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THEMATIC ISSUE

Comparison of Distribution Procedures in Blended Finance

A. V. Shchepkin

Trapeznikov Institute of Control Sciences, Russian Academy of Sciences, Moscow, Russia
e-mail: av_shch@mail.ru

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Abstract—This paper is devoted to the blended (joint) finance mechanism of a megaproject consisting of several projects. One part of the megaproject budget comes from the megaproject manager and the other part from project contractors. When distributing this budget, the megaproject manager considers information about the amount of the contractor's internal funds allocated to project implementation. Project contractors seek to get more funds from the megaproject manager; in turn, the megaproject manager is interested in attracting more funds from project contractors. To achieve this goal, the megaproject manager applies different procedures to distribute the budget. Project contractors use the information reported to the megaproject manager to increase the funds allocated to them. Straight and reverse priority distribution procedures in the blended finance mechanism are analyzed. A distribution procedure is determined that stimulates project contractors to allocate more of their internal funds to the project in a Nash equilibrium.

Keywords: blended finance, straight priorities, reverse priorities, planned profit, factual profit

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1. INTRODUCTION

Megaprojects are often financed by several sources jointly. In this case, a typical situation is that one source is the megaproject manager and the other is the contractors of the individual projects making up the megaproject. In other words, the blended finance mechanism is implemented; see [1–3]. (Such a mechanism is also called joint finance.) As a rule, the budget of the entire megaproject is limited and turns out to be insufficient to implement the required projects. According to [4], the idea of blended finance is that funds from the megaproject budget are allocated on the condition that the contractor of each project commits to allocate its internal funds to its project.

Blended finance implies that it is profitable for project contractors to invest their internal funds. However, the megaproject manager faces the problem of distributing the budget among project contractors. Traditionally, in the theory of active systems [5, 6], the megaproject manager requests information about the necessary funds from project contractors to implement the corresponding distribution mechanisms. The amount of funds received by the project contractors significantly depends on the information reported, the megaproject budget, and its distribution procedure. At the same time, the amount of funds for each contractor depends on its information and the information of all project contractors.

In the studies of foreign researchers, the consideration of blended finance mechanisms is associated with the evaluation of specific instruments, such as equity capital, guarantees, loans, etc. [7, 8]. Blended finance is treated as the use of capital from public or philanthropic sources to augment private-sector investment [9]. Special attention is paid to the issues of investment under which blended finance increases the potential return on investments or reduces risk factors, making them more attractive to investors [10, 11].

In this paper, we analyze straight and reverse priority distribution procedures applied by the megaproject manager in the blended finance mechanism. We determine a distribution procedure that stimulates project contractors to allocate more of their internal funds to the project in a Nash equilibrium [5].

2. AGENTS FUNDING UNDER PRINCIPAL'S COMPLETE AWARENESS

Consider a two-level system consisting of a Principal (the megaproject manager, the upper level), which distributes a budget for project implementation, and agents (project contractors, the lower level). The megaproject consists of n projects and is implemented by n contractors (agents). Each agent knows the factual costs z_i of implementing project i, where $i = 1, \ldots, n$. The Principal has funds in an amount R, which are distributed among project contractors. The Principal's complete awareness implies that the Principal knows the factual costs of each project.

The game-theoretic statement of the problem is as follows.

1. Each agent reports to the Principal the value w, which is some part of the factual project implementation costs allocated by the agent from its internal funds. For agent i, the planned amount $u_i^{(\mathrm{p})}$ of its internal funds for project implementation is therefore given by

$$u_i^{(\mathrm{p})} = w_i z_i, \quad i = 1, \ldots, n.$$

It follows that the finance request of agent i is given by

$$s_i = (1 - w_i) z_i, \quad i = 1, \ldots, n.$$

2. The Principal determines the amount of funds c_i, $i = 1, \ldots, n$, for all projects based on the information received. If $c_i < s_i$, the factual amount $u_i^{(\mathrm{f})}$, $i = 1, \ldots, n$, of agent's internal funds for project implementation is given by

$$u_i^{(\mathrm{f})} = z_i - c_i, \quad i = 1, \ldots, n.$$

3. The agents and the Principal determine their payoffs. The agent's payoff is its profit. The Principal's payoff function may have different forms. It does not matter here: this paper aims to establish conditions ensuring the allocation of more agents' internal funds to the project.

Let agent i gain an effect E_i from the project implemented. Assume also that the project will be implemented (and the agent will gain the effect) only if $c_i + u_i^{(\mathrm{f})} \geqslant z_i$. In this case, the profit of agent i can be written as

$$f_i = \mathrm{E}_i + c_i - u_i^{(\mathrm{f})}, \quad i = 1, \ldots, n. \tag{1}$$

We begin with the case when the Principal can distribute the requested funds in full to all agents. Then, obviously, $c_i = s_i$, $i = 1, \ldots, n$, and

$$f_i = \mathrm{E}_i + (1 - 2w_i) z_i, \quad i = 1, \ldots, n. \tag{2}$$

According to (2), to increase their profits, agents are interested in reducing their internal funds for project implementation and maximizing their finance requests. To eliminate this interest, the Principal introduces an additional condition. For receiving funds from the Principal, agents should allocate their internal funds in an amount not less than dz_i, where d is the share of factual costs set by the Principal. In this case, the request of agent i is given by

$$s_i = (1 - d) z_i, \quad i = 1, \ldots, n.$$

Consequently, the profit of agent i is given by

$$f_i = \mathrm{E}_i + (1-2d)z_i \geqslant 0, \quad i = 1, \ldots, n.$$

Due to the latter expression, the agent can affect the amount of profit only when setting $w_i > d$. However, see the discussion above, agents are interested in reducing their internal funds for project implementation; this corresponds to $w_i = d$.

If the Principal's funds are limited, priority distribution procedures [6] are used to determine the amount of funds c_i for project i, $i = 1, \ldots, n$. These procedures have the following form:

$$c_i^{(\mathrm{sp})} = \min\left\{ s_i;\ \frac{A_i s_i}{\sum\limits_{q=1}^{n} A_q s_q} R \right\}, \quad i = 1, \ldots, n$$

(straight priorities) and

$$c_i^{(\mathrm{rp})} = \min\left\{ s_i;\ \frac{A_i}{s_i \sum\limits_{q\in N} A_q / s_q} R \right\}, \quad i = 1, \ldots, n \tag{3}$$

(reverse priorities). Here, A_i denotes the project priority set by the Principal for agent i.

First, we study the straight priority procedure. Since the agents are financed under the Principal's complete awareness, the amount of funds allocated to project i is given by

$$c_i^{(\mathrm{sp})} = \frac{A_i(1-w_i)z_i}{\sum\limits_{q=1}^{n} A_q(1-w_q)z_q} R, \quad i = 1, \ldots, n. \tag{4}$$

The condition $c_i^{(\mathrm{sp})} + u_i^{(\mathrm{f})} \geqslant z_i$ must hold for agent i to gain the effect E_i. Hence,

$$\sum_{q=1}^{n} u_q^{(\mathrm{f})} \geqslant \sum_{q=1}^{n} z_q - R. \tag{5}$$

This conclusion seems obvious enough. If the implementation of all projects requires the amount of funds $\sum\limits_{q=1}^{n} z_q$, and the Principal allocates the amount of funds R, then the expression (5) exactly determines the amount of agent's internal funds.

Given (4), the goal function (1) of agent i takes the form

$$f_i = \mathrm{E}_i + \frac{2A_i(1-w_i)z_i}{\sum\limits_{q=1}^{n} A_q(1-w_q)z_q} R - z_i, \quad i = 1, \ldots, n.$$

Obviously,

$$\frac{\partial f_i}{\partial w_i} = -2A_i z_i \frac{\sum\limits_{q=1}^{n} A_q(1-w_q)z_q - A_i z_i(1-w_i)}{\left(\sum\limits_{q=1}^{n} A_q(1-w_q)z_q\right)^2} R < 0.$$

Therefore, the agents have an interest in reducing their internal funds for project implementation and maximizing their finance requests.

On the other hand, the Principal seeks to attract more of the agents' internal funds for project implementation. Accordingly, the Principal sets the priority of agent i so that it increases with the growing amount of the agent's internal funds allocated to the project. For example, the priority can be defined as

$$A_i = \frac{a_i}{1 - w_i}. \tag{6}$$

This priority has a peculiarity as follows. The more internal funds the agent allocates to the project, the higher its priority will be.

In this case, formula (4) can be written as

$$c_i^{(\mathrm{sp})} = \frac{a_i z_i}{\sum\limits_{q=1}^{n} a_q z_q} R, \quad i = 1, \ldots, n. \tag{7}$$

Accordingly, agent i, $i = 1, \ldots, n$, allocates the following factual amount of its internal funds for project implementation:

$$u_i^{(\mathrm{f,dp})} = z_i - c_i^{(\mathrm{sp})}, \quad i = 1, \ldots, n.$$

Let all projects being implemented satisfy the following requirement.

Condition 1. All projects are divided into two groups. The projects of the first group, those with the numbers $i = 1, \ldots, m$, have the high priorities $a_i = b^3 > 1$. The projects of the second group, those with the numbers $i = m + 1, \ldots, n$, have the low priorities $a_i = 1$.

In this case, formula (7) can be written as

$$c_i^{(\mathrm{sp})} = \begin{cases} \dfrac{b^3 z_i}{b^3 \sum\limits_{q=1}^{m} z_q + \sum\limits_{q=m+1}^{n} z_q} R, & i = 1, \ldots, m, \\[2ex] \dfrac{z_i}{b^3 \sum\limits_{q=1}^{m} z_q + \sum\limits_{q=m+1}^{n} z_q} R, & i = m + 1, \ldots, n. \end{cases} \tag{8}$$

Let $z_1 = z_n$, i.e., the costs of project 1 with the high priority coincide with those of project n with the low priority. In this case, due to (8), the agent whose project has the low priority receives fewer funds from the Principal and, accordingly, allocates more of its internal funds to the project.

In addition, according to (7), the amount of agents' funds is independent of the information reported by the agents.

Now, we analyze the reverse priority procedure. The procedure (3) can be represented as

$$c_i^{(\mathrm{rp})} = \min \left\{ (1 - w_i) z_i;\ \frac{A_i}{(1 - w_i) z_i \sum\limits_{q \in N} A_q \Big/ [(1 - w_q) z_q]} R \right\}, \quad i = 1, \ldots, n.$$

The agent receives the maximum amount of funds under the condition

$$(1 - w_i) z_i = \frac{A_i}{(1 - w_i) z_i \sum\limits_{q \in N} A_q \Big/ [(1 - w_q) z_q]} R, \quad i = 1, \ldots, n.$$

After straightforward calculations, we obtain

$$(1 - w_i) z_i = \frac{\sqrt{A_i}}{\sum\limits_{q \in N} \sqrt{A_q}} R, \quad i = 1, \ldots, n. \tag{9}$$

If the Principal sets the priorities (6), then the relation (9) can be written as

$$c_i^{(\mathrm{rp})} = (1 - w_i) z_i = \frac{\sqrt[3]{a_i z_i}}{\sum\limits_{q \in N} \sqrt[3]{a_q z_q}} R, \quad i = 1, \ldots, n, \tag{10}$$

and, accordingly,

$$u_i^{(\mathrm{f,rp})} = z_i - c_i^{(\mathrm{rp})}, \quad i = 1, \ldots, n.$$

Under Condition 1, formula (10) reduces to

$$c_i^{(\mathrm{rp})} = \begin{cases} \dfrac{b\sqrt[3]{z_i}}{b\sum\limits_{q=1}^{m} \sqrt[3]{z_q} + \sum\limits_{q=m+1}^{n} \sqrt[3]{z_q}} R, & i = 1, \ldots, m, \\[2ex] \dfrac{\sqrt[3]{z_i}}{b\sum\limits_{q=1}^{m} \sqrt[3]{z_q} + \sum\limits_{q=m+1}^{n} \sqrt[3]{z_q}} R, & i = m+1, \ldots, n. \end{cases} \tag{11}$$

Assuming $z_1 = z_n$ and considering (11), we obtain $u_1^{(\mathrm{f,rp})} = z_1 - c_1^{(\mathrm{f,rp})}$ and $u_n^{(\mathrm{f,rp})} = z_n - c_n^{(\mathrm{rp})}$. Direct comparison of $u_1^{(\mathrm{f,rp})}$ and $u_n^{(\mathrm{f,rp})}$ gives a result similar to the one established for the straight priority principle.

3. AGENTS FUNDING UNDER PRINCIPAL'S INCOMPLETE AWARENESS

Under incomplete awareness, the Principal does not know the factual costs z_i, $i = 1, \ldots, n$, of each project and receives information about the planned costs Z_i, $i = 1, \ldots, n$, of projects from the agents.

In this case, each agent reports to the Principal the planned costs Z_i, $i = 1, \ldots, n$, and the value w_i, which is some part of the planned costs covered by the agent from its internal funds. Hence,

$$u_i = w_i Z_i, \quad i = 1, \ldots, n.$$

Accordingly, the finance request of agent i is given by

$$s_i = (1 - w_i) Z_i, \quad i = 1, \ldots, n. \tag{12}$$

The factual profit of agent i is given by

$$f_i^{(\mathrm{f})} = \mathrm{E}_i + c_i - z_i, \quad i = 1, \ldots, n, \tag{13}$$

and its planned profit can be written as

$$f_i^{(\mathrm{p})} = \mathrm{E}_i + c_i - Z_i, \quad i = 1, \ldots, n.$$

Let us represent (13) in the form

$$f_i^{(\mathrm{f})} = \mathrm{E}_i + c_i - z_i = \mathrm{E}_i + c_i - (z_i - Z_i + Z_i) = f_i^{(\mathrm{p})} + Z_i - z_i, \quad i = 1, \ldots, n.$$

The factual costs z_i are known to the agents, and the agent cannot receive more funds from the Principal than it plans to spend. Therefore, by a natural assumption, the planned costs Z_i exceed the factual ones. In this case, the difference $(Z_i - z_i) > 0$ can be treated as the excess planned profit $f_i^{(\mathrm{ep})} = Z_i - z_i$. In the sequel, the factual profit of agent i is calculated as

$$\begin{aligned} f_i^{(\mathrm{f})} &= f_i^{(\mathrm{p})} + q f_i^{(\mathrm{ep})} = \mathrm{E}_i + c_i - Z_i + q(Z_i - z_i) \\ &= \mathrm{E}_i + c_i - (1-q)Z_i - qz_i, \quad i = 1, \ldots, n, \end{aligned} \tag{14}$$

where $q \leqslant 1$. If $q \in (0, 1]$, the Principal leaves some of the excess profit at the agent's disposal. Accordingly, q is the norm determining the amount of excess profit left to the agent. If $q \leqslant 0$, then q is the penalty coefficient for manipulating the agent's information about the project implementation costs; see [12].

As before, we begin with the case where the Principal can distribute the requested funds to all agents in full. Then, obviously, $c_i = s_i$, $i = 1, \ldots, n$, and

$$f_i^{(\mathrm{f})} = \mathrm{E}_i + s_i - (1-q)Z_i - qz_i, \quad i = 1, \ldots, n. \tag{15}$$

In view of (12), the expression (15) can be written as

$$f_i^{(\mathrm{f})} = \mathrm{E}_i + (1 - w_i + q)Z_i - qz_i, \quad i = 1, \ldots, n. \tag{16}$$

According to (16), the agents always benefit by overestimating their planned costs: for $q \in (0, 1]$,

$$1 - w_i + q > 0.$$

If the Principal's funds are limited, then (similar to the case of complete information) the Principal uses priority distribution procedures [6] to determine the amount of funds c_i for project i, $i = 1, \ldots, n$, and the agent's goal function has the form (14).

First, we consider the straight priority procedure. The amount of funds allocated by the Principal for implementing project i is given by

$$c_i^{(\mathrm{sp})} = \frac{A_i(1-w_i)Z_i}{\sum\limits_{q=1}^{n} A_q(1-w_q)Z_q} R, \quad i = 1, \ldots, n.$$

If the Principal sets the priorities (6), then

$$c_i^{(\mathrm{sp})} = \frac{a_i Z_i}{\sum\limits_{q=1}^{n} a_q Z_q} R, \quad i = 1, \ldots, n.$$

In this case, the goal function (14) takes the form

$$f_i^{(\mathrm{f})} = \mathrm{E}_i + \frac{a_i Z_i}{\sum\limits_{q=1}^{n} a_q Z_q} R - (1-q)Z_i - qz_i, \quad i = 1, \ldots, n.$$

To find the planned costs Z_i^* in a Nash equilibrium, we solve the system of equations

$$\frac{\partial f_i^{(\mathrm{f})}}{\partial Z_i} = a_i \frac{\sum\limits_{q=1}^{n} a_q Z_q - a_i Z_i}{\left(\sum\limits_{q=1}^{n} a_q Z_q\right)^2} R - (1-q) = 0, \quad i = 1, \ldots, n. \tag{17}$$

The solution of (17) is

$$Z_i^* = \frac{n-1}{(1-q)a_i \sum\limits_{q=1}^{n} \dfrac{1}{a_q}} R \left(1 - \frac{n-1}{a_i \sum\limits_{q=1}^{n} \dfrac{1}{a_q}} \right), \quad i = 1, \ldots, n. \tag{18}$$

In the Nash equilibrium, agent i receives the amount of funds

$$c_i^{*(\mathrm{sp})} = \left(1 - \frac{n-1}{a_i \sum\limits_{q=1}^{n} \dfrac{1}{a_q}} \right) R, \quad i = 1, \ldots, n. \tag{19}$$

Accordingly, $u_i^{*(\mathrm{sp})} = z_i - c_i^{*(\mathrm{sp})}$, $i = 1, \ldots, n$.

Under Condition 1, the expression (18) can be written as

$$Z_i^{*(\mathrm{sp})} = \begin{cases} \dfrac{(n-1)[(b^3-1)(n-m)+1]}{(1-q)[m+b^3(n-m)]^2} R, & i = 1, \ldots, m, \\ \dfrac{(n-1)b^3[b^3 - m(b^3-1)]}{(1-q)[m+b^3(n-m)]^2} R, & i = m+1, \ldots, n. \end{cases} \tag{20}$$

In this Nash equilibrium, agent i receives the amount of funds

$$c_i^{*(\mathrm{sp})} = \begin{cases} \dfrac{(b^3-1)(n-m)+1}{m+b^3(n-m)} R, & i = 1, \ldots, m, \\ \dfrac{b^3 - m(b^3-1)}{m+b^3(n-m)} R, & i = m+1, \ldots, n. \end{cases}$$

The positivity requirement of project funding leads to the inequality

$$b^3 - (b^3-1)m > 0. \tag{21}$$

From (21) we arrive at

$$m < \frac{b^3}{b^3-1}. \tag{22}$$

Due to (22), the greater ratio of the maximum priority to the minimum one is, the smaller the number of projects with the maximum priority should be.

In the case $m = n$ (all projects are equally important for the Principal), the expressions (18) and (19) reduce to

$$\begin{cases} \hat{Z}_i^* = \dfrac{n-1}{(1-q)n^2} R \\ \hat{c}_i^{*(\mathrm{sp})} = R/n, \end{cases} \quad i = 1, \ldots, n. \tag{23}$$

Using (23), we can express the amount of agents' internal funds allocated to projects in the Nash equilibrium: $\hat{u}_i^{*(\mathrm{sp})} = z_i - \hat{c}_i^{*(\mathrm{sp})}$, $i = 1, \ldots, n$.

Under the assumption $z_1 = z_n$, direct comparison of $\hat{u}_1^{*(\mathrm{sp})}$ and $\hat{u}_n^{*(\mathrm{sp})}$ indicates the following: the agent whose project has the low priority allocates more of its internal funds to project implementation.

Indeed, this result is immediate from the inequality

$$z_n - \frac{b^3 - m(b^3-1)}{m + b^3(n-m)}R > z_1 - \frac{(b^3-1)(n-m)+1}{m+b^3(n-m)}R.$$

Now, we take the reverse priority procedure. In this case, the Principal distributes to the implementation of project i the amount of funds

$$c_i^{(\mathrm{rp})} = \min\left\{(1-w_i)Z_i;\ \frac{A_i}{(1-w_i)Z_i \sum\limits_{q\in N} A_q\Big/[(1-w_q)Z_q]}R\right\}, \quad i = 1,\ldots,n.$$

The agent receives the maximum amount under the condition

$$(1-w_i)Z_i = \frac{A_i}{(1-w_i)Z_i \sum\limits_{q\in N} A_q\Big/[(1-w_q)Z_q]}R, \quad i = 1,\ldots,n.$$

Hence, it follows that

$$c_i^{(\mathrm{rp})} = \frac{\sqrt[3]{a_i Z_i}}{\sum\limits_{q\in N}\sqrt[3]{a_q Z_q}}R, \quad i = 1,\ldots,n. \tag{24}$$

Let Condition 1 be valid; then (24) can be written as

$$c_i^{(\mathrm{rp})} = \begin{cases} \dfrac{b\sqrt[3]{Z_i}}{b\sum\limits_{q=1}^{m}\sqrt[3]{Z_q} + \sum\limits_{q=m+1}^{n}\sqrt[3]{Z_q}}R, & i = 1,\ldots,m, \\[2ex] \dfrac{\sqrt[3]{Z_i}}{b\sum\limits_{q=1}^{m}\sqrt[3]{Z_q} + \sum\limits_{q=m+1}^{n}\sqrt[3]{Z_q}}R, & i = m+1,\ldots,n. \end{cases} \tag{25}$$

In this case, the goal function (14) takes the form

$$f_i^{(\mathrm{f})} = \begin{cases} \mathrm{E}_i + \dfrac{b\sqrt[3]{Z_i}}{b\sum\limits_{q=1}^{m}\sqrt[3]{Z_q} + \sum\limits_{q=m+1}^{n}\sqrt[3]{Z_q}}R - (1-q)Z_i - qz_i, & i = 1,\ldots,m, \\[2ex] \mathrm{E}_i + \dfrac{\sqrt[3]{Z_i}}{b\sum\limits_{q=1}^{m}\sqrt[3]{Z_q} + \sum\limits_{q=m+1}^{n}\sqrt[3]{Z_q}}R(1-q)Z_i - qz_i, & i = m+1,\ldots,n. \end{cases}$$

Under the weak contagion condition [5]

$$\frac{\partial}{\partial Z_i}\frac{1}{b\sum\limits_{q=1}^{m}\sqrt[3]{Z_q} + \sum\limits_{q=m+1}^{n}\sqrt[3]{Z_q}} = 0,$$

the planned costs Z_i^* in a Nash equilibrium are found by solving the system of equations

$$\frac{\partial f_i^{(\mathrm{f})}}{\partial Z_i} = \begin{cases} \dfrac{b}{3Z_i^{2/3}\left[be\sum\limits_{q=1}^{m}\sqrt[3]{Z_q} + \sum\limits_{q=m+1}^{n}\sqrt[3]{Z_q}\right]}R - (1-q) = 0, \quad i = 1, \dots, m, \\ \dfrac{1}{3Z_i^{2/3}\left[be\sum\limits_{q=1}^{m}\sqrt[3]{Z_q} + \sum\limits_{q=m+1}^{n}\sqrt[3]{Z_q}\right]}R - (1-q) = 0, \quad i = m+1, \dots, n. \end{cases} \tag{26}$$

From (26) we obtain

$$Z_i^* = \begin{cases} \dfrac{b\sqrt{b}}{3(1-q)\left[mb\sqrt{b} + (n-m)\right]}R, \quad i = 1, \dots, m, \\ \dfrac{1}{3(1-q)\left[mb\sqrt{b} + (n-m)\right]}R, \quad i = m+1, \dots, n. \end{cases} \tag{27}$$

According to (27), the planned costs of the agent with the high priority exceed in the Nash equilibrium those of the agent with the low priority.

Using (25), we calculate the amount of agent funds in the Nash equilibrium:

$$c_i^{*(\mathrm{rp})} = \begin{cases} \dfrac{b^{3/2}}{b^{3/2}m + (n-m)}R, \quad i = 1, \dots, m, \\ \dfrac{1}{b^{3/2}m + (n-m)}R, \quad i = m+1, \dots, n. \end{cases} \tag{28}$$

According to (28), the funding of the agent with the high priority exceeds in the Nash equilibrium that of the agent with the low priority.

Using (28), we can express the amount of agents' internal funds allocated to projects in the Nash equilibrium: $u_i^{*(\mathrm{rp})} = z_i - c_i^{*(\mathrm{rp})}$.

Under the assumption $z_1 = z_n$, direct comparison of $u_1^{*(\mathrm{sp})}$ and $u_n^{*(\mathrm{sp})}$ shows the following: the agent whose project has the low priority allocates more of its internal funds to project implementation.

Indeed, this result is immediate from the inequality

$$z_n - \frac{1}{b^{3/2}m + (n-m)}R > z_1 - \frac{b^{3/2}}{b^{3/2}m + (n-m)}R.$$

In the case $m = n$ (all projects are equally important for the Principal), the expressions (27) and (28) take the form

$$Z_i^* = \frac{R}{3(1-q)}, \quad i = 1, \dots, n,$$

and, consequently, $c_i^{*(\mathrm{rp})} = R/n$, $i = 1, \dots, n$.

Let us demonstrate that

$$c_i^{*(\mathrm{sp})} < c_i^{*(\mathrm{rp})}, \quad i = m+1, \dots, n. \tag{29}$$

Inequality (29) can be written as

$$\frac{b^3 - m(b^3 - 1)}{m + b^3(n-m)}R < \frac{1}{b^{3/2}m + (n-m)}R.$$

Trivial transformations yield

$$\left[b^3 - m(b^3 - 1)\right]\left(b^{3/2} - 1\right) - (n-1)(b^3 - 1) < 0. \tag{30}$$

Since $m \geqslant 1$, inequality (30) holds if

$$\left(b^{3/2} - 1\right) - (n-1)(b^3 - 1) < 0.$$

With this condition written as

$$1 - (n-1)\left(b^{3/2} + 1\right) < 0,$$

inequality (29) obviously holds. In fact, we have established the following result: in a Nash equilibrium, using the inverse priority principle, the Principal distributes more funds to the agents with the low priority than in the case of the straight priority principle. Therefore, $u_i^{*(\mathrm{f,rp})} < u_i^{*(\mathrm{f,dp})}$, $i = m+1, \ldots, n$.

4. CONCLUSIONS

According to the above analysis of the blended finance mechanism model, we draw the following conclusions. In the case of the Principal's complete awareness and the straight (or reverse) priority distribution procedure, agents allocate different amounts of their internal funds for projects with different priorities but the same factual costs. In addition, the agent whose project has a low priority receives less funds from the Principal and, accordingly, allocates more of its internal funds for project implementation.

In the case of the Principal's incomplete awareness and the straight (or reverse priority) distribution procedure, the agent with the high priority receives more funds in a Nash equilibrium than that with a low priority. Under the same factual costs, the agent whose project has a low priority allocates more of its internal funds to the project. Note that in a Nash equilibrium, the Principal's reverse priority distribution procedure provides the agents with a low priority with more funds compared to the case of straight priorities.

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