About a Relation of Retention of Assets by Contractor on Termination Clause and Additional Finance in Bankrupt Private Finance Initiative Project

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1. Introduction

This paper considers the outcomes when a business project, using Private Finance Initiative (PFI) as a method of supplying public services (including social infrastructure), faces bankruptcy and the financial institution or government considers purchase price, externalities, and risk of the respective facilities as the causes for businesses to either continue or collapse. At the same time, it clarifies that price is a mechanism that induces business failure. The results of this study have a certain suggestion, especially when considering possibility of further PFI business failures, such as Taraso Fukuoka—Japan’s first PFI business failure.

Japan employs many privatization methods, a prime example of which is the PFI that originated in the United Kingdom. More specifically, PFI is a method that provides public services using private sector funds and the management techniques of business operators. Features of this method include the following expectations: (1) lower cost, (2) increased quality, and (3) appropriate distribution of risk between the public and private sectors compared with the public utility being supplied as direct public services from the government.\(^1\)

However, there are also projects that have been inappropriately managed. For example, the financial institution that was expected to undertake the funding and supervising role for Taraso Fukuoka (initiated by Fukuoka City) conferred a secured loan with effectively equated to a

\(^1\) Refer to Noda (2003).
“Retention of Assets by Contractor on Terminate Clause (RACTC).” RACTC stipulates that the government, which initiates the project, will purchase the remaining facilities if the project is suspended. In this case, the monitoring of the business by the financial institution did not succeed. As a result, the company went bankrupt after three years.

Previous research has noted that there is no certainty regarding the success of a business project when a long-term contract is created using the PFI method. For this reason, progress has been made in applied research based on Hart’s (1995) Incomplete Contract Theory, as seen in studies by Bennett and Iossa (2006), Oshima (2001), Miura (2008), Mitsui (2003), and Onishi, Seki, and Kobayashi (2005). Upon closer examination, Bennett and Iossa (2006) and Oshima (2001) conducted comparative verifications of social welfare by considering the public works method and the PFI method as the respective business methods. Mitsui (2003) noted that additional burden would be placed on the private sector business operator if the possibility of a project being canceled before expiration is introduced, thus resulting in new inefficiencies with a reduction in the number of tender participants. Based on the assumption that a financial institution can determine a subsequent revitalization scheme if a project fails, Miura (2008) analyzed the effect on social welfare from an investment efficiency perspective. Conversely, from a financial perspective, Onishi, Seki, and Kobayashi (2005) considered corporate revitalization and liquidation in light of subsidy policies and pre-contract guarantees while considering the externalities for a project confronted with a liquidity shock.

Although successive prior research has analyzed the bankruptcies of projects, consideration was not made regarding the RACTC induces

2 Refer to Ooshima (2007).
such bankruptcies. In practice, there are also projects that enjoy societal expectations of having their lives extended through additional funding from financial institutions that are conscious of externalities, even if the business fails once. However, some projects that rely on an assessment of the risk and RACTC are quickly terminated, which results in a loss for the society. Therefore, this study provides a certain degree of significance by clarifying the relationship between the RACTC and additional funding from two different perspectives: 1) the financial institution that decides whether to extend additional funding to a company once it has failed, and 2) the government that wants to maximize social welfare.

The remainder of this paper is as follows. Section 2 describes a basic model while Section 3 analyzes the impact on the RACTC, risk, and social welfare. Section 4 presents an example of a failed Japanese business together with the policy implications. Finally, Section 5 summarizes the results.

2 Model

This study presents a model based on Holmström and Tirole (1998) and Onishi, Seki, and Kobayashi (2005). The model is set out as follows. We consider a situation in which the government uses a PFI to supply a public service. Fig.1 considers a multi-period model from Date 1 to Date 3. In this model, there are three players, i.e., the government, the Special Purpose Company (SPC), and the financial institution. We consider all the players to be risk neutral and set the discount rate and interest rate at zero. There is only one of each type of entity and there are individual contracts between single players. Although there are multiple financial
institutions, competition means that it is synonymous as one party.³ We assume that the financial institution can raise an unlimited amount of funds from the capital markets at a zero interest rate.

Fig.1 Timeline
(Source: created by the author)

At Date 1, the government presents the SPC with a PFI business contract. The government is charitable and aims to accumulate the net benefits that also include the SPC, the financial institution, and the public to maximize the social welfare. If the SPC rejects the business contract, then this reservation utility for the player ceases. Conversely, if the business contract is signed, then the government and the SPC specify the design and operating costs of the project as well as the actions to be taken if the contract is dissolved due to business failure. For simplicity, we assume that the SPC does not have any of its own capital.⁴ In this case, the SPC must enter into a loan contract with the financial institution on Date 1 and procure Initial Investment 1. The loan contract specifies

³ Refer to Dewatripont and Maskin (1995) regarding where a financial institution has limited funds and there are multiple financial institutions.
⁴ In practice, the SPC raises various funds from general contractors, banks, securities companies, and corporate bonds. External funds have a major impact on an SPC’s behavior. That is, there is “discipline imposed by debt” from corporate finance. Conversely, since this study aims to analyze the price of RACTC, we have excluded the problem of discipline imposed on the SPC by the various funding methods and debt from this analysis.
Loan Amount 1 and Repayment Amount \( D \). The SPC then launch the project after entering into the business contract. If successful with the first loan, the SPC receives Service Transfer Fee \( R \) from the government (for the value of the project based on the business contract document) and subsequently provides the financial institution with Repayment Amount \( D \).

If the project fails with the first funding and the SPC faces an unanticipated “liquidity shock”\(^5\) caused by the lack of funds on Date 2, then the government faces a business failure. If the risk of business failure due to the failure with the first funding increases and there is a temporary lack of funds, the SPC that does not hold assets shall borrow \( x \) as additional funding from the financial institution. Moreover, a decision must be made whether the project must once again borrow additional funding (long-term: life extension) or liquidate (short-term: quick termination). The magnitude of the additional funding is \( x \in [0, \bar{x}] \), \( x \geq 0 \). If additional funding is not obtained, then the project ceases, the SPC is liquidated, and the government (as the lender) pays the “Retention of Assets by Contractor on Terminate Price (RACTP)” to the financial institution. The RACTP is the value to be paid by the government to the financial institution to purchase the remaining facilities if the SPC continues to execute the project till the expiry of the contract or if it fails before the contract.

\(^5\) In recent years, there have been many cases worldwide where projects, business operators, financial institutions, and governments have suffered liquidity shocks due to a temporary lack of funding and have, thus, faced bankruptcy. Previously, there was limited academic debate concerning this problem. However, Allen, Carletti, Krahnen, and Tyrell (2011) and Holmström and Tirole (2011) have undertaken a systematic discussion of credit supply in the public sector, and the response to financial crises, currency, liquidity, and asset prices. The case of the PFI business failure presented in Section 4 is a typical example of a project failing through a liquidity shock.
expires. That is, this condition equates to a “government guarantee” and effectively functions as a security. Furthermore, the source of funding for the facility purchase price has a social cost of $\lambda \geq 0$ (as an excess tax burden indicated in Laffont and Tirole(1987)), which results in a burden of $1 + \lambda$, $1 > \lambda \geq 0$ for each unit of tax levy.

When there is additional funding once a project fails, the SPC progresses to Date 3 with $\beta$ probability of success, resulting in the expected benefit of $R + R_t + B_t$ and $E_t$. $R$ is the service transfer fee paid by the government when the project is successful through either the first funding or through additional funding after failing once. $R_t$ is the additional service transfer fee paid by the government when the project faces liquidity constraints after failing once, but then succeeds with additional funding. $B_t$ is the private benefit\(^6\) of the SPC for the project’s success of receiving additional funding after failing once. Furthermore, PFI businesses include many operations that are highly public in nature and $E_t$ is assumed to represent the corresponding business sector externalities for the entire society. Although project areas are wide-ranging, externalities are assumed to have a constant value for all $E_t$. Regarding expediency, the expected benefit $E_t$ is assumed to belong to citizens. Furthermore, the expected benefit evaluated at the beginning of Date 1 is assumed to have a non-negative value. Conversely, the financial institution will derive RACTP $C_G$ from the government if the project fails with a probability of $1 - \beta$.

As noted in Miura (2008), we assume that the SPC will transfer

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\(^6\) Private benefit $B_t$ is a non-monetary benefit that can only be gained by an SPC that cannot establish proof. For example, it is the evaluation of a project that fails with the first funding and succeeds with additional funding. Such a track record is considered at the time of the tender for the subsequent PFI transaction.
the business operations to the financial institution for projects that are
given an extension of life through the provision of additional funding
by financial institution. Therefore, in the case of a project failing once
but subsequently succeeding, the financial institution shall gain $R+R_t$,
which includes additional benefits, in which case the SPC will only gain
private benefit $B_t$. All aspects will be realized and end at Date 3, and the
government shall pay either service transfer fee $R+R_t$ or RACTP $C_G$ to
the financial institution.⁷

If the project succeeds with the first funding, the SPC’s monetary
benefits on Date 2 shall be the expected benefit $R-D$, which can be proven
by deducting repayment amount $D$ from service transfer fee $R$.

From the above, the timing (in order of the contract) shall be as
follows:

Timing

Date 1

1. The government and the SPC execute a business contract. There will be
   a reservation utility if not executed.
2. The SPC requests a loan contract for initial investment 1 from the
   financial institution. This ends if there is no loan.
3. If successful with the first funding, the benefit to the SPC is $R-D$, and
   the benefit to the financial institution is $D-1$.

⁷ Dewatripont and Maskin (1995) analyzed the decision-making process
regarding whether to extend funding in accordance with the profitability of a
project in centralized and decentralized markets. Conversely, this paper treats
the failure of a project as being identical to transferring business operations
to the financial institution. Furthermore, one feature of this paper is to clarify
the externalities and the risk not evaluated by the financial institution that
has been secured by the facility purchase clause provided by the government,
even if the project fails after the first or second additional funding.
1. If the first funding results in failure, the SPC requests additional funding from the financial institution.

2. If additional funding is not received, the financial institution gains $C_g - 1$.

3. If there is additional funding and success with probability $\beta$, the benefit to the SPC is $B_t$, and the benefit to the financial institution is $R + R_t - (1 + x)$, while the benefit to citizens is $E_t$. If failing with a probability $1 - \beta$, the expected benefit of the SPC and citizens is 0, while the benefit to the financial institution is $C_g - (1 + x)$.

Date 3

1. Every aspect is realized.

The ultimate expected net benefit is summarized in Fig. 2.

![Fig. 2 Expected net benefit tree](Source: created by the author)
Based on Fig.2 and from the perspective that the expected benefit to society as a whole evaluated at the beginning of Date 1 is not a negative value, the following equation is derived:

$$R + \max[Rt + Bt + Et, C_o] - 1 - E(x) \geq 0 \quad (1)$$

$E(x)$ represents the expected value of the probability variable $x$ due to the risk of additional cost, with $E(x) \geq 0$. Furthermore, the condition in which there is social utility in continuing the project rather than liquidating it at Date 2 can be expressed as follows:

$$\beta (Rt + Bt + Et) + (1 - \beta)C_o - x \geq 0 \quad (2)$$

Under the basic model, from the social welfare perspective, it is always effective for a project to continue with additional funding with the given probability. Thus, from Equation (1), it can be assumed that the following equation will hold true:

$$R + \max[Rt + Bt + Et, C_o] \geq x \quad (3)$$

In contrast, if the amount of additional funding necessary for the continuation of a project (that has failed with the first funding and has continued to suffer a liquidity shock) is large, then the following equation holds true:

$$R + \beta (Rt + Et + Bt) + (1 - \beta)C_o < x \quad (4)$$

However, ignoring external impacts at Date 2, the additional funding is quite large for a financial institution that has failed with the first funding. That is, if there are larger expected benefits from quick termination with the first funding rather than prolonging the life, then the following equation must be true:

$$\beta Rt + (1 - \beta)C_o < x \quad (5)$$

Furthermore, the financial institution will only agree to additional funding if it is able to recover part of the initial investment. Thus, the following
equation represents the conditionality of additional funding:

$$x \leq R + \max \{R_t, C_G\} \left(= x^*\right)$$  \hspace{1cm} (6)

If $x > R + \max \{R_t, C_G\}$, then there will be no additional funding. Therefore, the assumptions from Equations (3) and (5) mean that if the $x$ needed for additional funding after a project fails from the first funding falls within the range of $(x^*, \bar{x}]$, then there will be inefficiencies with the selection of a short-term project and quick termination even if a long-term project is efficient from a social welfare perspective.

3 RACTC, Risk, and Social Welfare

3.1 RACTC

This section clarifies the economic utility of the RACTP paid by the government to the financial institution if the business fails. If $\beta R_t + (1 - \beta) C_G - x \geq C_G$ for the financial institution, then the expected benefit of extending additional funding would be larger than the RACTP paid by the government to the financial institution, especially if the project was liquidated after the first funding. Therefore,

$$R_t - \frac{x}{\beta} \geq C_G$$  \hspace{1cm} (7)

Proposition 1.

*The increase (decrease) in the expected net benefit, if there is additional funding, and the decrease (increase) in additional cost and the RACTP provides the incentive for the financial institution to select a long- (short-) term project.*

Based on Proposition 1, if the expected net benefit of additional funding for a long-term project that has failed once is larger than the RACTP if the project is liquidated without additional funding, then the long-term project would be the equilibrium path. In other words,
the financial institution has the incentive to extend additional funding if Equation (7) holds true.

Furthermore, if Equation (2) holds true\(=Rt + Et + Bt - \frac{x}{\beta} \geq C_{o}\), then the government would enjoy more social welfare from the long-term project than from the short-term project, similar to the financial institution. Therefore, a government hoping to maximize social welfare would execute a contract that reduces the RACTP purchase price so that the life of the project would be extended.

However, the welfare of both the financial institution and the government differs from the valuation of the externalities and the private benefit of the SPC \((Et + Bt)\). The decision regarding additional funding based only on the utility of the financial institution does not consider the externalities and the private benefit of the SPC, thus leading to Equation (7). If the government wants to extend the life of the project, it can reduce the RACTP purchase price, reduce the additional funding, or increase the expected net benefit from success.

Let us now consider the case in which the business fails from a liquidity shock on Date 2. Specifically, the government sets a RACTP with the external effect as the upper limit to prevent inefficient liquidation. If the liquidity shock conforms to \(0 < x \leq R + Rt\), the financial institution will extend additional funding even without the provision of a RACTC from the government. Conversely, if the liquidity shock conforms to \(R + Rt < x \leq \bar{x}\), then the SPC will be unable to obtain additional funding, unless the government confers a RACTC. Thus, if the government sets a minimum RACTP\(x - (R + Rt) = 0\) so that the SPC's expected benefit is zero, then the project will continue with additional funding. The social welfare at Date 1, if such a clause is provided, can be represented by:
If a long-term project obtains additional funding and achieves success, then the social welfare can be derived using the following formula:

\[ R + \beta \int_0^{Rt} \int_0^{Et} (Rt + Et + Bt) f(x)dx + (1 - \beta) \left[ C_G + \int_{C_G}^{x} (x - C_G) f(x)dx \right] - 1 - E(x) \]

In other words, social welfare on Date 1 becomes:

\[ R - 1 + \beta \left[ \int_0^{Rt+Et+Bt} (Rt + Et + Bt) f(x)dx - x \right] \]

Proposition 2.

Setting a RACTC to avoid inefficient liquidation results in a non-negative value for social welfare of the long-term project in accordance with Equation (1).

There is also an excess tax burden when providing a RACTC, which is represented as follows:

\[ (1 - \beta)\lambda \left[ \int_{C_G}^{G} (x - C_G) f(x)dx \right] \]

Furthermore, social welfare allowing for such an excess tax burden is represented as follows:

\[ \beta \int_{Rt+Et+Bt}^{x} (Rt + Et + Bt - x) f(x)dx + (1 - \beta) \left[ \int_{C_G}^{x} (C_G - x) f(x)dx - \lambda \int_{C_G}^{x} (x - C_G) f(x)dx \right] \]

\[ = \beta [Rt[1 - F(Rt)] + Et[1 - F(Et)] + Bt[1 - F(Bt)] - x] - (1 - \beta)(1 + \lambda) \int_{C_G}^{x} (x - C_G) f(x)dx \]

Equation (9) indicates the respective additional service transfer fee,
the external effect, the private benefit, the excess tax burden, and the RACTP of a project whose life is extended, even if the project fails with the first funding. If the excess burden is small in Equation (9), then the government can increase the social welfare by introducing a RACTC.

Moreover, the government can control the RACTP, making it possible to quickly terminate or extend the life of the operating period. At the same time, the government can avoid inefficient liquidation by manipulating this price. However, the requirement for resources results in an excess tax burden. In contrast, Equation (8) indicates that there is a difference between social welfare and the expected benefit of the financial institution. For this reason, there is a distortion in the external effect and the private benefit (even if the life is extended, as in Equation (2)). As a result, the project will not even reach first best. Furthermore, in some cases, the external effect from extending the life of the business through the introduction of a RACTP will increase social welfare.

3.2 Risk

This section considers the risk of externalities which results in distortion and prevents the project from reaching first best. Furthermore, it examines the expansion of the basic model and the uncertain external effect ($E_t$) indicated by the probability variable. The external effect is confirmed on Date 2 as $E_t$ with probability $\beta$, and 0 with probability $1 - \beta$. We assume a definite value for the service transfer ascertained from the first and additional funding.

The model considers the case of a substantial liquidity shock that complies with Equation (5). If the assumptions for Equation (2) are eased and the external effect is small, then there could be a situation with a liquidity shock, meaning that the continuation of the project is not
necessarily efficient in terms of social welfare. That is, it would be more effective to extend the life of the project from a social perspective in the case that the liquidity shock $x$ conforms to $x \in [0, R + Rt + Et]$. However, it would be more effective to liquidate the project from a social perspective where $x \in [R + Rt + Et, \bar{x}]$.

The model takes $\widehat{C}_g$ to be the RACTP at which the project fails with the initial investment on Date 1 with a probability $(1 - \beta)$ of failing again after receiving additional funding on Date 2, where $0 \leq \widehat{C}_g \leq Et$. Furthermore, the external effect on Date 2 is defined as $Et = \overline{Et}$. At this time, it would be more efficient from a social welfare perspective for the government to extend the life of the project, if $x \leq R + Rt + E\overline{t}$. Conversely, if $x > R + Rt + E\overline{t}$, it would be more efficient for the government to quickly terminate the project. However, if the liquidity shock is within the realm of $x \in (R + Rt + \widehat{C}_g, R + Rt + E\overline{t})$, the project should be terminated quickly, even if it is efficient to extend the life of the project.\footnote{If $\widehat{C}_g > E\overline{t}$, $Et = \overline{Et}$, there would be a social loss from the inefficient extension of the life of the project in a similar way to when the liquidity shock conforms with $x \in (R + Rt + E\overline{t}, R + Rt + \widehat{C}_g)$. The results of this analysis essentially have the same meaning as the case of $0 \leq \widehat{C}_g \leq E\overline{t}$ raised in Section 3.2.}

Here, the social loss from quick termination can be represented as follows:

\[
\int_{R + Rt + \widehat{C}_g}^{R + Rt + E\overline{t}} (R + Rt + E\overline{t} - x)f(x)dx
\]

If the external effect is defined as $Et = 0$, it would be more efficient for the government to extend the life of the project, if $x \leq R + Rt$. In contrast, if $x > R + Rt$, then it would be more efficient for the government to quickly terminate the project. Therefore, if the liquidity shock conforms with $x \in (R + Rt, R + Rt + \widehat{C}_g)$, then the life of the project will be extended, even if it is more efficient to quickly terminate the project.
the inefficient continuation of the project can be represented as follows:

\[ \int_{R+Rt}^{R+Rt+\bar{C}_G} (x - R - Rt) f(x) dx \]

In other words, the social loss, assuming the RACTP set at \( C_G \), is as follows:

\[ L_{C_G}(C_G) = \beta \int_{R+Rt}^{R+Rt+\bar{E}t} (R + Rt + \bar{E}t - x) f(x) dx + (1 - \beta) \int_{R+Rt}^{R+Rt+\bar{C}_G} (x - R - Rt) f(x) dx \quad (10) \]

The problem of setting the optimal RACTP price can be formularized (based on Equation (10)) as follows:

\[ \min_{C_G} L_{C_G}(C_G) \]

The optimal condition for this problem is

\[ \frac{dL_{C_G}(C_G)}{dC_G} = [-\beta(\bar{E}t - C_G) + (1 - \beta)C_G] f(R + Rt + C_G) \]

\[ = (C_G - \beta \bar{E}t) f(R + Rt + C_G) = 0 \quad (11) \]

Furthermore, the RACTP \( C_G \) that minimizes the expected social cost due to the inefficient quick termination or life extension in accordance with Equation (11) is
Furthermore, the expected social cost to be realized when $C^*_G$ is as follows:

\[ L_{C_G}(C^*_G) = \beta \int_{R+Rt}^{R+Rt+C^*_G} (R + Rt + \bar{Et} - x)f(x)dx + (1 - \beta) \int_{R+Rt}^{R+Rt+C^*_G} (x - R - Rt)f(x)dx \]  \hspace{2cm} (13)

**Proposition 3.**
Depending on the amounts set for the RACTP and the external effect, there can be inefficiencies even with additional funding. The optimal value is when the RACTP equals the external effect.

Equation (10) indicates that unconditionally conferring a RACTC (due to the risk from Proposition 3) does not necessarily result in the optimum position for social welfare due to the social loss. That is, the social welfare is maximized when the RACTP and the expected value of the external effect are the same, as shown in Equation (12).

However, if there is no RACTC, the expected social loss can be represented by:

\[ \beta \int_{R+Rt}^{R+Rt+\bar{Et}} (R + Rt + \bar{Et} - x)f(x)dx \]

Furthermore, the effect of introducing a RACTC $\Phi(R + Rt, R + Rt + C^*_G)$ leads to:

\[
\Phi(R + Rt, R + Rt + C^*_G) = \beta \int_{R+Rt}^{R+Rt+\bar{Et}} (R + Rt + \bar{Et} - x)f(x)dx - L_{C_G}(C^*_G) \\
= \beta \bar{E}[F(R + Rt + C^*_G) - F(R + Rt)] - \int_{R+Rt}^{R+Rt+C^*_G} (x - R - Rt)f(x)dx
\]  \hspace{2cm} (14)

When the external effect from Equation (14) is large, the RACTP
Ooshima About a Relation of Retention of Assets by Contractor on Termination Clause and Additional Finance in Bankrupt Private Finance Initiative Project has the effect of increasing the social welfare by avoiding inefficient quick termination. However, when the external effect is small, the RACTP fosters inefficient life extension and reduces social welfare.

3.3 Social Welfare

This section considers whether it is desirable to have either the PFI method or the public utility from a social welfare perspective. The social welfare from the public utility is defined as

\[ SW_{PW} \equiv R - 1 \] (15)

This section considers three cases of social welfare under the PFI method. The first is social welfare that incorporates the RACTC attributed to the distortion in the external effect and the tax for a given probability of additional funding, even if the project fails with the first funding. This is defined as

\[ SW_{PFI} \equiv R - 1 + \int_0^x \max[R_t + E_t, -\lambda C_G]f(x)dx - x \]

\[ = R - 1 + \beta \int_0^x [R_t + E_t]f(x)dx - (1 - \beta) \int_0^x \lambda C_G f(x)dx - x \] (16)

The second is social welfare in which project life is extended, even though there is the risk of additional cost \( x \in (R_t, R_t + C_G) \), and is more efficient to terminate quickly. This is defined as follows:

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9 The RACTP and the remaining assets are considered to be the same under Equation (16), if the project fails after the first funding. Therefore, if there is a probability 1-\( \beta \) of failure with additional funding, then there will be distortion \( -\lambda C_G \) in the tax resources to pay the financial institution the RACTP. The same is applicable for Equations (17) and (18).
The third is social welfare in which the project is quickly terminated, even though $x \in (R_t + \hat{C}_G, R_t + E_t)$ and project life extension is efficient. This is defined as:

$$SW_{PFI2} \equiv R - 1 + \int_{R_t}^{R_t + E_t} \max[R_t + E_t - \lambda C_G] f(x)dx - x$$
$$= R - 1 + \beta \int_{R_t}^{R_t + E_t} [R_t + E_t] f(x)dx - (1 - \beta) \int_{R_t}^{R_t + E_t} \lambda C_G f(x)dx - x \quad (17)$$

Let us now perform a comparison of the social welfare for the respective cases. The problem for the government of whether the business should fail or continue, due to a liquidity shock on Date 2, is considered by using Equation (16) for the PFI method and Equation (15) for the public utility. Whether to extend additional funding is based on the following:

$$SW_{PFI3} \equiv R - 1 + \int_{R_t + \hat{C}_G}^{R_t + E_t} \max[R_t + E_t - \lambda C_G] f(x)dx - x$$
$$= R - 1 + \beta \int_{R_t + \hat{C}_G}^{R_t + E_t} [R_t + E_t] f(x)dx - (1 - \beta) \int_{R_t + \hat{C}_G}^{R_t + E_t} \lambda C_G f(x)dx - x \quad (18)$$

Case 1

$$SW_{PFI1} \lesssim SW_{PW} \Leftrightarrow \beta \int_{0}^{\beta} [R_t + E_t] f(x)dx - (1 - \beta) \int_{0}^{\beta} \lambda C_G f(x)dx \lesssim E(x)$$

However, it is important to note the difference in the evaluation of the government, which hopes to maximize social welfare that incorporates the externalities and the excess tax burden (as in Case 1), whereas the financial institution does not consider this.

This section considers Equation (17), which is the PFI method incorporating risk, and Equation (15), which is the public utility. That is, $x \in (R_t, R_t + \hat{C}_G)$, where the life of the project is extended, even though liquidation is efficient. In this case, social welfare is represented by
In Case 2, quick termination without additional funding can increase social welfare. However, since a RACTC is conferred, the expected benefit to the financial institution is increased by extending the life of the project. Thus, the financial institution will extend additional funding, which suggests a possibility of the PFI method being deployed with an extension of the project. However, it would be more beneficial from a social welfare perspective to use the public utility. However, when a RACTP is granted, the PFI method is not necessarily the most desirable, at least from a social perspective.

Similarly, this paper considers additional cost being \( x \in (R_t + C_G, R_t + E_t) \). In this case, the project will be liquidated even though it is efficient to extend the life of the project. Therefore, using Equations (15) and (18) results in social welfare, as represented by

\[
\text{Case 2} \quad SW_{\text{PFI2}} < SW_{\text{PW}} \iff \beta \int_{R_t}^{R_t+C_G} [R_t + E_t] f(x) dx - (1 - \beta) \int_{R_t}^{R_t+C_G} \lambda C_g f(x) dx < E(x)
\]

Under Case 3, it is better for social welfare to extend the life of the project. However, rather than a PFI method, the structure will be the public utility. The reason being that the financial institution has the incentive to utilize the RACTC and quickly terminate the project, especially in the case of a PFI business that includes substantial risk for externalities and the RACTP. This suggests that when the range of additional cost is within \( x \in (R_t + C_G, R_t + E_t) \), the project can be quickly terminated, even though it is desirable from a social perspective to extend
the life of the project.

**Proposition 4.**

*Where there are large risks in the PFI method, this method will not necessarily increase the social welfare. Furthermore, since there is a difference between the expected benefit for the financial institution and social welfare, there could also be cases in which quick termination or life extension are not desirable, at least from a social welfare perspective.*

This can be confirmed with numerical examples. For example, the Gauss–Legendre quadrature, a numerical integration algorithm, can be used to derive an approximation of the integral from Cases 1 to 3. The specific values are assumed to be $R_t=1$, $E_t=0.2$, $t=0.3$, $\lambda=0.1$, and $\beta=0.5$, and when they are transposed into the left-hand side of Equation (7), the result is $C_g=0.4$.

An approximation by transposing each value into the right-hand side inequality of Case 1 results in the government's valuation of $0.174<0.3$ and a tax distortion. Meanwhile, the financial institution, which does not need to consider the remaining facilities, has a valuation of $0.31>0.3$. In Case 2, the government's valuation is $0.232<0.3$, while the financial institution's valuation is $0.28<0.3$. In Case 3, the government's valuation is $0.116<0.3$, while the financial institution's valuation is $-0.28<0.3$. The results of the theoretical analysis and the numerical calculations are consistent for Cases 1 and 2. However, due to the high valuation of the facility purchase price and the low valuation of the externalities, they differ for Case 3.

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10 The government will decide whether to extend the life of the project from

$$0.5 \int_0^{0.3} (1 + 0.2)f(x)dx - (1 - 0.5) \int_0^{0.3} (0.1 \times 0.4)f(x)dx \geq 0.3.$$
Based on the above mentioned findings, it is clear that the government and the financial institution have different interpretations, depending on the valuation of the externalities and the RACTP, as in Case 1. In particular, it is interesting to note that if there is a large valuation of the RACTP (even after failing twice), the financial institution has the incentive to use the PFI method and extend the life of the project. Where there is low evaluation of externalities, as in Cases 2 and 3, the public utility is adopted. In other words, there is a tendency for the RACTP to be an incentive for quick termination of the project. Similar results are ascertained using other numerical integration algorithms such as the trapezoidal rule, Simpson’s rule, and the midpoint rule.

4 Case Study

This section provides a comparative verification of the theoretical consequences of Section 3 and the example of Taraso Fukuoka, Japan’s PFI business failure. This particular business was selected due to the definitive effect of the RACTP compared with other examples of business failures.¹¹

Taraso Fukuoka was a business that operated and maintained Taraso Therapy, which used warm seawater, exercise facilities, and facilities to promote regional community interaction and efficiently use thermal energy created from waste processed at the Fukuoka City waste disposal facility (Fukuoka City Seaside Facility). The main details of its operations are presented in Table 1.

¹¹ For example, “Maintenance and operations of HibikiContainer Terminal in Kita Kyushu, Fukuoka Prefecture,” “Operation of new hospital in Kochi City, Kochi Prefecture,” and “Operation of Shiritsu-Sogo Medical Center, Omihachiman, Shiga Prefecture.”
The history of Taraso Fukuoka’s business is presented in Table 2. After commencing operations in April 2002, the business deteriorated with sluggish user numbers in its first year, leading to the closure of the facilities and collapse of the former SPC (Taraso Fukuoka KK) in November 2004. The facilities subsequently reopened after a four-month break in April 2005 under a new SPC (Fukuoka Seaside PFI KK).

Table 2 History of Taraso Fukuoka’s collapse and revival
(Source: same as Table 1).
A reason for the collapse of the business was the existence of the RACTC. Inclusion of such a clause meant that the financial institution only invested to the "extent that it could recover the investment from Fukuoka City through the RACTP." As a result, a project financing scheme was used to recover the amount of the loan from the business profits. However, the expected role of the financial institution to monitor the business and enforce management discipline did not work.\textsuperscript{12} The main reason being that the RACTC only functioned as a type of security.

This clause was originally a method for a government to purchase the remaining facilities and provide an extended period of service when the provision of such service is required following termination. This was in accordance with the end of a contract that used a PFI method aimed at reducing costs, improving quality, and distributing risk to the public when there was a certain level of requirement from the local public for public service. However, in reality, this clause became a requirement in the name of service continuity. For this reason, the financial institution only provided loans up to the amount of the RACTP. The result was that the loan was risk-free to the financial institution. Furthermore, the project monitoring function and prompt corrective action (for deteriorating finances and eventual bankruptcy from the financial institution) were completely absent.

From a theoretical perspective, this is consistent with Proposition 1. More specifically, the entire loan amount to Taraso Fukuoka was guaranteed and the management deteriorated from the beginning, thus requiring additional costs. Under such circumstances, the financial institution had the incentive to quickly terminate the project rather than improve the business by extending its life.

\textsuperscript{12} Refer to the Fukuoka City PFI Promotion Committee, 2005.
Under Proposition 2, if a long-term project is desirable from a social welfare perspective, but the large additional cost and either one or both of the additional expected benefit and externalities are highly valued, then conferring a facility purchase clause is also considered desirable to avoid a short-term project. However, there were large additional costs for the Taraso Fukuoka operations with virtually no externalities evident. If the features of the business are considered, there would be no need for a facility purchase clause. At the very least, this clause should not have been mandatory, but nothing more than a so-called right.

Proposition 3 implies that an unconditional RACTP is undesirable in terms of social welfare. More specifically, when the price is the same amount as the external effect, it conforms to the optimal condition. In Taraso Fukuoka’s business, the financial institution considered the profitability of the project and not the risk of externalities. Thus, it merely decided to liquidate by exercising its right to the RACTP since the expected benefit was larger than what would have been obtained by extending the life of the project. If the evaluation criteria for this price had set an amount that was the same as the social value of the project, including externalities rather than the value of the remaining facilities at the time of business failure or end of the contract, then moral hazard would not have been created for the financial institution. Moreover, there may not have been such an inefficient quick termination or liquidation.

Finally, Proposition 4 cannot prove that the PFI method will necessarily be better than the public utility in accordance with the additional cost, risk, RACTP, and the external effect. In the case of Taraso Fukuoka, a better approach would have been to not provide additional funding and quickly terminate the project under the public utility, as in Case 2. However, the provision of a RACTP meant that the
PFI method, which can lead to an extension of the life of the project, was used. In sum, the public utility with quick termination would have been better for Taraso Fukuoka.

5 Conclusion

This paper conducted a theoretical analysis of the relationship between the effect of RACTC and additional funding for a PFI business that had failed once. There are four points in the overall argument. First, the increase (decrease) in the expected net benefit and the decrease (increase) in the additional funding and RACTP when a business has failed once provides the incentive for the financial institution to extend (quickly terminate) the life of the project. Second, depending on the additional costs, additional expected benefits, and externalities, there are cases in which conferring a RACTC is also beneficial for social welfare. Third, it is not beneficial in terms of social welfare to confer a RACTP for all businesses. Specifically, if this price is the same as the external effect, then it conforms to the optimal conditions. Fourth, it cannot be concluded that the PFI method is necessarily better than the public utility.

Based on these four theoretical conclusions, it is possible to determine whether there are clauses that can contribute to maximizing social welfare. These clauses include business details, externalities, public nature, additional costs if the business fails once, additional expected benefits, private benefits, and the setting of the facility purchase price. Furthermore, the results of a comparative verification of Taraso Fukuoka indicate that the quick termination or extension of the life of the project required a decision on whether the method of providing the business was through the PFI method or the public utility.
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