizations in order to increase democratization. In the other case, the country has democratic decision making in its organizations, but must increase democratic participation by increasing the size of the decision committee in its organizations. In both cases it is shown that increasing democratization stimulates lending under the homogeneity assumption. We first show that concessional debt increases lending because it increases the a-priori probability that a project is good from the point of view of the credit disbursing organization. We then provide sufficient conditions for democratization to increase the marginal effectiveness of concessionary debt.

Both concessional debt and debt relief reduce the debt burden of a country and hence reduce the cost of financing projects. One difference between the two is that, in the case of concessional debt, the reduction is immediate while with debt relief the
reduction is uncertain at the time of loan approval. However, since the results are derived from reduction in the cost of financing loans, they can easily be extended to the case of debt relief. In this way we reveal the theoretic underpinnings of the relationship between three crucial factors: democratization in decision making, loan approval and debt assistance exploring the justification of debt assistance that is conditional upon organizational reforms that require greater democratization in decision making at the organizational level.

Our theoretic model also shows that in the case of converting autocratic decision making to democracy, the importance of democracy in increasing debt assistance effectiveness is dependent on skills. For democratic decision making to be most effective, the decision makers' skills must be high. Otherwise, that is, if these skills are low while the autocrat has considerably greater skills, debt assistance is more effective under autocracy. In this latter case, there is a trade-off between debt assistance and democratization reforms. We therefore point to education as a crucial factor for the effectiveness of debt assistance programs. Namely, it is not sufficient to demand organizational reforms without enabling decision makers to have the necessary skills to make correct decisions.

References


More on Skill and Remuneration in Committees*

by

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Abstract

Relatively modest differences in individual decisional skills may warrant substantial inequality in personal reward. This is illustrated in Ben Yashar and Nitzan (2019), applying the uncertain dichotomous choice setting and assuming that reward is based on the skill-dependent power. The current letter adds to the picture the marginal contribution of a decision maker, which plays a central role in the determination of remuneration, clarifying its relationship to his power. We show that, under the optimal decision rule, the distribution of the marginal contributions can be even more unequal than the distribution of power.

Keywords:

decisional skills, reward, status, skill-dependent power, remuneration, marginal contribution, inequality.

*The authors are indebted to Erel Segal Halevi for pointing out the significance of the marginal contributions as determinants of the group members’ payments.

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1. Introduction
Applying the symmetric uncertain dichotomous choice model, Ben Yashar and Nitzan (2019) present a new notion of an individual's skill-dependent (s-d) power. The proposed power index is the probability that a decision maker is pivotal; it takes into account not only the relative number of the decision profiles enabling the decision maker to be pivotal, but the probability of such profiles. They show that even modest heterogeneity in individual decisional skills may warrant substantial inequality in their power. If reward hinges on power, then modest skill heterogeneity may result in substantial inequality of personal reward. Although this finding sheds new light on the possible justification of unequal distributions of rewards within groups of professionals of seemingly inconsequential diverse personal qualifications (in our case, their decisional competencies), it does not distinguish between reward in terms of status that naturally depends on power and reward in terms of payment that usually depends on the marginal contribution (mc) to the performance of the group – the probability that a correct decision is made. In order to overcome this shortcoming, we add to the picture the marginal contribution of a decision maker and, first, expose its relationship to his power. We then show that this extension strengthens the answer to the question “can unequal reward be deemed economically warranted” because, not only that the justified power distribution can be very unequal, the distribution of the marginal contributions and, in turn, the payments of the decision makers can be even more unequal.

2. The symmetric uncertain dichotomous choice model

Consider a committee $N = \{1, \ldots, n\}$ that chooses one of the alternatives 1 and $-1$ one of which is the correct choice and, therefore, better for all the decision makers. The two alternatives are symmetric. The symmetry between the two alternatives has two aspects. First, the priors of the two states of nature determining whether an alternative is correct or incorrect are equal and, secondly, the net benefits of a correct decision under the two states of nature are equal. The state of nature $\omega$ therefore satisfies $\omega \in \{1, -1\}$ and $\alpha = \text{Prob}(\omega = 1) = 1/2$. As is common in decision problems, the identity of the correct alternative is unknown, depending on the state of nature. The symmetry assumption implies that the objective of the group (and each of its members) can be stated in terms of the collective probability of making a correct decision rather than the expected benefit of the group. The problem of maximizing this probability is therefore equivalent to the problem of maximizing the expected benefit of the group.
Every decision maker selects one alternative, 1 or −1. We denote by $x_i$ individual $i$’s decision, $x_i \in \{1, -1\}$. $i$ chooses the correct alternative with probability $p_i$, which reflects his competence, $p_i = \text{Prob}(x_i = \omega)$, $p_i \in (1/2, 1)$. We assume independent competencies and denote the skill vector of the group members by $p = (p_1, \ldots, p_n)$. With no loss of generality, it is assumed that group members are ordered by their skills. The collective decision is based on the decisions of the individuals. It is made by a decisive aggregation rule $f$ that assigns 1 or −1 to any decision profile $x = (x_1, x_2, \ldots, x_n)$. That is, $f: \{1, -1\}^N \rightarrow \{1, -1\}$.

The collective decision rule that optimizes the decision making process, i.e., maximizes the collective probability of making a correct decision, is a weighted majority rule, Nitzan and Paroush (1982) and Shapley and Grofman (1984). Specifically, the optimal aggregation rule is $f^*(x_1, \ldots, x_n, p) = \text{sign}(w^*_1 x_1 + \cdots + w^*_n x_n)$, where $w^*_i = \ln \frac{p_i}{1-p_i}$ and $\text{sign}(m) = 1$, if $m > 0$ and −1 otherwise. The probability of obtaining a decision profile $x$ given the state of nature $\omega$ and the skill vector $p$ is given by

$$g(x; \omega, p) = \prod_{i \in N: x_i = \omega} p_i \prod_{i \in N: x_i = -\omega} (1 - p_i).$$

3. Skill dependent power

For $S \subseteq N$, let $x^S \in \{1, -1\}^N$ be the profile satisfying $x^S_i = 1$, for every $i \in S$ and $x^S_j = -1$, for every $j \in N \setminus S$. Notice that in the profile $x^{S\setminus\{i\}}$, individual $i$ switches his decision relative to the profile $x^S$.

In the general case of an $n$-member group of decision makers, individual $i$’s skill-dependent (s-d) power index proposed by Ben Yashar and Nitzan (2019), his probability of being pivotal given the skill vector $p$ and the corresponding optimal rule $f^*$, takes the following form:

$$\psi_i^{SD}(p) = \sum_{S \subseteq N, S \ni i} \frac{1}{2} [f^*(x^S, p) - f^*(x^{S\setminus\{i\}}, p)] \cdot g(x^{S\setminus\{i\}}),$$

where \( x_{-i} \) denotes the decision vector \( x \) excluding individual \( i \)'s decision. Because of the symmetry assumption, with no loss of generality, we can assume that 1 is the correct decision and \(-1\) is the incorrect one. So

\[
g(x^S_i) = \text{Prob}(x_j = 1, \forall j \in S \setminus \{i\} \text{ and } x_j = -1, \forall j \in N \setminus S)
\]

\[
= \prod_{j \in S \setminus \{i\}} p_j \prod_{j \in N \setminus S} (1 - p_j).
\]

Note that if \( f(x^S, p) = f(x^{S\setminus\{i\}}, p) \), then \( i \) switching his choice from \( x_i = 1 \) to \( x_i = -1 \) is not pivotal. If \( f(x^S, p) \neq f(x^{S\setminus\{i\}}, p) \), then if switching his choice, \( i \) is pivotal.

### 4. The marginal contribution (MC) to the group decision and its relationship to the s-d power

Let \( v(p) \) be the maximal expected probability that committee \( N \) makes a correct decision. Then,

\[
v(p) \max_f \sum_{x \in X(1; f)} \alpha g(x; 1, p) + \sum_{x \in X(-1; f)} (1 - \alpha) g(x; -1, p),
\]

where \( X(1; f) = \{x : f(x) = 1\} \) and \( X(-1; f) = \{x : f(x) = -1\} \).

In the following result, \( v(p) \) is rewritten in terms of \( f^*(x, p) \).

**Lemma 1**: \( v(p) = \sum_x \frac{1}{2} f^*(x, p) (g(x; 1, p) - g(x; -1, p)) + \frac{1}{2} \)

**Proof**: Let \( w(p) \) be the expected utility. \( w(p) = \sum_{\omega \in \{1, -1\}} \sum_x \text{Prob} (\omega) f(x, p) g(x; \omega, p) \). Since \( \text{Prob} (\omega) = 1/2 \), using \( f^*(x, p) \), we obtain that \( w(p) = \sum_x \frac{1}{2} f^*(x, p) (g(x; 1, p) - g(x; -1, p)) \).

Note that the expected utility is given by:

\[
w(p) = v(p) - (1 - v(p)) = 2v(p) - 1.
\]

\[
\Rightarrow v(p) = \frac{1}{2} w(p) + \frac{1}{2}
\]

Rearranging terms in the above equation completes the proof. \( \square \)

The marginal contribution of individual \( i \), \( \phi_{i}^{MC}(p) \), is:

\[
\phi_{i}^{MC}(p) = v(p) - v(p_{N\setminus\{i\}})
\]
where $p_M$ denotes the skill vector of all the group members in $M$.

The following result establishes the relationship between an individual's marginal contribution and his skill-dependent power, assuming that the group applies the optimal decision rule.

**Proposition 1**: \[ \varphi_i^{MC}(p) = p_i \psi_i^{SD}(p) - N_i(p), \]

where \[ N_i(p) = \sum_{S \subseteq N, i \in S} \frac{1}{2} \left| f^*(x^{S\setminus\{i\}}, p) - f^*(x_{-i}^S, p_{N\setminus\{i\}}) \right| g(x_{-i}^S). \]

**Proof**: Let us calculate $\varphi_i^{MC}(p)$.

By symmetry of the optimal voting rule, $f^*(-x) = -f^*(x)$ and $g(x; 1, p) = g(-x; -1, p)$. We can therefore write

\[ v(p) - v(p_{N\setminus\{i\}}) \]

as:

\[ = \sum_{S \subseteq N} \left( p_i f^*(x^S, p) + (1 - p_i) f^*(x^{S\setminus\{i\}}, p) - f^*(x_{-i}^S, p_{N\setminus\{i\}}) \right) \frac{1}{2} g(x_{-i}^S) \]

\[ = \sum_{S \subseteq N} \left( p_i f^*(x^S, p) - f^*(x^{S\setminus\{i\}}, p) + f^*(x_{-i}^S, p_{N\setminus\{i\}}) - f^*(x_{-i}^S, p_{N\setminus\{i\}}) \right) \frac{1}{2} g(x_{-i}^S) \]

\[ = p_i \psi_i^{SD}(p) + \frac{1}{2} \sum_{S \subseteq N} \left( f^*(x^{S\setminus\{i\}}, p) - f^*(x_{-i}^S, p_{N\setminus\{i\}}) \right) g(x_{-i}^S) \]

\[ = p_i \psi_i^{SD}(p) - \left[ \frac{1}{2} \sum_{S \subseteq N} \left( f^*(x^{S\setminus\{i\}}, p) - f^*(x_{-i}^S, p_{N\setminus\{i\}}) \right) g(x_{-i}^S) \right] \]

\[ = p_i \psi_i^{SD}(p) - N_i(p) \]

Note that $\sum_{S \subseteq N} \left( f^*(x^{S\setminus\{i\}}, p) - f^*(x_{-i}^S, p_{N\setminus\{i\}}) \right)$ is non-positive since an additional $-1$ by $i$ makes the decision more likely to be $-1$. □
\( p_i \psi^SD_i(p) \) is the probability that \( i \) determines the collective decision and make it a correct one whereas \( N_i(p) \) is the expected probability of turning a correct decision to an incorrect one due to the participation and incorrect decision of individual \( i \). The proposition clarifies why \( \Phi^MC_i(p) \neq p_i \psi^SD_i(p) \). The reason is that the computation of \( i \)'s marginal contribution requires consideration of the case that \( i \) is absent, The tight relationship between \( \Phi^MC_i(p) \) and \( \psi^SD_i(p) \) is emphasized by the fact that \( \Phi^MC_i(p) = 0 \iff \psi^SD_i(p) = 0 \).

**Example 1:** For \( p = (0.8, 0.7) \) and under the optimal rule, \( v(0.8, 0.7) = 0.8 \) and \( v(0.7) = 0.7 \), which implies that \( \Phi^MC_1(0.8, 0.7) = 0.1 \). Since \( \psi^SD_1(0.8, 0.7) = 1 \). Applying Proposition 1, we get that

\[
\Phi^MC_1(0.8, 0.7) = 0.8 \psi^SD_1(0.8, 0.7) - \frac{1}{2} \left( |f^*((-1,1), (0.8, 0.7)) - f^*((1,0.7))| g(1) + |f^*((-1,-1), (0.8, 0.7)) - f^*((-1,0.7))| g(-1) \right)
\]

\[
= 0.8 * 1 - \frac{1}{2} (|1-1-1|0.7 + |1-1-1|0.3) = 0.8 - 0.7 = 0.1.
\]

**Example 2:** Now consider another illustration assuming a three-member group with \( p = (.9, .9, .6) \) and the application of the optimal decision rule.

\[
\psi^SD_1(0.9, 0.9, .6) = 0.9 \cdot 0.4 + 0.1 \cdot 0.6 = 0.36 + 0.06 = 0.42.
\]

Then, the marginal contribution of individual 1 is:

\[
\Phi^MC_1(0.9,0.9,0.6) = 0.9 \psi^SD_1(0.9,0.9,0.6)
\]

\[
= 0.9 \cdot 0.42 - \frac{1}{2} \left( 0 \cdot g(1,1) + 0 \cdot g(-1,1) + |-2| \cdot 0.9 \cdot 0.4 + 0 \cdot g(-1,-1) \right)
\]

\[
= 0.9 \cdot 0.42 - 0.9 \cdot 0.4 = 0.018.
\]
5. Comparison of inequality of s-d power and mc

Table 1 presents seven possible skill profiles that result in all the seven possible optimal weighted majority rules and their corresponding distributions of s-d power, as in Ben Yashar and Nitzan (2019). In the fourth column we have added the corresponding marginal contributions. The table provides an unequivocal positive answer to the question “can unequal reward in terms of power-status or marginal contribution-payment be justified, given modest variability in the decisional skills of the group members”. For example, in row five, the skills \((0.8,0.7,0.6,0.54,0.54)\) give rise to the optimal weighted majority rule defined by the normalized optimal weights \((w_1^*, \ldots, w_5^*) = (3,1,1,1,1)\). These weights imply that the normalized s-d power distribution is \((69.57,8.38,7.31,7.31,7.31)\) and the normalized distribution of the individual marginal contributions is \((87.9,3.5,3.5,2.5,2.5)\). In this case, the difference between the skills of individuals 1 and 2 is just 0.1, however, 1's power, 69.57, is more than eight times larger than 8.38, the power of individual 2. The normalized mc of individual 1, 87.9, is 25 times larger than 3.5, the mc of individuals 2 and 3. That is, 1 deserves a pay which is 25 times larger than that of individuals 2 and 3 and more than 35 times larger than that of individuals 4 and 5. In row four, the optimal decision rule corresponding to the skills \((0.8,0.7,0.7,0.7,0.64)\) is the simple majority defined by equal decisional weights. The skill differences are insufficient to warrant an asymmetric weighted majority rule so the decision makers are assigned equal optimal decisional weights. Still, the s-d power distribution is \((21.73,19.89,19.89,19.89,18.6)\), reflecting the difference in the individual skills. The mc distribution \((62.7,11.8,11.8,11.8,1.9)\) is considerably more unequal, justifying a very large gap between the income of individual 1 and the relatively equally skilled, equally weighted and almost equally powered other group member. To sum up, modest skill heterogeneity can yield substantial power inequality and even more extreme inequality in terms of mc and payments.

Table 1: Skills, optimal weights, s-d power and mc
9. Conclusion

Applying the uncertain dichotomous choice model, we have focused on the power and marginal contribution of decision makers that determine their reward. As already known, modest difference in individual skills may warrant substantial inequality in power, Ben Yashar and Nitzan (2019). Defining the general s-d power of an individual who belongs to an n-member group, we have introduced into the model the individual marginal contributions to the performance of the group (the probability that a correct collective decision is made). These variables play a central role in the determination of the distribution of the group members' payment. We then exposed the relationship between an individual's marginal contribution and his s-d power, establishing that, under the optimal decision rule, the distribution of payments determined by the marginal contributions can be even more unequal than the distribution of power.

References


