Master of Science in Engineering

Financial Analysis of Risk-Reallocation in PPP projects: focusing on the Transactions between Private Investors in Korea

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Abstract

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In last decades, project private partnerships (PPP) projects have been provided as solutions to reduce the government's financial burdens by encouraging private sector participation. The use of PPPs to build and operate infrastructure, such as roads, has been increasing in many countries worldwide. Due to the large project scale, long concession period, complexity, and social sensitivity, the risk-allocation between public sector and private sector is important for both parties to achieve a more efficient and profitable process during the concession period. Particularly, as the private sector investors aim to earn profits, the evaluation of the financial viability from the risk-allocation is very important for the stakeholders. In recent times, private sector allocates the

risk between private sector investors in terms of equity transaction and agreement transaction, after the abolishment of minimum revenue guarantee (MRG) which is the risk allocation agreement with the public sector in Korea. Especially, the additional risk-allocation have made the cash flows of private sector investors fluctuated and some of the PPP projects delayed. Therefore, analyzing the impact of risk reallocation between private sector investors on their cash flows is the critical for encouraging the private sector participants.

Although existing financial viability analysis models have considered risk-allocation in PPP projects, equity transaction and agreements transaction between private sector investors are not fully reflected in the models. However, It is difficult to understanding the fluctuation of private investor′s cash flows in recent projects because previous models have focused on the transaction and agreement in PPP primary market from SPC′s point of view. Therefore, the purpose of this research is to analyze the impact of risk-reallocation between private investors by developing the financial analysis model which considers the equity and agreements transaction in the PPP secondary market.

In this research, frameworks have established for identifying how the transactions affect private investors′ financial performance through reviews on recent PPP projects in Korea, and integrated research model that captures the impact of equity and agreement transaction on cash flows constructed by using Discounted Cash Flow (DCF) model. Based on this, the linkage between

transaction and investors' return on investment (ROI) have verified based on empirical analysis. This research can be used to better understand the impact of risk-reallocation on private investors' expected rate of returns, and the main contribution is that participants willing to invest in PPP projects can determine which strategy offers a superior performance.

Keywords: Public-Private Partnerships (PPPs), Discounted Cash flow (DCF), Risk Allocation, Equity Transaction, Agreement Transaction

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Chapter 1. Introduction

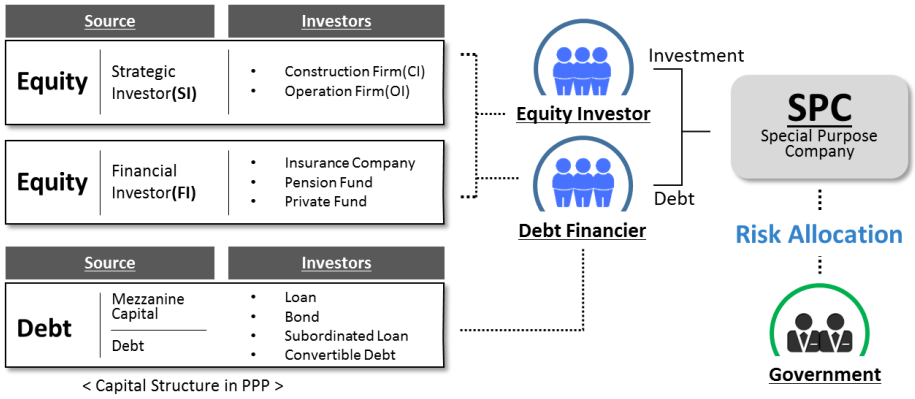
This chapter deals with the current risk allocation problem in the public private partnership (PPP) projects in terms of private sector investor's point of view. In addition, research process to acquire the objectives with effect is addressed.

1.1 Research Background

The use of public private partnerships (PPPs) to build and operate infrastructure or social facilities has been increasing in many countries worldwide (De Marco et al. 2013). Due to the characteristics of PPP projects, such as the large project scale, long concession period, complexity, and social sensitivity, public and private sector must particular attention on the project process while negotiating contracts for PPP to ensure a fair risk-allocation between them (Grimsey and Lewis 2002; Ke et al. 2010). The risk-allocation between public sector and private sector is important for both parties to achieve a more efficient and profitable process during the concession period (Li et al. 2005; Ke et al. 2010). In particular, as the private sector investors aim to earn profits, negotiating the agreements of risk-allocation is the critical process of determining the investment on PPP project (Pantelias 2010). Private sector investors assessing the risk-allocation strategy and its profitability by evaluating the financial viability of PPP projects (Zhang 2005; Pantelias 2010).

After the process of evaluating, private sector investors participate on PPP project through an equity contribution which can make them have the rights of project ownership. Private investors take the responsibility on the whole process (i.e. financing, design, construction, and operation) which were originally managed by public sector (Grout 1997; Yescombe 2007), and they earn the economic rights or return on equity (Tiong 1995; Grimsey and Lewis

2002; Schaufelberger 2003; KDI 2015). Since risk-allocation agreement with the public sector such as the minimum revenue guarantee (MRG) was abolished, private investors have experienced difficulty in securing profit. Additional risk-allocation between private investors occurred in recent times, in term of transaction (Kim et al, 2012).



< Capital Structure in PPP >

Figure 1-1. Capital Structure in PPP Projects

First, private investors transfer the risks to the other private parties through equity transaction. Commonly, PPP projects can be viewed as two distinct projects, a high-risk construction project and relatively low-risk operation project (Schaufelberger 2003). Private sector in PPP projects can also be divided into two investors, Exit Strategy Investors (ESI) and Stay Strategy Investors (SSI) (Public Infra Bulletin 2005; Epec 2009; Albornoz 2015; KDI 2015). ESI may be those who are solely interested in a return on their investments or those who have direct interest in project contract in construction

phase, and ESI have the strategies for securing liquidity by sale on equity. Otherwise, SSI may be the lender who are interested in a return on equity (ROE) or debt financing in whole concession period, and SSI have the strategies for expanding the rights of project by investment on ESI's equity. Due to the different objectives of the private investors, PPP secondary market have been grown for a long time and it can make private investors transfer the risk to the other private parties (Whitfield 2012).

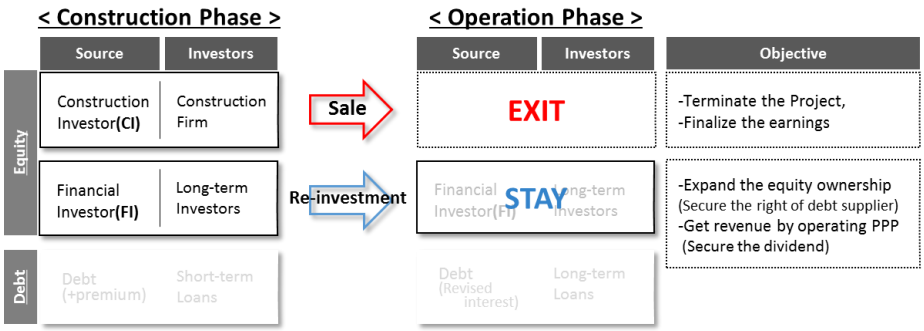


Figure 1-2. Different Investment Strategies in PPP Projects

Meanwhile, private investors in Korea re-allocate the risk with different investors through agreements transaction. Basically, various risks can be effectively managed by allocating them through appropriate contractual arrangements (Zhang 2005). The agreements are contracted between private investors with a financial structure that can transfer the risks of loss to other private investors, such as loss of construction, loss of debt financing. Especially,

some of the PPP projects in Korea were suspended after a public announcement due to delay on implementation agreement between private investors (KDI 2012).

The environment mentioned above have affected to the variability of private investor's cash flows, and the variability becomes the constraint on the PPP projects. PPP projects need to encourage the participation of both private investors ESI and SSI. Thus, the impacts of risk-reallocation between private investors need to be analyzed and additional plans for promoting the participation should be suggested to Korean PPP projects. In particular, it needs to identify how the equity transaction and agreements transaction affect the cash flow of private investors.

However, previous studies have evaluated the PPP projects based on the cash flows of the SPC and have not fully reflected the way in which risk-reallocation in terms of equity and agreement transactions affect the financial viability of private investors. The relationship between the risk reallocation and private investor's financial viability need to be addressed.

1.2 Research Objective and Scope

In order to assess the variability of private investor's financial viability from risk-reallocation, this research aims to evaluate the financial impact of equity and agreements transaction on the cash flow from the private investor's perspective. To analyze financially, the framework is established for identifying how the transactions affect private investors' financial performance through reviews on recent PPP projects in Korea. Moreover, integrated research model that captures the impact of equity and agreement transaction on cash flows is constructed by using Discounted Cash Flow (DCF) model. Based on this, the relationship between the transactions and private investors' return on investment (ROI) had verified based on empirical analysis.

The scope of this research is limited to transport sector projects where private investors transaction their equity and agreements. The reasons for the limitation is because the transactions between private investors have been processed only in the case of large scale transport sector projects. Furthermore, the transactions have been occurred only between construction investors (CI) who have a short -term strategy and financial investors (FI) who have a long-term strategy on PPP projects.

1.3 Research Process

In order to confirm the success of PPP projects, it is important to know whether special purpose company (SPC) has earned appropriate income during construction and operation through the project. From the private investor′s point of view, however, the feasibility of PPP projects can be identified by figuring out whether participants who are organizing the SPC have earned sufficient profit. Therefore, this research analyzes the impact of risk-allocation between private investors from their perspective.

The process of the study is based on the following.

(1) Identify the financial factors affecting the cash flows of ESI and SSI through literature reviews on equity transaction and agreements transaction.

(2) Study on Discounted Cash Flow (DCF) model for evaluating financial viability of the Project.

(3) Reflect the financial structure of equity transaction and agreements transaction derived through the literature reviews to the DCF model.

(4) Analyze the variance of private investor's profitability based on the DCF model from ESI and SSI's the point of view, and suggest improvement plans to derive a financial structure from the result of analysis.

The research process can be illustrated as Figure 1-3.

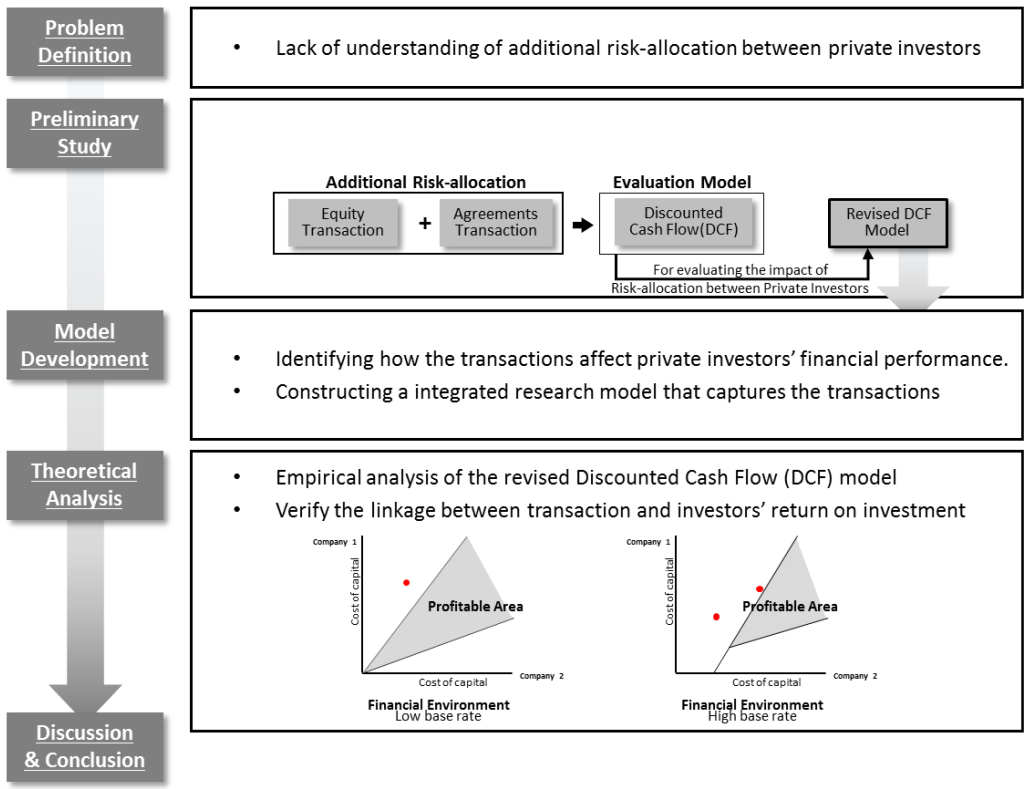


Figure 1-3 Research Process

Chapter 2. Preliminary Study

In this chapter, contents of preliminary studies for a risk allocation in PPP projects and financial viability analysis for evaluating the private investors' financial performance are described. In detail, studies for risk allocation between private sectors in PPP projects by researchers, especially equity transaction and agreement transaction, and the use of Discounted Cash Flow (DCF) as a methodology for this study were confirmed.

2.1 Risk Allocation in PPP Projects

During concession period in PPP projects, various risks have identified due to the characteristic of PPP like the large project scale, long concession period, complexity, and social sensitivity (Grimsey and Lewis 2002). In preparing for a PPP project, public sector would state its preferred allocation of project risks and private investors would assess their capability of taking these risks, and then propose a bidding price (Ke et al. 2010). Delmon (2000), Schaufelberger (2003), and Zhang (2005) identified risks in PPP projects as follows: development risk, completion risk, cost-increase risk, performance risk, operation risk, market risk, political risk, environment risk, and credit risk of project participants.

Moreover, the risks in PPP project had influenced on private investor's financial performance (i.e. return on investment, ROI). According to the research by Fitzegerald (1998) private investors had mitigated the risks through the way of followings: high equity/debt ratio, turnkey contracts, contractor performance bonds, third party guarantees, offtake contracts, government support and subsidy.

The SPC had earned revenue (i.e. toll fee during operational period) from PPP project by taking the risks. Otherwise, private investors who is organizing the SPC like construction company, financial institutions, operation company made profits from return on equity (ROE) or from the contracts (i.e. loan

contract, construction contract) (Schaufelberger 2003). As the private investors aim to earn profits, evaluating the risks and revenue of PPP projects is very important to decision-making on investment.

2.2 Financial Analysis Model for Risk-Allocation

The evaluation of project's financial viability is the most commonly used industry practice for assessing the potential of the project to achieve the financial targets of its various stakeholders and ultimately affects its selection for implementation (Pantelias 2010). In PPP projects, financial analysis is performed usually through assessing the cash flows in projects (Esty 1999).

Discounted Cash Flow (DCF) analysis is a well-established technique that has been successfully used in evaluating projects for several decades (Kodukula and Paoudesu 2006). Through the DCF model, the financial viability of PPP projects has been assessed based on the net present value (NPV), internal rate of return (IRR), or debt service coverage ratio (Zhang 2005), and those can be calculated by Eq. (1).

$$\sum_{i=0}^{n} \frac{CC_i}{(1+r)^i} = \sum_{i=n+1}^{n} \frac{OR_i - OC_i}{(1+r)^i} + \sum_{i=0}^{n} \frac{ANR_i}{(1+r)^i} \quad (1)$$

Meanwhile, the discount rate is important to evaluate the financial viability of PPP project as it includes the long-term concession period (Jeong 2015). The valuation of PPP projects often used to employ the weighted average cost of capital (WACC), which is the risk-adjusted discount rate under uncertainties (Ho and Liu 2002). And it is adopted as a concept of the project's returns from the perspective of total investment cost including equity and debt financing, and it can be calculated by Eq.(2) (Lee 2015).

$$\mathbf{WACC} = \boldsymbol{W_e}\times\boldsymbol{C_e} + \boldsymbol{W_d}\times\boldsymbol{C_d}\times(\mathbf{1}-\boldsymbol{tax}) \quad (2)$$

In the process of DCF analysis, the variables of cash-in and cash out generated in the concession period are very important to calculate the NPV (Ashuri 2012; Jeong 2015). Therefore, the studies of the financial viability of PPP project identified and assumed the variables of cash-out and cash-in.

Xueqing Zhang (2009) proposed the DCF model from the SPC's perspective, and used the variable of annual revenue (i.e. toll fee) as a cash-in and the variables of construction cost; annual operation cost; annual maintenance cost; depreciation; debt; tax as a cash-out.

Pantelias et al. (2010) established the DCF model from the SPC's perspective, and used the variable of annual revenue (i.e. toll fee) as a cash-in and the variables of total cost of construction; annual operation cost; annual maintenance and rehabilitation cost as a cash-out.

Jian-Cheng et al. (2013) identified the DCF models from public sector, shareholder, and creditor's point of view. In this research, annual revenue (i.e. metro ticket) and operating income were used as the variables of cash-in and construction cost; financing cost; operation cost; income tax were used as the variables of cash-out.

Jeong et al. (2015) developed the DCF model and Real Option Valuation (ROV) model from the SPC's perspective. This research used the variable of annual revenue (i.e. tolls) as cash-in and the variables of annual construction

cost; annual land use fee; annual operation cost, annual maintenance cost, debt service, tax as cash-out.

Albornoz and Solino (2015) analyzed the PPP secondary market through the DCF model from the shareholder's point of view. This research focused on equity transaction by using the variables of sale of the PPP project and annual net cash flow. Investment cost during construction phase; transaction entry cost were used as variables of cash-out.

Table 2-1 shows previous researched on financial viability analysis.

Table 2-1 Previous Researches on Financial Viability Analysis on PPP

Author	Perspective	Methodology	Variables of Cash- in	Variables of Cash- out
Zhang (2005)	SPC	Discounted Cash Flow Analysis (DCF)	Annual revenue (Tolls)	Construction cost/ Annual operation cost/ Annual maintenance cost/ Depreciation/ Debt/ Tax
Pantelias et al. (2010)	SPC	Discounted Cash Flow Analysis (DCF)	Annual revenue (Tolls)	Total cost of construction/ Annual operation cost/ Annual maintenance and rehabilitation cost
Jeong et al. (2015)	SPC	Discounted Cash Flow Analysis (DCF) Real Option Valuation (ROV)	Annual revenue (Tolls)	Annual construction cost/ Annual land use fee/ Annual operation cost/ Annual maintenance cost/ Debt service/ Tax
Jian et al. (2013)	Public sector Shareholder Creditor	Discounted Cash Flow Analysis (DCF)	Annual revenue (Metro ticket), Operating income	Construction cost/ Financing cost/ Operation cost/ Income tax
Albornoz et al. (2015)	Shareholder	Discounted Cash Flow Analysis (DCF)	Annual net cash flow, Sale of the PPP project	Investment cost during construction phase/ Transaction entry cost

2.3 Risk-Reallocation in PPP projects

2.3.1 Equity Transaction between Private Investors

Private sector investors participating in PPP projects can be classified as Exit Strategy Investors (ESI) and Stay Strategy Investors (SSI). In general, ESI's strategy is to sell their equity to the other parties and SSI usually purchase ESI's stake to expanding the rights of the PPP project (Figure 2-2). According to the research about the participants by Demirag et al. (2010), about 33% of private investors intended an early exit and 67% of the investors reported their intention to stay with a PPP until the end of the concession period. National Audit Office (2012) reported that infrastructure funds and other PPP companies accounted for 30% and 26% of equity purchasers. Other purchasers included toll road company (15%), pension funds (12%), PPP/bank joint ventures (5%).

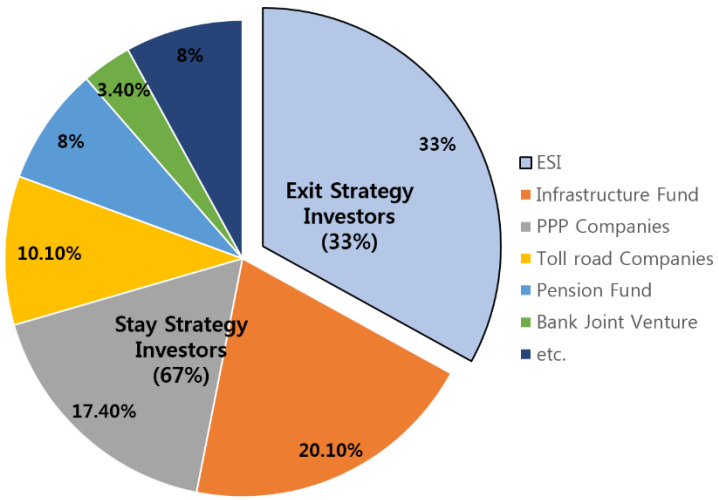


Figure 2-1 Private Investors in PPP Projects
(Demirag et al. 2010; National Audit Office 2012)

Due to the demand to sell or buy the project's equity, PPP secondary market was formed after the construction phase. Both ESI and SSI had traded a part or whole of the equity in the secondary market (Public Infra Bulletin 2005; Epec 2009; Whitfield 2010; International Public Partnership 2013; Albornoz 2015).

ESIs had earned profits from the sale of the equity or secured a liquidity through the equity transaction, and they could transfer potential risks from long concession period to SSIs. Otherwise, SSIs could plough into the operational phase or expand the rights of a PPP project through the equity transaction. The equity transaction has been increasing in recent times, and the reason of the growth is because private investors can participate in operational project where the risks that are considered to have a significant impact on the financial soundness of infrastructure were eliminated (Whitfield 2012).

Additional cash flows by the equity transaction have affected to private investor's financial performance (Albornoz 2015). The additional cash flows differed from the value of equity which was negotiated between ESI and SSI. But notice of the value, such as sale price and purchaser's profit, was rare because of the lack of transparency in most PPP equity transaction (National Audit Office 2012). Some researches by Hellowell and Vecchi (2012), Cuthbert (2008), Bain (2008) inferenced the value by estimating private investor′s internal rate of return of average return on equity, but those had a large variation

in time and size of PPP project. Therefore, it was difficult to utilize it as a basis for the price of equity traded between private investors. Meanwhile, the research by Albornoz (2015) estimated the price of equity by calculating the expected cash flow. It identified the discounted cash flow model with the variables of after tax shareholder average yearly net cash flow during the operational phase of the project, growth factor of net cash flow, discount rate, and period of project.

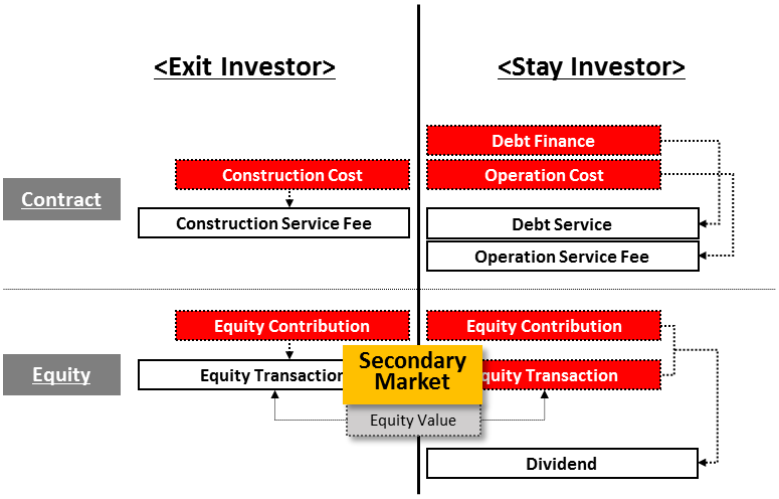


Figure 2-2 Structure of Equity Transaction

2.3.2 Agreements Transaction between Private Investors

Contractual agreements in large-scale infrastructure projects, such as road construction, are very important factors for private sector and public sector to allocate project risks (Sanvido et al. 1992). In normal, the agreements can be divided into two kinds of contracts, one is the contract between private and public sectors (i.e. concession agreement, subsidy etc.) and the other is the contract between the private sector investors (i.e. shareholder agreement, design and construction contract, loan agreement, insurance agreement, supply agreement, operation agreement, and offtake agreement) (Merna and Dubey 1998; Delmon 2000). Strong and effective legal input with the agreements at the beginning of the project cycle might have save time, efforts, and costs in the project (Asian Development Bank 1997).

In addition to the arrangements between public and private sector, additional agreements between private investors were signed. Particularly, these agreements are concluded between long-term investors such as financial institutions and short-term investors such as construction companies in Korean PPP project (Park 2014; Lee 2015). First, financial institutions as SSI transferred the demand risk that had been allocated with public sector through MRG to the ESIs, in terms of put option or credit default swap (CDS). Meanwhile, the construction companies as ESI transferred liquidity risk to SSIs whose financial competition has intensified due to the decline in the benchmark

interest rate. ESIs required a premium on the price of the equity sold after the construction phase or conclude the annulment of the CDS (Park 2014).

To sum up, the additional agreements between private investors are characterized by the function of transferring the risks previously allocated to the public sector in the past, so the private investors took the additional project risks recently. Therefore, this research aims to analyze the impact of the additional agreement on private sector investors' cash flows.

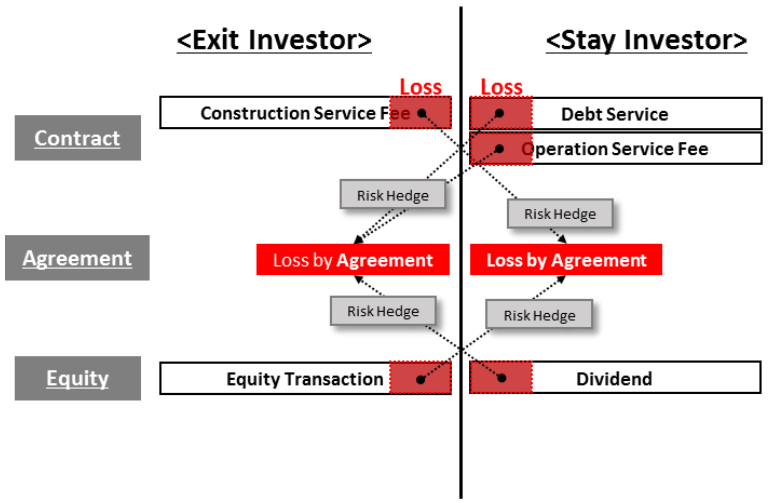


Figure 2-3 Structure of Agreements Transaction

2.4 Summary

In this chapter, investigated the process of allocating the risks in PPP projects and discounted cash flow (DCF) as methodology of evaluating the financial viability. The risk allocation is the key factor of improving the profitability of projects, so the private sector investors are allocating the risks by contributing the equity and contracting the agreements. However, there are additional risk allocation between private sector investors, which is the equity transaction and agreement transaction. First, ESI′s equity have been traded after the construction phase for transferring the risks to SSI, and the value of equity have been determined through the negotiation between ESI and SSI in PPP secondary market. Secondly, there are additional contractual agreements between ESI and SSI for preparation on demand risk, and private sector investors compensate for the project loss the other party by the agreements. However, the transactions between private sector investors are not fully reflected in previous research. Therefore, the methodology of this study, DCF was used to analyze the impact of transactions between private investors by evaluating the financial viability of PPP projects. Because it is a well-established technique that has been successfully used in evaluating the cash flows, and it is suitable for analyzing the impact of the equity and agreements transaction on the cash flows.

Chapter 3. Financial Analysis Model Development

In this chapter, revised DCF model considering equity transaction and agreement transaction between ESI and SSI was developed. First, this research identified the base DCF model from the ESI and SSI's point of view. Secondly, equity transaction was reflected by calculating the future value of equity based on the expected net cash flow of shareholders. Lastly, the agreements transaction was considered by identifying the influence factors in agreements.

3.1 General Concept of Model using Discounted Cash Flow (DCF) Analysis

In this chapter, revised DCF model was developed for analyzing the impact of equity transaction and agreement transaction between ESI and SSI on their financial performance, and the framework of this model was shown on Figure 3-1.

The private investor's financial performance can be evaluated by calculating the revenue as cash-in flows and the cost as cash-out flows in PPP project. There are three kinds of cash flows; cash flow from project contracts such as construction profit and loan interest, cash flow from equity transaction, cash flow from agreements transaction, and those are calculated differently according to the strategy of the private investors. First, ESI has cash-out flows such as equity investment, construction cost, reimbursement cost of opportunity cost for equity investment and cash-in flows such as construction profit, revenue from equity selling. Meanwhile, SSI has cash-out flows such as equity investment, loan investment, cost of purchasing the ESI's equity, reimbursement cost of opportunity cost for equity investment and cash-in flows such as principle and interest, dividend.

Furthermore, the followings are the assumptions in the financial evaluation of PPP project:

1. Discount rate capital structure: Basically, there are various financial

resources and capital structure are constructed for allocating the risks, so that the discount rate and capital structure are set in a complex manner in PPP projects. In order to improve the accuracy of the cash flow model, it is necessary to reflect the cash flow that reflects the characteristics of the complex financial resources. However, in this case, there is a limitation in analyzing the correlation between the single variable and the rate of returns of private investor's. For the purpose of this research, the DCF model is assumed to consist solely of a single discount rate and the resources of ESI and SSI.

2. Uncertainty in PPP project: Cash flows by private investors include commissions and taxes, and additional cash flows arise especially due to uncertainties in long-term project. There are various deviations according to the policies of public sector, such as government and authorities (Jeong 2015). The uncertainty in this research is assumed to be provided through the agreements between private investors, and it is reflected to the DCF model.
3. Equity and agreement transaction: Private investors participating in PPP projects are limited to ESI and SSI, and the transactions after the construction phase are also limited to occur between ESI and SSI.

The DCF model for the returns and costs of private investors assuming the above assumptions was derived from previous studies and modified to fit the purpose of this study, and Figure 3-1 shows model framework of this research.

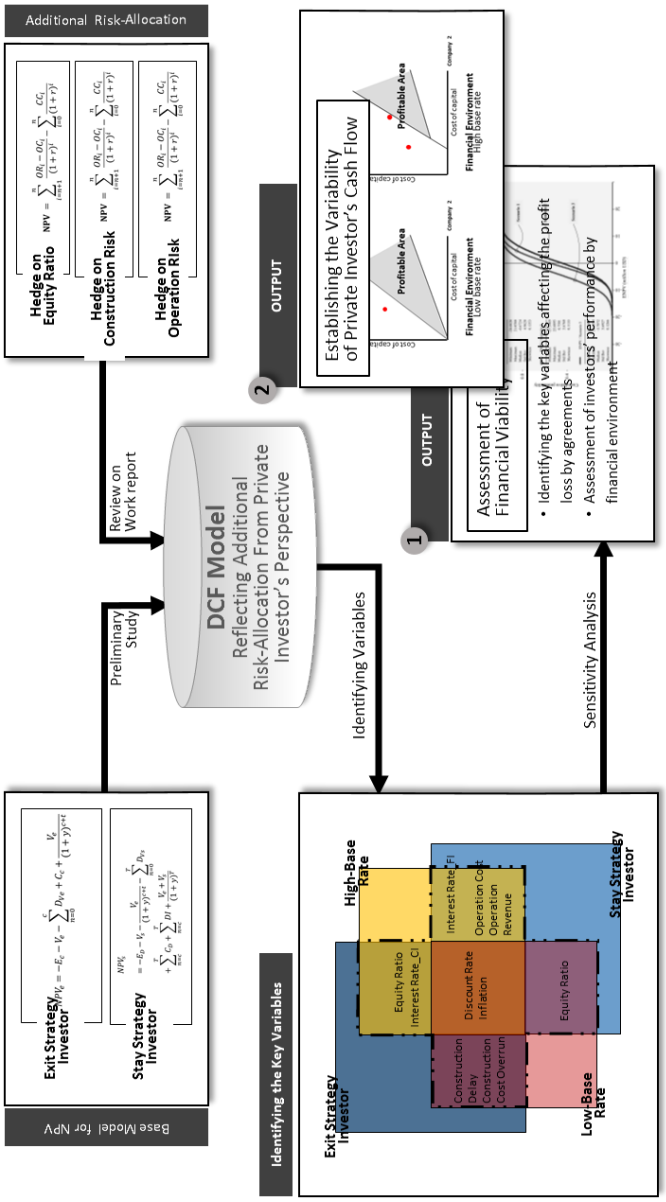


Figure 3-1. Model Framework

In addition, the cash flow factors in this study were derived from the perspective of private investors and develop a DCF model based on the this. At first, the cash flows can be divided into the equity investment and cash flows from project contracts. Moreover, the cash flows from the equity investment can be divided into equity contribution and return on equity (ROE), and the cash flow from the project contract can be separated into the cost of project execution and compensation accordingly.

Also, additional cash flows arise from equity transaction between private investors in the PPP secondary market, and the cash flows depends on the price of the ESI-sold equity. In general, the price of the equity negotiated and traded by the private investors is based on expectations of the project's future cash flows. These future cash flows typically come from operating revenues, such as tolls, from the perspective of the SPC (Cooper 2014). From the private investor's perspective, however, tolls are not calculated as direct cash inflows but are calculated in the form of dividend income or interest income on equity contributions. Therefore, in this study, the price of equity is calculated based on the expected return on dividend or interest incomes by equity contribution, which is modified by the equation of Albornoz (2015) for this study purpose.

The cash flow model of private investors considering the above assumptions has variables of project cost (O_p); equity contribution cost (V); profit from the contract (I_p). In addition, the price of equity is calculated base

on the net cash flows during operational period (F); expected rate of returns or discount rate of investors (y); growth factor of net cash flows (g) in the following Eq. (3).

$$\boldsymbol{NPV = -O_p - V + I_p + \sum_{c}^{T} \frac{F(1+g)^{n-c}}{(1+y)^n}} \quad (3)$$

3.2 DCF Model Development for Risk-Reallocation Analysis

3.2.1 Model from ESI and SSI's Perspective

In this section, the cash flows of ESI and SSI were analyzed by using the DCF model of the private investors identified above. This research is based on the premise that ESI would close the project financially by selling their equity at once after the completion of the construction period like Fig. 3-2. Also, SSI would purchase the ESI's equity and sell it once after the concession period like Fig. 3-3.

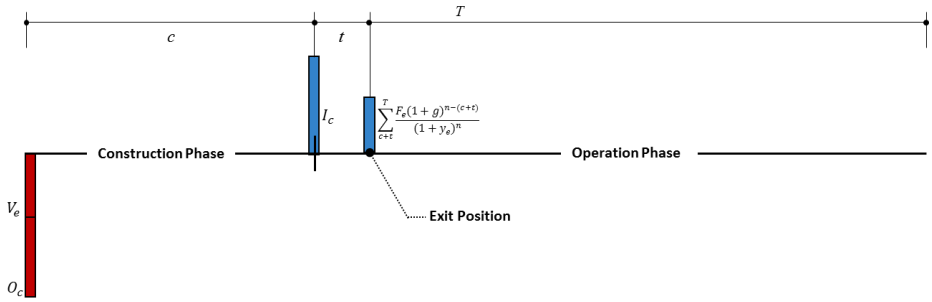


Figure 3-2. ESI's Net Cash Flow

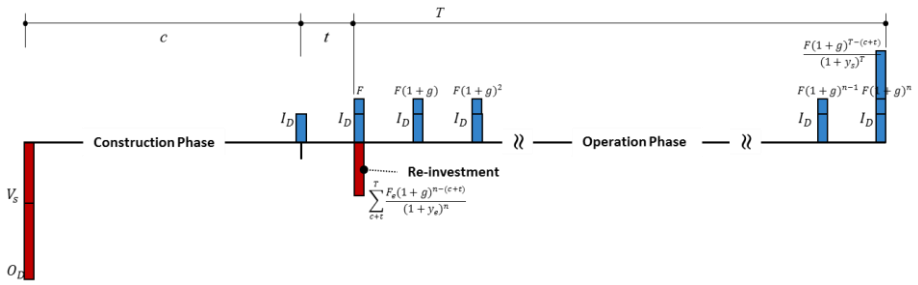


Figure 3-3. SSI's Net Cash Flow

As evidenced in the preceding chapters, ESI's cash flows arise from the return on equity investment and the construction contract. First, cash outflows are calculated with the variables of equity contribution by ESI (V_e); construction cost (O_c), and cash inflows are calculated by incomes from construction (I_c); equity selling price (V'_e). The V'_e is calculated by following equation which has variables of the expected return on dividend or interest incomes of ESI (F_e); growth factor of net cash flows (g_e); construction period (c); concession period (T); discount rate of ESI (y_e):

$$\boldsymbol{V'_e = \sum_{c+t}^{T} \frac{F_e(1+g)^{n-(c+t)}}{(1+y_e)^n}} \quad (4)$$

ESI's NPV (NPV_e) is the result of adding all the discounted net cash flows of the project, and it is calculated by following equation:

$$\boldsymbol{NPV_e = -O_c - V_e + I_c + \sum_{n=c+t}^{T} \frac{F_e(1+g)^{n-(c+t)}}{(1+y_e)^n}} \quad (5)$$

Meanwhile, SSI's cash flows arise from the return on equity investment and loan contract. First, cash outflows are calculated with the variables of equity contribution by SSI (V_s); loan investment (O_D); equity purchasing price (V'_e), and cash inflows are calculated based on the variables of principle and interest (I_D); dividend or interest income during operation period (D_s); equity selling price after concession period (V'_s). The D_s and V'_s are calculated by

following equation Eq. (6) and Eq. (7) with the variables of the expected return on dividend or interest incomes (F); growth factor of net cash flows g (); discount rate of SSI (y_s):

$$\boldsymbol{D_s = \sum_{c+t}^{T} \frac{F(1+g)^{n-(c+t)}}{(1+y_s)^n}} \quad (6)$$

$$\boldsymbol{V'_s = \frac{F(1+g)^{T-(c+t)}}{(1+y_s)^T}} \quad (7)$$

In the case of I_D is calculated by assuming an equitable repayment with the SSI's rate of return (y_s) as the interest rate through the equation Eq. (8).

$$\boldsymbol{I_D = \frac{O_D \cdot y_s(1+y_s)^T}{(1+y_s)^{T-c}-1} \cdot \sum_{n=c}^{T} \frac{1}{(1+y_S)^n}} \quad (8)$$

SSI's NPV (NPV_s) is the result of adding all the discounted net cash flows of the project, and it is calculated by following equation:

$$NPV_s = -O_D - V_s + \frac{O_D \cdot y_s(1+y_s)^T}{(1+y_s)^{T-c}-1} \cdot \sum_{n=c}^{T} \frac{1}{(1+y_S)^n}$$

$$- \sum_{c+t}^{T} \frac{F_e(1+g)^{n-(c+t)}}{(1+y_e)^n} + \sum_{n=c+t}^{T} \frac{F(1+g)^{n-(c+t)}}{(1+y_S)^n}$$

$$+ \frac{F(1+g)^{T-(c+t)}}{(1+y_s)^T} \qquad (9)$$

3.2.2 Analysis Model of Equity Transaction

In this section, the expected return on dividend or interest incomes (F, F_e) are identified for calculating the price of equity (V'_e, V'_s). The amount of dividend or interest income that can be expected from investing in the equity varied widely among PPP projects, and there is no dividend in some of the project. In particular, uncertainty due to long-term periods makes it difficult to draw cash flows in the future (KDI 2012). Thus, this research assume that the size of dividend or interest income expected from investing equity depends on the cost of equity investment. F and F_e can be calculated by discounting the future price of the equity (V_e, V) at ESI or SSI's cost of capital (r) through following equation:

$$\boldsymbol{F = \frac{V(1+r)^T}{\sum(1+r)^{n-1}}} \tag{10}$$

The price of ESI's equity is calculated by following equation:

$$\boldsymbol{V'_e = \frac{V_e(1+r_e)^T}{\sum_c^T(1+r_e)^{n-1}} \cdot \sum_{n=c+t}^{T} \frac{(1+g_e)^{n-(c+t)}}{(1+y_e)^n}} \tag{11}$$

SSI's NPV (NPV_s) is calculated by following equation:

$$NPV_s = O_D\left[\frac{y_{sD}(1+y_{sD})^T}{(1+y_{sD})^{T-c}-1}\cdot\sum_{n=c}^{T}\frac{1}{(1+y_s)^n}-1\right]-V_s$$
$$+\frac{V(1+r_s)^T}{\sum_c^T(1+r_s)^{n-1}}\cdot\sum_{n=c+t}^{T}\frac{(1+g_s)^{n-(c+t)}}{(1+y_s)^n}$$
$$-\left[\frac{V_e(1+r_e)^T}{\sum_c^T(1+r_e)^{n-1}}\cdot\sum_{n=c+t}^{T}\frac{(1+g_e)^{n-(c+t)}}{(1+y_e)^n}\right]$$
$$\cdot\frac{1}{(1+y_s)^c}+\frac{V(1+r_s)^T}{\sum_c^T(1+r_s)^{n-1}}\cdot\frac{(1+g_s)^{T-(c+t)}}{(1+y_s)^T} \quad (12)$$

This equation has variables of O_D (loan investment); V (the initial price of equity); V_e (the initial price of equity of ESI); r_s (SSI's cost of capital); r_e(ESI's cost of capital); g_s (growth factor of SSI's dividend and interest income); g_e (growth factor of ESI's dividend and interest income); c (construction period); T (concession period); y_s; (SSI's discount rate); y_e (ESI's discount rate). Under the condition of $NPV_s = 0$, the DCF model obtains variable y_s and y_e as a IRR or expected rate of return, the variables determine the relationship between private investor's profitability and equity transaction.

3.2.3 Analysis Model considering Agreements Transaction

In this section, the structures of the agreements between ESI and SSI are analyzed, and to further identify the influence factors that affect the cash flows of private investors. In addition, the influence factors are reflected to the DCF model for considering the agreements transaction.

The agreements between private investors are basically contracted in order to prepare for the loss by the risk of the PPP project. The structures of the agreements are to transfer the risk of the ownership, the risks at the stage of construction or operation to the other private parties (Park 2010; Park 2014).

First, an agreement for equity contribution (A_q) is the contract to adjust the investment ratio in the early stages of all of the PPP projects. Generally, expected cash flows by dividend or interest income is depending on the ratio of equity contribution. However, it also includes liquidity risk, due to the nature of the PPP project in which large-scale financial resources are invested (Park 2014). Under the characteristic of PPP projects, A_q determines the size of the initial investment cost of the private investors, and it is affecting the cash flows of them in the form of interest cost or opportunity cost at the same time. Therefore, the ratio of V_e and V_s could be the influence factors of agreement A_q, and the factors are reflected to the DCF model.

Secondly, an agreement for the risks in the stage of construction (A_c) is the contract on the cost of equity premiums paid to ESI at the stage of equity

transaction. The agreement was negotiated in Korean PPP project, such as S underpass project in Seoul (2010), J tunnel project in Seoul (2012), O express way project in Gyeongi-do (2015). Due to the decline in the benchmark interest rate, domestic banks and insurers had lost the profitability of traditional loans, bonds, and securities investments, which has led to participate in alternative investment projects. The environment of Korean financial market had intensified financial competition between SSIs (i.e. financial institutions). In the process of equity transaction, ESI increased the price of their equity and SSI purchased it with an additional cost (Park 2014). It might be seen as the agreement A_c determined the size of g_e(growth factor of net cash flow by selling the equity), and the g_e affect to the size of V'_e (the price of ESI's equity). Therefore, g_e could be the influence factors of agreement A_c, and the factors are reflected to the DCF model.

Lastly, an agreement for the risks in the stage of operation (A_o) is the contract about compensation for the loss of revenue in PPP projects. If the amount of traffic or revenue does not reach the level that expected by the initial agreement, A_o would be activated. The agreement can be divided into two types of contracts; a put option for operating revenue (A_{oP}) and credit default swap (CDS) (A_{oD}) for interest return (KDI 2013). First, A_{oP} was an agreement between the public and private sector in the form of put option as an income guarantee. Although it had promoted the PPP projects by sharing the risks

between the public sector and the private sector, it is now being abolished or renegotiated because it had the structural problems that can deliberately overestimate traffic volume. SSI was exposed to the risk from the lack of demand, so SSI have transferred part of the risk to the ESI (KDI 2015). It might be seen as A_{op} determined the size of g_s(growth factor of net cash flow by purchasing the equity), and the g_s affect to value of V'_s (Expected cash flow by purchasing the equity). Therefore, g_s could be the influence factor of agreement A_{oP}, and the factors are reflected to the DCF model. Otherwise, A_{oD} is an agreement to prepare for the risk of the repayment income by lower operating profit in terms of CDS (KDI 2015). A_{oD} has a structure of jointly responsible for financial risk in PPP projects. In some of the recent PPP projects, ESI has contracted an agreement to transfer the risk to SSI by termination of CDS. It might be seen as A_{oD} determined the size of y_{sD} (debt interest rate), and the y_{sD} affect to value of I_D (repayment income of SSI). Therefore, y_{sD} could be the influence factor of the agreement A_{oD}.

In this research, the range of cash flow variability by compensation is limited to the loss of earnings which was negotiated at the initial stage. Also, the cash flow variability by the agreements is to be changed by adjusting the ratio to the influence factors. SSI's NPV is calculated by considering the equity and agreements transaction in following equation:

$$NPV_s = O_D\left[\frac{y_{sD}\cdot A_o(1+y_{sD}\cdot A_o)^T}{(1+y_{sD}\cdot A_o)^{T-c}-1}\cdot\sum_{n=c}^{T}\frac{1}{(1+y_s)^n}-1\right]-V_s$$

$$+\frac{V(1+r_s)^T}{\sum_c^T(1+r_s)^{n-1}}\cdot\sum_{n=c+t}^{T}\frac{(1+g_s\cdot A_o)^{n-(c+t)}}{(1+y_s)^n}$$

$$-\left[\frac{V_e(1+r_e)^T}{\sum_c^T(1+r_e)^{n-1}}\cdot\sum_{n=c+t}^{T}\frac{(1+g_e\cdot A_c)^{n-(c+t)}}{(1+y_e)^n}\right]$$

$$\cdot\frac{1}{(1+y_s)^c}+\frac{V(1+r_s)^T}{\sum_c^T(1+r_s)^{n-1}}\cdot \qquad (13)$$

This equation has variables of O_D (loan investment); V (the initial price of equity); V_e (the initial price of equity of ESI); r_s (SSI's cost of capital); r_e(ESI's cost of capital); g_s (growth factor of SSI's dividend and interest income); g_e (growth factor of ESI's dividend and interest income); c (construction period); T (concession period) y_s; (SSI's discount rate); y_e (ESI's discount rate). Under the condition of $NPV_s = 0$, the DCF model obtains variable y_s and y_e as a IRR or expected rate of return, the variables determine the impact of equity and agreement transaction on private investor's expected rate of return.

3.3 Model Test: The Implication of Cases in Korea

The variables identified in the DCF model are loan investment (O_D); the cost of equity contribution (V, V_e); private investor's cost of capital (r_s, r_e); growth factor of dividend or interest income (g_s, g_e); construction period (c); concession period (T). Variables were adopted the most common values in 18 Korean PPP projects from 1997 to 2010 are following:

1) Expenditure of debt financing ($\boldsymbol{O_D}$): Value of debt financing depends on the size of the investment and project, and the average of the value is 842,560,000,000 KRW.
2) Value of equity contribution (V_s, V_e): Value of equity contribution depends on the size of the investment and regulation. In Korea, minimum percentage of PPP project is 20%, and the average of the value is 292,740,000,000 KRW. Also, the ratio of equity is determined by private investors', the base model use the ratio of 20:80.
3) Cost of capital for equity investment ($\boldsymbol{r_s}$, $\boldsymbol{r_e}$): In the absence of information on actual return on equity (ROE), benchmark interest rate in Korea (1.25%) is used in this model.
4) Length of construction period ($\boldsymbol{c}$): the average of construction period, 5 years, is used
5) Length of concession period ($\boldsymbol{T}$): the average of concession period, 35 years, is used in this research

6) Growth factor of private investors net cash flow ($\boldsymbol{g_s}$, $\boldsymbol{g_e}$): the consumer price index in Korea from 1997 to 2010, 3.26%, is used in this research.

Through the DCF model with the value of the variables, the relationship between y_s (expected rate of return of SSI) and y_e(expected rate of return of ESI) is identified like figure 3-4. If the PPP project is arranged between private investors to be made within the extent of $y_e, y_s > 0$, which means ESI and SSI does not draw up a deficit contract, ESI might expect the rate of returns from 0.000% to 9.936%, and SSI might expect the rate of returns from 8.399% to 36.812%. Especially, ESI expect the maximum rate of returns at 9.936%, as y_s=20.599%.

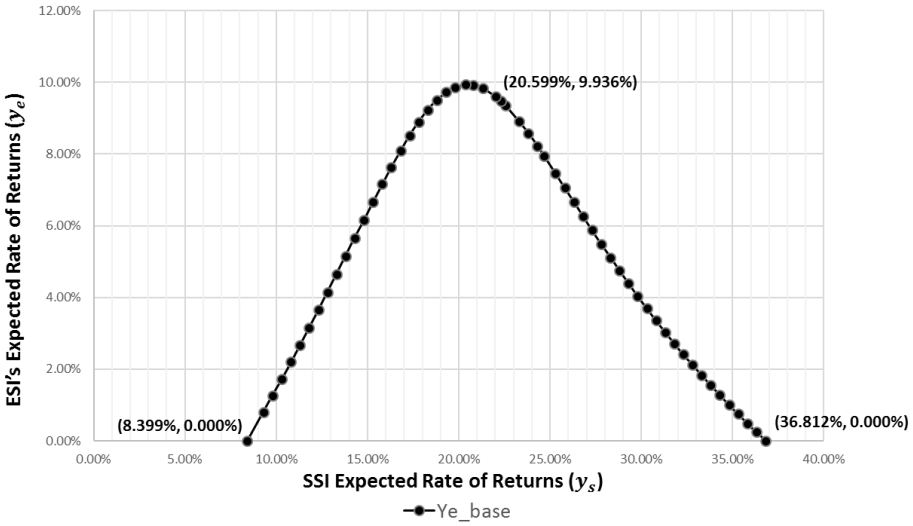


Figure 3-4. Relationship between ESI and SSI's Expected Rate of Returns

Table 3-1. The Result of the Base Case

IRR (%) / Input Variable	y_e ($y_e > 0$)	y_s ($y_s > 0$)
Base case	0.000 ~ 9.936	8.399 ~ 36.812

3.4 Summary

To develop revised discounted cash flow (DCF) model considering the characteristics of equity transaction and agreement transaction, existing contract information has reviewed. Then, the variables and influence factors are identified. Finally, the variables about equity transaction and influence factors of agreement transaction are reflected to the previous DCF model, the revised DCF model from the private investor's perspective is developed.

Chapter 4. Risk Reallocation Analysis

To analyze the relationship between the transactions and private investor's return, the key variables are identified in this chapter. The size of the major variables from the DCF model is estimated through the existing PPP projects in Korea. Furthermore, the size is assigned to the DCF model to measure the variability of the ESI and the SSI according to the equity and agreements transaction. At last, the impact of the transaction between private investors is analyzed through the DCF model.

4.1 The Impact of the Equity Transaction

4.1.1 Key Variables on Equity Transaction

Additional cash flows by the equity transaction are differed from the value of equity which was negotiated between ESI and SSI. The variability of y_e and y_s from the additional cash flow by equity transaction is affected by the price of ESI's equity. The price of ESI's equity is based on the expected net cash flow from dividend which is calculated by equation (10). According the equation (10), the expected net cash flow from dividend is fluctuated by private investor's initial equity value and cost of capital for equity investment. Moreover, the ESI's equity price depends on the ESI's discount rate and growth rate of net cash flow. According to the equation (11), ESI's equity price is calculated with Initial equity value, cost of capital, and growth factor.

The key variables identified in the analysis model (eq. 11) developed in the previous chapter are the followings:

1. V_e(Initial equity value of ESI)
2. r_e(ESI s cost of capital)
3. g_e(growth factor of expected net cash flow of ESI).

4.1.2 Equity Transaction's Effects on Private Investor's Financial Performance

The relationship between y_e and y_s established in previous chapter is set as a base case (figure 3-4), and the variability of y_e and y_s by equity transaction is compared to the base case.

In this research, the variability of y_e and y_s by equity transaction was established through a sensitivity analysis on the key variables of the transaction. The sensitivity analysis was conducted by assuming that the values of the key variables were reduced by 10% each.

The results of the sensitivity analysis are established on Figure 4-1.

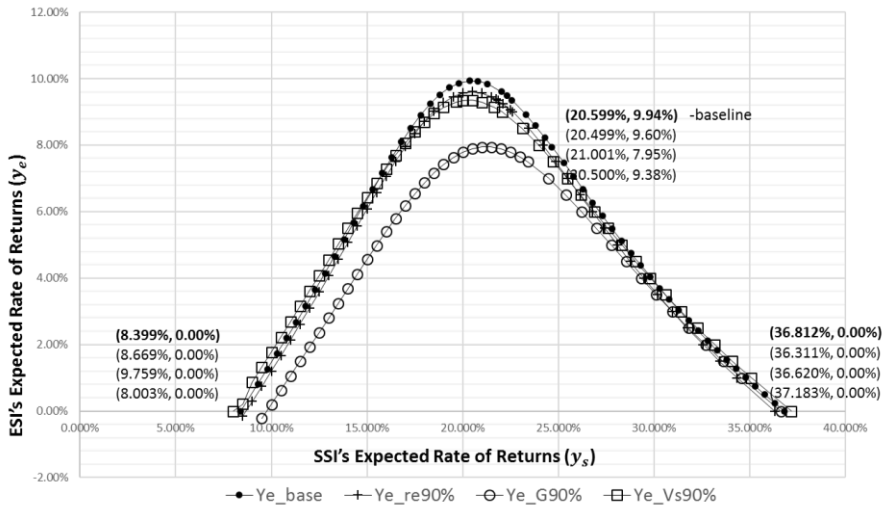


Figure 4-1. The Impact of Equity Transaction on Private Investors' Rate of Returns

Table 4-2. The Results of Sensitivity Analysis of Key Variables

IRR (%) / Input Variable	y'_e ($y_e > 0$)	y'_s ($y_s > 0$)
Base case	0.000 ~ 9.936	8.399 ~ 36.812
1.1 r_e	0.000 ~ 9.604	8.699 ~ 36.311
0.9 g_e	0.000 ~ 7.946	9.759 ~ 36.620
1.1 V_e	0.000 ~ 9.935	8.003 ~ 37.183

First, when r_e (ESI's cost of capital) was reduced 10% compared to base case, y_e could expect the rate of return from 0.000% to 9.604% and y'_s could expect the rate of return from 8.699% to 36.311%.

Secondly, when g_e (growth factor of expected net cash flow of ESI) was reduced 10% compared to base case, y_e could expect the rate of return from 0.000% to 7.946% and y'_s could expect the rate of return from 9.759% to 36.620%.

Lastly, when V_e (Initial price of ESI's equity) was reduced 10% compared to base case, y_e could expect the rate of return from 0.000% to 9.935% and y'_s could expect the rate of return from 8.003% to 37.183%.

Additionally, the rate of returns is compared separately based on the ESI and SSI's perspective in order to understand the impact of the variables on each private investors' returns.

First, the variability from the ESI's point of view is calculated by the $y'_e - y_e$ based on the SSI's expected rate of returns ($x = y'_s$). In this research, PPP project is arranged between private investors to be made within the extent of $y_e > 0$, which means ESI and SSI does not draw up a deficit contract.

The results of the variability are established on Figure 4-3

Figure 4-3 shows that ($y'_e - y_e$) has the order of $V_e < r_e < g_e$ in the range of $9.30\% < y'_s \leq 17.82\%$, the order of $V_e < g_e < r_e$ in the range of

$17.82\% < y'_s \leq 25.81\%$, and the order of $V_e < r_e < g_e$ in the range of $25.81\% < y'_s \leq 36.81\%$.

Secondly, the variability from the SSI's point of view is calculated by the $y'_s - y_s$ based on the ESI's expected rate of returns ($x = y'_e$). However, the DCF model has multiple values of $y'_s - y_s$ because y'_e can be obtained by y'_{s1} and y'_{s2}. Therefore, this research assumes that $y'_s = \min(y'_{s1}, y'_{s2})$, and it can be seen in Figure 4-4.

According to Figure 4-4, that $(y'_s - y_s)$ has the order of $V_e < r_e < g_e$ in the range of $0.00\% < y'_s \leq 7.95\%$, the order of $V_e < r_e$ in the range of $7.95\% < y'_s \leq 8.72\%$, and the order of $r_e < V_e$ in the range of $8.72\% < y'_s \leq 9.34\%$.

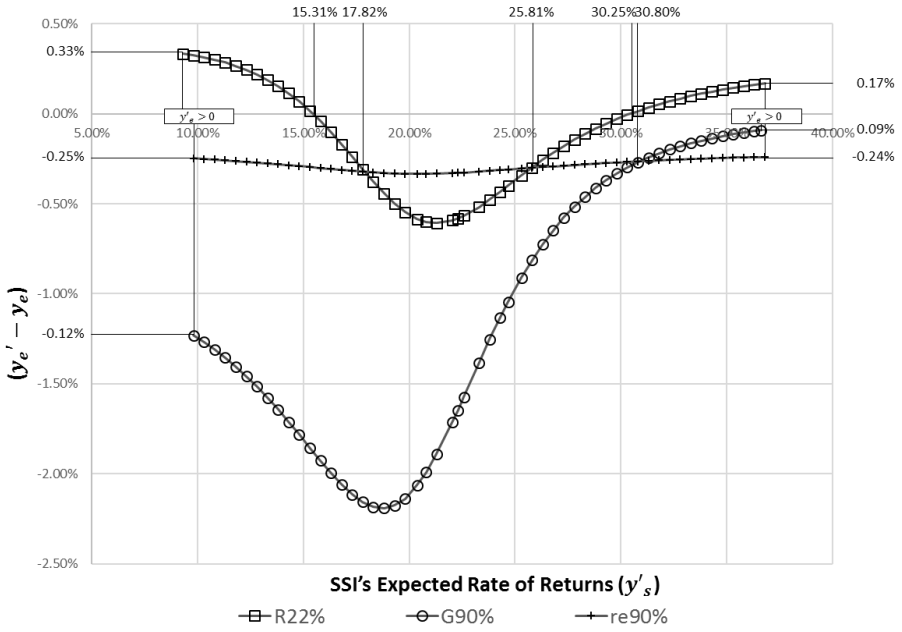


Figure 4-3. The Impact of Equity Transaction from the ESI's Perspective

Table 4-3. The Result of ESI's Profit Variability by Equity Transaction

Variability (%) / SSI's IRR (%)	$y'_e - y_e$ ($y_e > 0$)		
	1.1 r_e	0.9 g_e	1.1 V_e
9.30 <y'_s ≤ 17.82	+0.334 ~ -0.321	-1.231 ~ -2.157	+0.334 ~ -0.321
17.82 <y'_s ≤ 25.81	-0.321 ~ -0.300	-2.157 ~ -0.813	-0.321 ~ -0.300
25.81 <y'_s ≤ 36.81	-0.300 ~ -0.240	-0.813 ~ -0.091	-0.300 ~ +0.169

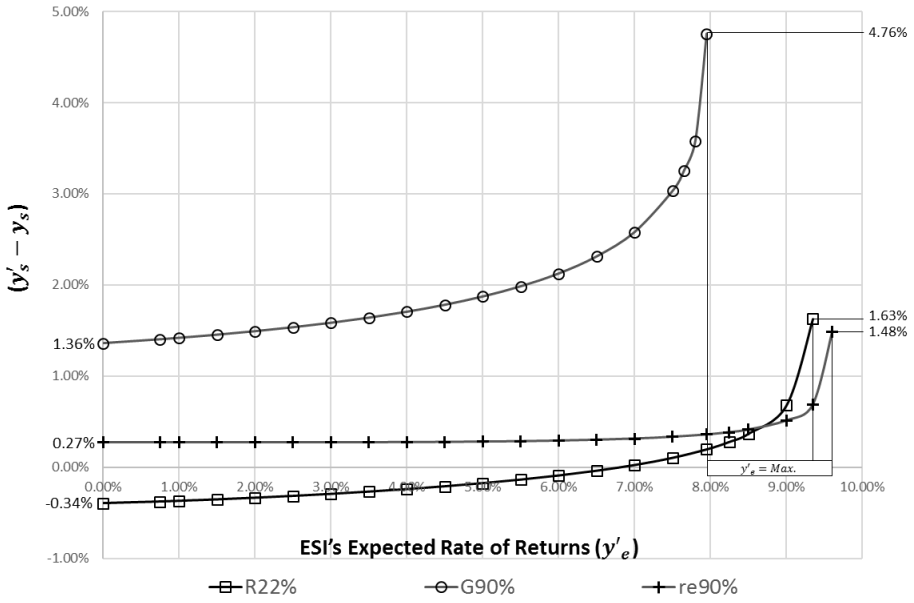


Figure 4-4. The Impact of Equity Transaction from the SSI's Perspective

Table 4-4. The Result of SSI's Profit Variability by Equity Transaction

Variability (%) / ESI's IRR (%)	$y'_s - y_s$ ($y_s > 0$)		
	1.1 r_e	0.9 g_e	1.1 V_e
0.00 <y'_e ≤ 7.95	+0.270 ~ +0.358	+1.359 ~ +4.759	-0.396 ~ +0.196
7.95 <y'_e ≤ 8.72	+0.358 ~ +0.411	-	+0.196 ~ +0.411
8.72 <y'_e ≤ 9.34	+0.411 ~ +0.685	-	+0.411 ~ +1.629
9.34 <y'_e ≤ 9.60	+0.685~ +1.485	-	-

4.2 The Impact of the Agreements Transaction

4.2.1 Influence Factors on Agreements Transaction

Additional cash flows by the agreements transaction are fluctuated from the agreements between private investors are basically contracted in order to prepare for the loss by the risk of the PPP project. The structures of the agreements are to reallocate the risk of the ownership (by agreement A_q), the risks at the stage of construction (by agreement A_c), or operation to the other private sector investors (by agreement A_{oP} or A_{oD}). The agreements above have been increasing or decreasing the private investor's financial viability through influence factors. In other words, the variability of y_e and y_s by agreement transaction is affected by the influence factors of the agreements. In this study, the influence factors were identified in previous chapter through literature reviews on actual contract in PPP projects. These are the followins:

1. Initial price of equity (V_e and V_s)
2. Growth factor of net cash flow by selling the equity from ESI's point of view (g_e)
3. Growth factor of net cash flow by purchasing the equity from SSI's point of view (g_s)
4. Interest rate for debt investment of SSI (y_{sD}).

4.2.2 Agreement Transaction's Effects on Private Investor's Financial Performance

In this research, the variability of y_e and y_s by agreements transaction was established through a sensitivity analysis on the influence factors. The sensitivity analysis was conducted by assuming that the values of the influence factors were decreased or increased by 10% each. The relationship between y_e and y_s established in previous chapter is set as a base case (figure 3-4), and the variability of y_e and y_s by equity and agreements transaction is compared to the base case.

The results of the sensitivity analysis are established on Figure 4-5

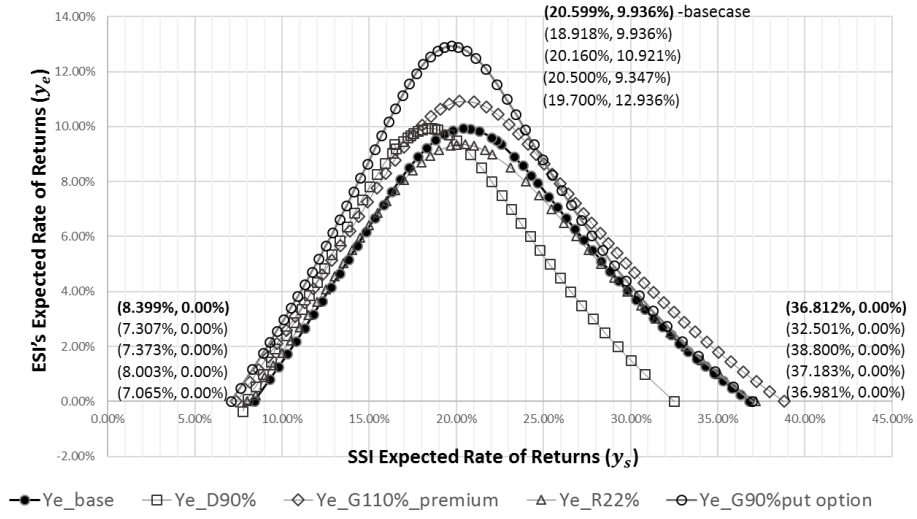


Figure 4-5. The Impact of Agreements Transaction on Private Investors' Rate of Returns

Table 4-5. The Results of Sensitivity Analysis of Influence Factors

IRR (%) / Input Variable	y'_e ($y_e > 0$)	y'_s ($y_s > 0$)
Base case	+0.000 ~ +9.936	+8.399 ~ +36.812
0.9 y_{sD}	+0.000 ~ +9.936	+7.307 ~ +32.501
1.1 g_e	+0.000 ~ +10.921	+7.373 ~ +38.800
1.1 V_s	+0.000 ~ +9.347	+8.003 ~ +37.183
0.9 g_s	+0.000 ~ +12.936	+7.065 ~ +36.981

First, when y_{sD} was reduced 10% compared to base case, y_e could expect the rate of return from 0.000% to 9.936% and y'_s could expect the rate of return from 7.307% to 32.501%.

Secondly, when g_e was increased 10% compared to base case, y_e could expect the rate of return from 0.000% to 10.921% and y'_s could expect the rate of return from 7.307% to 32.501%.

Thirdly, when V_s was increased 10% compared to base case, y_e could expect the rate of return from 0.000% to 9.347% and y'_s could expect the rate of return from 8.003% to 37.183%.

Lastly, when g_s was reduced 10% compared to base case, y_e could expect the rate of return from 0.000% to 12.936% and y'_s could expect the rate of return from 7.065% to 36.981%.

Additionally, the rate of returns is compared separately based on the ESI and SSI's perspective in order to understand the impact of the influence factors on each private investors' returns.

First, the variability from the ESI's point of view is calculated by the $y'_e - y_e$ based on the SSI's expected rate of returns ($x = y'_s$). In this research, PPP project is arranged between private investors to be made within the extent of $y_e > 0$, which means ESI and SSI does not draw up a deficit contract.

The results of the variability are established on Figure 4-6.

Figure 4-6 shows that $(y'_e - y_e)$ has the order of $V_s < y_{sD} < g_s < g_e$ in the range of $8.40\% < y'_s \leq 11.80\%$, the order of $V_s < g_s < y_{sD} < g_e$ in the range of $11.80\% < y'_s \leq 17.81\%$, the order of $V_s < y_{sD} < g_s < g_e$ in the range of $17.81\% < y'_s \leq 20.38\%$, the order of $y_{sD} < V_s < g_s < g_e$ in the range of $20.38\% < y'_s \leq 25.30\%$, and the order of $y_{sD} < V_s < g_e < g_s$ in the range of $25.30\% < y'_s \leq 34.32\%$.

Otherwise, the variability from the SSI's point of view is calculated by the $y'_s - y_s$ based on the ESI's expected rate of returns $(x = y'_e)$. It can be seen in Figure 4-7.

According to Figure 4-7, that $(y'_s - y_s)$ has the order of $g_s < g_e < y_{sD} < V_s$ in the range of $00.00\% < y'_e \leq 3.76\%$, the order of $g_s < y_{sD} < g_e < V_s$ in the range of $3.76\% < y'_s \leq 9.35\%$, and the order of $g_s < y_{sD} < g_e$ in the range of $9.35\% < y'_s \leq 9.72\%$, and the order of $g_s < g_e < y_{sD}$ in the range of $9.72\% < y'_s \leq 9.93\%$.

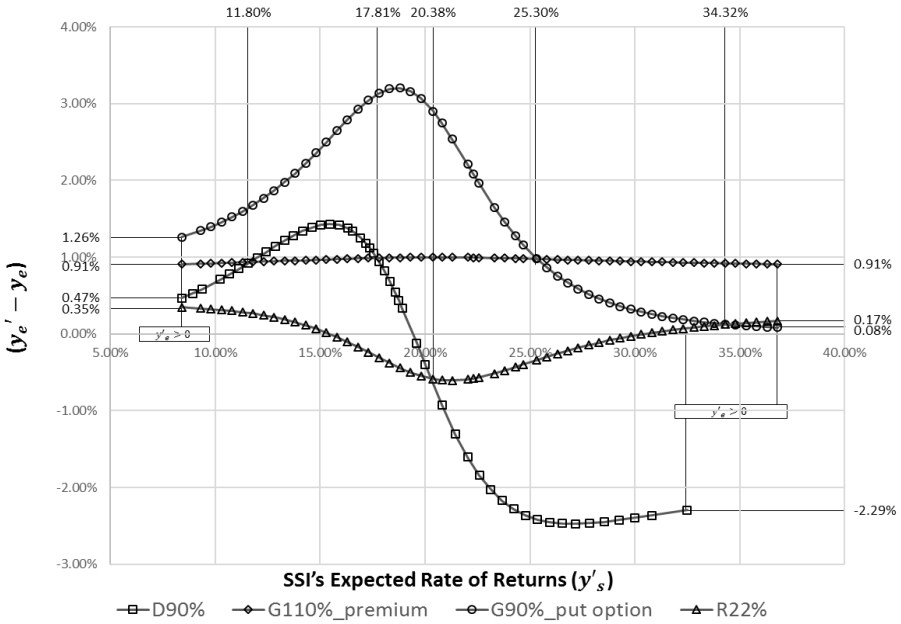


Figure 4-6. The Impact of Agreements Transaction from ESI's Perspective

Table 4-6. The Result of ESI's Profit Variability by Agreements Transaction

Variability (%) / SSI's IRR (%)	$y'_e - y_e$ ($y_e > 0$)			
	0.9 y_{sD}	1.1 g_e	1.1 V_s	0.9 g_s
8.40 <y'_s ≤ 11.80	+0.468 ~ +0.938	+0.909 ~ +0.938	+0.346 ~ +0.266	+1.263 ~ +1.677
11.80 <y'_s ≤ 17.81	+0.938 ~ +0.990	+0.938 ~ +0.990	+0.266 ~ -0.309	+1.677 ~ +3.137
17.81 <y'_s ≤ 20.38	+0.990 ~ -0.585	+0.990 ~ +0.999	-0.309 ~ -0.585	+3.137 ~ +2.902
20.38 <y'_s ≤ 25.30	-0.585 ~ -2.418	+0.999 ~ +0.983	-0.585 ~ -0.343	+2.902 ~ +0.983
25.30 <y'_s ≤ 32.50	-2.418 ~ -0.240	+0.983 ~ +0.931	-0.343 ~ +0.070	+0.983 ~ +0.188
32.50 <y'_s ≤ 34.32	-	+0.931 ~ +0.921	+0.070 ~ +0.123	+0.188 ~ +0.123

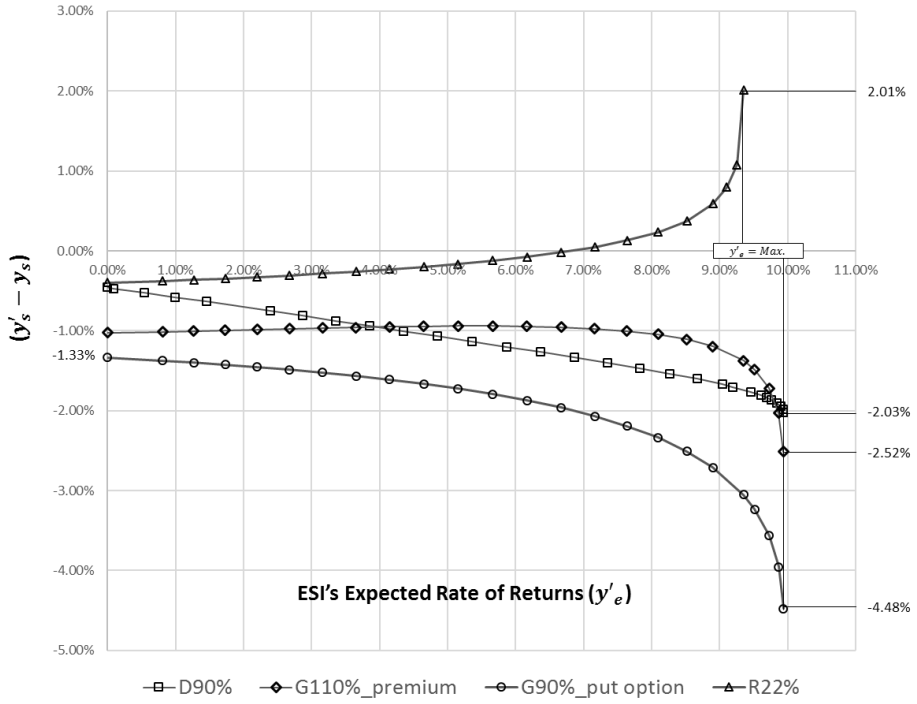


Figure 4-7. The Impact of Agreements Transaction from SSI's Perspective

Table 4-7. The Result of SSI's Profit Variability by Agreements Transaction

Variability (%) / ESI's IRR (%)	$y'_s - y_s$ ($y_s > 0$)			
	0.9 y_{sD}	1.1 g_e	1.1 V_s	0.9 g_s
0.00 <y'_e ≤ 3.76	-0.471 ~ -0.958	-1.026 ~ -0.958	-0.396 ~ -0.260	-1.334 ~ -1.566
3.76 <y'_e ≤ 9.35	-0.958 ~ -1.766	-0.9568 ~ -1.375	-0.260 ~ +2.009	-1.566 ~ -3.052
9.35 <y'_e ≤ 9.72	-1.766 ~ -1.719	-1.375 ~ -1.719	-	-3.052 ~ -3.565
9.72 <y'_e ≤ 9.93	-1.719 ~ -2.024	-1.719 ~ -2.515	-	-3.565 ~ -4.478

4.3 Summary

In this chapter, in order to analyze the risk-allocation between private investors in terms of equity and agreements transactions, key variables were adopted the most common values in Korean PPP projects from 1997 to 2010. The variabilities of y_e and y_s by the transactions were established through a sensitivity analysis on the key variables and the influence factors. The sensitivity analysis was conducted by assuming that the values of the key variables and the influence factors were reduced by 10% each. The results of the variability of y_e and y_s are different by the range of opposite investor's expected rate of returns.

Chapter 5. Conclusions

5.1 Results and Discussions

This research develops the DCF model that establishes the key variables of equity transaction and influence factors of agreements transaction and understanding financial the impact of equity and agreements transaction on private investor's expected rate of returns. According to the model, the key variables of the equity transaction are V_e(Initial equity value of ESI); r_e(ESI s cost of capital); and g_e(growth factor of expected net cash flow of ESI); c (construction period); T (concession period). Otherwise, the influence factors of the agreements transaction are the ratio of V_e and V_s (rate of equity contribution); g_e(growth factor of net cash flow of dividend); g_s(growth factor of net cash flow by purchasing the equity; y_{sD} (debt interest rate).

In addition, the variability of y_e and y_s by equity and agreements transaction was established through a sensitivity analysis on the variables and influence factors. The sensitivity analysis was conducted by assuming that the values of the influence factors were decreased or increased by 10% each.

First, the result of the impact of key variables in the equity transaction is following:

ESI's profit yields the smallest loss by the growth factor of net cash flow of ESI's dividend (g_e) in the section of $9.30\% < y'_s \leq 17.82\%$, by ESI's cost

of capital (r_e) in $17.82\% < y'_s \leq 25.81\%$, and by the growth factor of net cash flow of ESI's dividend (g_e) in $25.81\% < y'_s \leq 36.81\%$. Meanwhile, SSI's profit yields the smallest loss by the growth factor of net cash flow of ESI's dividend (g_e) in the section of $0.00\% < y'_s \leq 7.95\%$, by ESI's cost of capital (r_e) in $7.95\% < y'_s \leq 8.72\%$, and by rate of ESI's equity contribution (V_e) in $8.72\% < y'_s \leq 9.34\%$.

Secondly, the result of the impact of influence factors in the agreements transaction is following:

ESI's profit yields the smallest loss by the growth factor of net cash flow of ESI's dividend (g_e) in the section of $8.40\% < y'_s \leq 25.30\%$, by the growth factor of net cash flow of SSI's dividend (g_s) in $25.30\% < y'_s \leq 34.32\%$. SSI's profit yields the smallest by rate of SSI's equity contribution (V_s) in the section of $0.00\% < y'_s \leq 9.35\%$, the growth factor of net cash flow of ESI's dividend (g_e) in $9.35\% < y'_s \leq 9.72\%$, and by debt interest rate (y_{sD}) in $9.72\% < y'_s \leq 9.93\%$.

As a result, the most important feature is that private investors make a zero-sum relationship due to the equity transaction and agreements transaction. The relationship is an impediment to the promotion of PPP projects that require securing both ESI and SSI's participation.

When equity is traded between short-term investors and long-term investors, 'the growth factor of short-term investor's expected net cash flow'

is the critical key variable influencing private investor's cash flow. 'ESI's cost of capital' is also key variable influencing on the cash flow. It can be interpreted that the expected returns during the operational phase directly affected the profitability of equity investors. However, there is uncertainty in forecasting the traffic volume, and the demand risk is increasing by the uncertainty (Shin 2009; KDI 2012). At last, Private investors who are trading in equity could deepen the zero-sum relationship. In order to overcome the relationship, A reasonable assessment of demand forecasting and alternatives to reduce the demand risk at the operational phase are needed.

Meanwhile, when private investors make the additional agreements, 'the growth factor of long term investor's expected net cash flow' is the critical influence factor on private investor's cash flow, and 'yield rate of debt financing' is also the major influence factor on the cash flow. All of the factors are from the agreements for hedging the operation risk, and it can be interpreted that the stability of actual demand affected the profitability of the short-term investors and the long-term investors. As the uncertainty increased after the MRG abolishment, however, it is difficult to induce the private investors' participation (Jeong 2015). The more risk of private investors, the greater the operational risk (Shin 2009). Therefore, it is necessary to establish the alternatives for reducing the risk of private investors with minimizing the public sector's fiscal burden.

5.2 Contributions and Further Research

The risk re-allocation in PPP projects increases in current financial environment, which is promoting project's uncertainty. This research identified the volatility of cash flows from equity and agreements transactions among private investors, and established how the transactions affect private investors' financial performance through reviews on recent PPP projects in Korea. The main implications of this research can be divided into academic aspect and practical or industrial aspect.

(1) Academic Contributions

First, the key variables in the process of equity transaction and the influence factors from the agreements were identified. Secondly, the revised DCF model established the relationship between private investors' risk-reallocation and their rate or investment. The financial impacts of key variables and influence factors will help to understand how the equity transaction and agreements transaction affect the financial viability of PPP projects.

(2) Practical and Industrial Contributions

From a practical or industrial point of view, there are two contribution from public sector's point of view and private sector's point of view. From the public sector's perspective, the main implication would be that public sector

can come up with the policies for preparing the loss in profitability by the variables from the transactions, and can reduce the delayed PPP projects which had consumed social costs. From the private sector's perspective, the main contribution would be that participants willing to invest in PPP projects can determine which strategy offers a superior performance.

The limitation of this research is that it has not considered various capital structures in PPP projects, but only focused on risk reallocation between short term and long term investors. Also, it has not reflected the long-term investors newly investing on operational phase.

Further study is required to address the financial analysis model reflecting complex capital structures in PPP projects, and establish the management plan on contractual delay for public sector.

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Abstract in Korean (국문 초록)

현금흐름모델을 이용한 민간투자자 간 리스크 재분담의 재무적 영향성 분석

-국내 민자도로사업을 중심으로-

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대규모 인프라 수요와 이에 대한 투자를 위해 민간의 금융 자본을 활용한 장기인프라 투자 즉, 민간투자사업(PPP, Public Private Partnership)의 활용이 증가하고 있다. 그러나 사업 운영에서 발생하는 손해를 정부가 보전해주는 제도가 폐지되는 등 사업에 대한 수익 안정성 확보가 점차 어려워지고 있다. 이러한 이유로, 민간투자자 사이에서 리스크 재분담(Risk Reallocation)이 지분거래(Equity Transaction)와 약정거래(Agreement Transaction)의 형태로 이루어 지고 있다. 민간투자자 사이에서의 리스크 재분담은 민간투자자의 현금흐름에 추가적인 변동성을 야기하며, 민간부문의 투자결정에 있어 제약요인이 되고

있다. 하지만 기존의 재정건전성 평가모델은 지분거래와 약정거래가 민간투자자의 현금흐름에 영향을 주는 경위를 충분히 파악하지 못하고 있으며, 이로 인해 민간투자자 간 리스크 재분담에 따른 현금흐름의 변동성을 충분히 분석하지 못하고 있다.

따라서 본 연구는 민간투자자 관점의 현금흐름이 지분거래와 약정거래로부터 받는 영향을 재무적으로 분석하고자 한다. 이를 위해, 민간투자자 사이에서 이루어지는 지분거래와 약정거래로 인한 현금흐름의 변동성을 규명하고, 이를 반영한 민간투자자의 재무적 평가 모델을 현금흐름할인법(DCF, Discounted Cash Flow)을 활용하여 개발하였다. 개발된 모델은 1997년부터 2010까지 수행된 18개 민자도로사업의 사례를 바탕으로 실증적 분석을 실시하였으며, 이를 통해 지분거래의 주요변수와 약정거래의 영향요인을 도출하였다.

그 결과, 지분거래가 이뤄질 때 민간투자자의 현금흐름에 영향을 주는 주요변수는 단기투자자의 지분출자비용(V_s), 단기투자자의 지분투자 자본비용(r_s), 단기투자자의 배당수익 성장지수(g_s)로 도출되었다. 한편, 약정거래가 이루어질 때 민간투자자의 현금흐름에 영향을 주는 영향요인은 지분출자비율(V'_s, V'_l), 단기투자자의 배당수익 성장지수(g_s), 장기투자자의 배당수익 성장지수(g_l), 장기투자자의 대출투자 이자율($y_{l,x}$)로 도출되었다. 더 나아가, 본 연구에서는 주요변수와 영향요

인에 대한 민감도 분석을 실시하였으며, 이를 통해 단기투자자와 장기투자자의 현금흐름에 대한 주요변수와 영향요인의 영향력은 상대 민간투자자의 목표수익률에 따라 달라지는 결과를 얻을 수 있었다. 특히, 민간투자자들이 지분거래와 약정거래로 인해 제로섬(Zero-sum)의 관계를 맺고 있었으며, 이와 같은 관계는 단기투자자와 장기투자자 재원 모두의 확보가 필요한 민간투자사업 추진의 장애요인이 되고 있음을 알 수 있다.

민간투자사업에서의 리스크 재분담은 금융환경에 따라 증가하고, 이는 프로젝트의 불확실성을 증가시키고 있다. 이러한 상황에서 본 연구에서 도출한 모델은, 리스크 재분담에 대한 수익률 변동을 분석하여 민간투자사업에 대한 민간투자자의 의사결정에 기여할 것이다. 더 나아가 정부고시 이후 민간부문 사이의 협약단계에서 지연되고 있는 민간투자사업을 관리하고 추진하여 사회적 비용을 최소화 하는데 도움이 될 것이다.

주요어: 민간투자사업, 리스크 관리, 현금흐름할인법

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