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A STUDY ON THE OPTIMAL PPP MODEL FOR TRANSPORT: The Case of Road and Rail in South Korea

by

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ABSTRACT

In recent decades the Public Private Partnership (PPP) has been widely regarded as an innovative way to construct transport infrastructures and to improve the quality of service. As the number of PPP cases has increased, many countries have tried to standardise PPP models to minimise the costs of trial and error. South Korea, where 426 PPP projects have been undertaken since 1994, usually preferred the BTO (Build-Transfer-Operate) model for transport. In the BTO model, the private sector recoups its investment by charging end users directly and hence should bear the traffic demand risk. However, the Korean Government shared the demand risk through a minimum revenue guarantee to induce private sector involvement, and this led to many criticisms of the BTO model. Tariffs in the BTO case were much higher than those of public operators, but the Government still had to pay large amounts of guaranteed revenue. Thus, BTL (Build-Transfer-Lease), where the demand risk is on the public sector, has become an alternative model. The BTL is the "service sold to the public sector" model which is similar to the DBFO (Design-Build-Finance-Operate) in the UK. This thesis examines which of the BTO and the BTL PPP models is optimal to save governmental expenditure for transport infrastructures such as road and rail. Appropriate traffic demand risk sharing, which a particularly controversial issue in South Korea, is explored. These research objectives are examined through five case studies: the Incheon Airport Expressway and the Oksan-Ochang Expressway cases for road PPP; the Incheon Airport Railway, the Daegok-Sosa Railway and the Seoul Metro 9 cases for rail PPP. Through a detailed literature review and five case studies, the thesis shows that the optimal PPP model, which is measured by the VFM (Value for Money) assessment, needs to satisfy the interests of public sector, private sector, and end users. Based on these assessments and including these three viewpoints, it is concluded that the optimal PPP model for road can be the BTL where the public sector can save expenditure or reduce the level of tariff. Traffic demand risk for roads is relatively low, so the public sector does not have to transfer it to the private sector with high profit rate. In the case of rail, the limited revenue and high cost make a project difficult to be financially free standing by the BTO model. However, the BTO can be a better option in urban rail if traffic demand risk is shared appropriately.

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DECLARATION OF AUTHORSHIP

I, Byungwoo Gil

declare that the thesis entitled

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and the work presented in the thesis are both my own, and have been generated by me as the result of my own original research. I confirm that:

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GLOSSARY

ADB	Asia Development Bank
AHP	Analytic Hierarchy Process
BBO	Buy-Build-Operate
BLOT	Build-Lease-Operate-Transfer
BOD	Build-Operate-Deliver
BOL	Build-Operate-Lease
BOO	Build-Own-Operate
BOT	Build-Operate-Transfer
BOOST	Build-Own-Operate-Subsidize-Transfer
BOOT	Build-Own-Operate-Transfer
BROT	Build-Rehabilitate-Operate-Transfer
BRT	Build-Rent-Transfer
BRT	Bus Rapid Transit
BTL	Build-Transfer-Lease
BTO	Build-Transfer-Operate
CBA	Cost Benefit Analysis
DBFO	Design-Build-Finance-Operate
DBO	Design-Build-Operate
DBOM	Design-Build-Operate-Maintain
DBOT	Design-Build-Operate-Transfer
DCMF	Design-Construct-Manage-Finance
DEDPI	Detailed Engineering and Design Plan for Implementation
EIB	European Investment Bank
ESCAP	Economic and Social Commission for Asia and the Pacific (UN)
FBOOT	Finance-Build-Own-Operate-Transfer
FI	Finance Investor
FIRR	Financial Internal Rate of Return
FNPV	Financial Net Present Value
IRR	Internal Rate of Return
KDI	Korea Development Institute
KOTI	Korea Transport Institute
KRW	Korean Won
KTX	Korea Train Express

LCC	Life Cycle Cost
LDO	Lease-Develop-Operate
LBO	Lease-Build-Operate
LOO	Lease-Own-Operate
MCDA	Multi-Criteria Decision Analysis
MLTM	Ministry of Land, Transport and Maritime affairs
MOCT	Ministry of Construction and Transportation (now MLTM)
MOSF	Ministry of Strategy and Finance
MRG	Minimum Revenue Guarantee
NAO	National Audit Office
NGO	Non Governmental Organisation
NPV	Net Present Value
OJEU	Official Journal of EU
PFI	Private Finance Initiative
PIMAC	Public and private Infrastructure investment Management Center
PPI	Private Participation in Infrastructure
PPP	Public Private Partnership
PSC	Public Sector Comparator
ROT	Rehabilitate-Operate-Transfer
ROOT	Rehabilitate-Own-Operate-Transfer
RTL	Rehabilitate-Transfer-Lease
R/C	Revenue/Cost
RFP	Request for Proposal
SPC	Special Purpose Company
SPV	Special Purpose Vehicle
SMG	Seoul Metropolitan Government
VFM	Value for Money
WACC	Weighted Average Capital Cost

CHAPTER 1

Introduction

1.1 Background

In recent decades the Public Private Partnership (herein after PPP) has been widely regarded as an innovative way to cope with rapidly increasing public demands on social infrastructures. Transport, which needs huge investment for construction in a short period, is one of the most invigorated sectors for the PPP (UN ESCAP, 2006). Moreover, the public services under the PPP scheme are expected to achieve higher quality of service by transferring risks and responsibility to the sector which is more effective to control them (HM Treasury, 2008).

For this reason, more than 100 countries in the world have used the PPP for public services (PPIAF, 2011). In South Korea, the PPP has been used since 1994 when the PPP Act was legislated, though several public projects had been individually constructed by the private sector before 1994.

Though the aims of the PPP are similar, the forms of PPP vary from country to country according to their social and economic circumstances. As the number of PPP cases has increased, many countries have tried to standardise PPP models to minimise the costs of trial and error. The PFI (Private Finance Initiative) of the UK seems one of the most famous PPP schemes in the world, and some countries and researchers use that term as a synonym with the PPP (Chiu and Bosher, 2005, Drapak, 2009). South Korea also has a unique PPP scheme which is named the PPI (Private Participation in Infrastructure). With regard to the PPP models, which model to choose depends on the circumstances of each country and the characteristic of a project.
In the PPI scheme of South Korea, where 426 PPP projects have been undertaken since 1994, the BTO (Build-Transfer-Operate) and the BTL (Build-

Transfer-Lease) models were mainly used for transport infrastructure projects (see Chapter 3). The BTO is a PPP model where the private sector builds a facility, transfers its ownership to the public sector and operates it for a specific period with the permission from the public sector. In the BTO model, the private sector recoups its investment by charging end users directly with the traffic demand risk. However, the Korean government shared the demand risk through a Minimum Revenue Guarantee (herein after MRG) to induce the private sector involvement, and this led to much criticism of the BTO model. The Incheon Airport Railway, which was the first BTO project for rail in South Korea, was sold to the public operator only after one year of operation because of low traffic demand. The Yongin Light Railway is in court because of a discrepancy in demand risk sharing. The Busan-Gimhae Light Railway and the Uijeongbu Light Railway are anticipated to be in trouble with the same reason (Vivant, 2011). The recent global financial crisis affected the PPP market negatively and it was worse for the BTO model where the demand risk is on the private sector (see Chapter 2).

Thus, the BTL (Build-Transfer-Lease), where the demand risk is on the public sector, is now suggested as an alternative model of the BTO for transport in South Korea. The BTL is a PPP model that the private sector builds a facility and transfers the ownership to the public sector. However the public sector gives the right to use it to the private sector for a specific period and the private sector leases it to the public sector again. In the BTL model, the private sector recoups its investment by the fee from the public sector for leasing. It is usually used for the public service with little income from the end user, so it was introduced to facilities like school without enough revenue for the private sector to make a profit (KDI, 2009b). The BTL model has not been used for road PPP, but the NABO (National Assembly Budget Office) of Korea suggested using the BTL model for road instead of the BTO model (Lee, 2005).

This thesis examines which PPP model out of the BTO and the BTL is optimal to save the governmental expenditure and to provide higher quality of service to the end users for road and rail in South Korea. For this examination, a method is newly suggested to compare the BTO and the BTL model. It also suggests the optimal traffic demand risk sharing, which is a key issue for the BTO model with MRG in South Korea.

1.2 Research Objectives

The purpose of this research is to find out an optimal PPP model between the BTO and BTL for road and rail in South Korea. Here, the meaning of 'optimal' can vary according to a view point. The PPP model saving the life cycle cost of the public sector, which reflects on the interest of tax payers, can be optimal to the public sector such as a government. On the other hand, the model giving higher return with lower risk can be optimal to the private sector. The model providing higher quality of service with lower tariff can be optimal to the end users of the service.

For a successful PPP, these three points of views from the public sector, the private sector, and the end users need to be satisfied. Among these, the view from the end user is mostly covered by the public sector, because the end users cannot directly attend the negotiation table for a PPP contract which is concluded between the private and public sectors. With regard to the view of the private sector, the involvement of the private sector is decided in the PPP market and various conditions of each company are difficult to be theoretically considered in the thesis. Also, since such public service using the PPP scheme has been provided by the public sector, the public sector usually has the initiative in the PPP market. Thus, the public sector needs to offer an attractive PPP model which is acceptable to the private sector by employing methods such as appropriate risk sharing.

This research aims to provide a guide for the public sector to choose an optimal model between the BTO and the BTL in road and rail in South Korea. An optimal PPP model needs to save the life cycle cost and to provide higher quality of service with lower tariff. This model should meet the interest of the private sector and offer an appropriate risk sharing to raise the feasibility of a PPP project itself. Especially, traffic demand risk is the key issue for the transport PPP in South Korea, so it needs to be considered mainly in terms of risk sharing. For this purpose, four research objectives are set out as follows:

- <u>To identify the features of the PPP models in transport in South Korea</u>
  The appraisal on the BTO model is provided and the characteristics of the BTL, as an alternative PPP model, are discussed through the literature

review. In South Korea, these two PPP models were regarded proper for different areas: the BTO for transport with incomes from the end users; and the BTL for the service without enough income such as a school and sewage facility. In this context, this research objective examines the possibility to use the BTL instead of the BTO for transport and which model is better for road and rail;

- <u>To develop a detailed methodology to compare the BTO and the BTL</u>

Comparing the BTO and the BTL models for a transport project has not been tried before, so a new methodology will be developed. Quantitative and qualitative approaches will be developed to explore ways to compare the life cycle cost (LCC) and the quality of service of different procurement models;

- <u>To examine the optimal PPP model for road and rail in South Korea</u>

Through the quantitative and qualitative comparison between the BTL and the BTO models in both road and rail cases in South Korea, better PPP model is explored to save governmental expenditure and to provide better quality of service; and

- <u>To determine the appropriate demand risk sharing in road and rail</u>

The public sector in South Korea still prefers the BTO model for saving the LCC spent from the public sector (government expenditure) on transport, so the discussion is needed as to whether the BTO model can be optimised through an appropriate traffic demand risk sharing instead of using the BTL model which is more risky to the public sector. This will require a probabilistic approach to determine risk. In addition, a method to determine the optimal Minimum Revenue Guarantee (MRG) will be developed for the BTO model.

The thesis will make significant contributions to knowledge by making detailed comparisons of BTO and BTL PPPs for the road and rail sectors for the first time. A new approach in which qualitative methods are used to supplement quantitative methods will assess the impact of service quality. This methodology will also be used to develop new guidelines for revenue risk sharing in BTO contracts.

1.3 Previous Studies

The private involvement in the public service area could broadly be shown throughout the history of the World. However, the PPP has boomed since the 1990s when the PFI was first introduced to the UK and many developing countries have tried to use the PPP for an early procurement of the infrastructures (Chen, 2010, Estache, 1999). As many countries introduced the PPP to cope with the increasing fiscal burdens and to improve the quality of public service, many researches about the PPP have been undertaken to suit the circumstances of each country.

Though the details of the PPP are different according to the characteristics of a project, the PPP basically needs to be designed to allocate obligations or risks to the sectors which are best able to manage them (ADB, 2008). Through the appropriate risk management or obligation allocation, the public sector aims to minimise costs while improving the quality of public service. In short, the purpose of the PPP can be understood to maximise the value for money through optimal risk or obligation allocation.

Thus, many issues of the PPP research have been mainly about risk allocation, value for money, and financial costs. Corner (2005) pointed out the real success of PFI projects depended on the degree to which risk was genuinely transferred from the public to the private sector and optimally shared through the qualitative and quantitative indicators. Clifton and Duffield (2006) explored the improved governance of the PFI/PPP in Australia through the contract structure between the private and public sectors, and risk management. Galilea and Medda (2010) studied the influence of the political and economic contexts such as a country's experience, corruption and democratic accountability on the success of the transport PPP. In specific, they argued that the inexperience and corruption in developing countries affected the success of the PPP negatively, so the multilateral lenders like the World Bank should support these countries to set up a regulatory frame work for the PPP. Debande (2001) analysed the PFI cases in transport infrastructures from the UK experience, and argued that though the transfer of risks made it possible to reduce the construction cost, transaction costs were relatively high. He also suggested that the optimal PPP take into account two phases of the transport projects: the design-construction and operation of the infrastructure. To evaluate the PPP projects, it looks necessary to test the VFM (Value for Money). Forshaw (1999) explored the UK's traditional public procurement and PFI through the VFM concept. Heald (2003) suggested the necessity of a framework for the best VFM under the UK accounting regulation. He argued that though the VFM analysis should be considered with total risk, the accounting treatment decision was mainly judged by the sharing of risk, so the best VFM should cover the risk such as construction risk where the private sector had a responsibility beyond the accounting treatment.

As the PPP cases increase, many governments are making a standard form for the PPP to minimize the cost of trial and error such as the transaction cost and time for negotiation. Such standard form of the PPP is called a PPP model, and it is designed to suit the characteristics of a project or to fit the social and economical circumstances of each country through the optimal risk allocation. The PPP model is based on a regulatory or legislative framework of each country, and it is best able to reflect the situation of PPP market of that country. Thus, the research on the PPP models seems the most practical way to allocate risks and to maximise the value for money.

However, research on the PPP model has not been broadly invigorated in the World because of the flexibility of the PPP context and the ambiguity in terms and conditions across countries and across sectors (Galilea and Medda, 2010, Delmon, 2010). Thus, studies on the PPP models mainly focus on general features of the PPP model and comparative studies at a country level or at the various sector levels such as transport and water services.

Palmer (2000) analysed the contract issues and financing between the DBFO model and the DBO model. He argued that the DBO model was different from the DBFO model in that the government was responsible for financing, so the DBO model would be more cost effective and quicker than the DBFO model. Vickerman (2003) analysed the characteristics of different types of PPP in the UK. The full privatisation, the PFI scheme, and the PPP scheme were explored through some UK transport cases such as the Channel Tunnel, Railtrack, PFI road, etc. He also argued that the private sector involvement required projects to be discrete and clearly defined PPP. Chiu and Bosher (2005) explored the risk sharing mechanism by looking at the various types of PPP arrangements for water and wastewater services. In the transport sector, researches on the PPP model are much related with the payment mechanism. The BOT (Build-Operate-Transfer) model, which is one of the most prevalent PPP models in the road sector, uses actual toll collected from the end user. The DBFO model, which is common in road in the UK, uses shadow toll or availability payment. Thus, several studies focus on a comparison between real toll and shadow toll (Aziz, 2007, Faivre d'arcier, 2003, House of Commons Transport Committee, 2005, Bain and Wilkins, 2003a).

In South Korea, the BTL model was newly introduced in 2005 and used to some railway projects from 2006. In the case of the rail BTL projects, the first project is still under construction. Thus, there are few studies on the BTL model for transport and most research on the BTL model was about general features and the sectors such as the school, military accommodation, and environment facilities (Park, 2011b, Ahn et al., 2011, Koo, 2011, Cho et al., 2009).

With regard to the comparison of the BTL and the BTO models of Korea, Shin (2006) tried to compare both PPP models for the Incheon Airport Railway from the perspective of financial cost. However, he ignored the qualitative factors and various risks in the financial analysis. Since this study did not consider various characteristics of the BTL model, it might not seem to sufficiently examine the use of the BTL model for transport as an alternative to the BTO model. Kwak et al. (2009) suggested the risk-integrated feasibility analysis model of the BTL and the BTO project for the military residence building. They tried to use both models for a single military project by dividing it into two parts which are suitable for the BTL and BTO respectively.

Though several studies examined the characteristics of each PPP model, an optimal PPP model for transport has not been studied enough. Especially, since the BTL model has not been used for road in South Korea yet, there is still doubt on the BTL model for rail. Thus, this thesis aims to suggest new methodology to compare the BTO and the BTL models not only for saving government expenditure and improving the quality of service, but also for identifying the optimal PPP model for transport infrastructures specified in road and rail.

1.4 Research Scope

Since there are many PPP models worldwide and they sometimes can be tailored to the circumstances of each country, it might be difficult to compare all the possible PPP models. However, many countries make an effort to standardise the PPP model to reduce the cost and time for negotiation when making a contract with the private sector. These efforts make it possible to compare the characteristics of each standardised PPP model. This study focuses on the BTO and BTL model in South Korea as a practical research for solving the current problems with the BTO model in South Korea.

This research deals with the PPP for transport infrastructures, especially road and rail. These two transport modes are the most prevalent users of PPP schemes not only in South Korea but also all over the World including the UK (see Chapter 2). Seaport and airport also represent important portions in the PPP fields, but this study primarily focuses on road and rail.

The stakeholders of PPP are the public sector, the private sector and the end user. These three sectors hold different views on the PPP. In other words, the government has the main interest in budget savings and providing public service on time. The private sector always wants to make a profit. On the other hand, the end users do not care who provides transport infrastructure. What they are only interested in is the quality of service and fee if there is one. However, in most cases the government makes a decision to use the PPP after taking various views into account because the government has to be in final charge of providing the public service. Thus, many parts of this study are mainly focused on the government view while several characteristics of the PPP from different perspectives will be added to the qualitative analysis.

The PPP is very sensitive to the social and economic circumstances of each country. Not only financial status but also credibility of country or people's behaviour to the public service are important for the success of the PPP. Though the regional scope of this research is mostly limited to South Korea, the UK cases will be also studied to understand the newly introduced BTL model in Korea, which is basically using the concept of "service sold to the public sector" model in the PFI of the UK.

1.5 Research Procedure

The research procedure for the optimal PPP model in South Korea consists of five steps with eleven chapters which cover the four research objectives.

The first step addresses the research background, research objectives, previous studies, research scope, and this research procedure as an introduction of the research (Chapter 1).

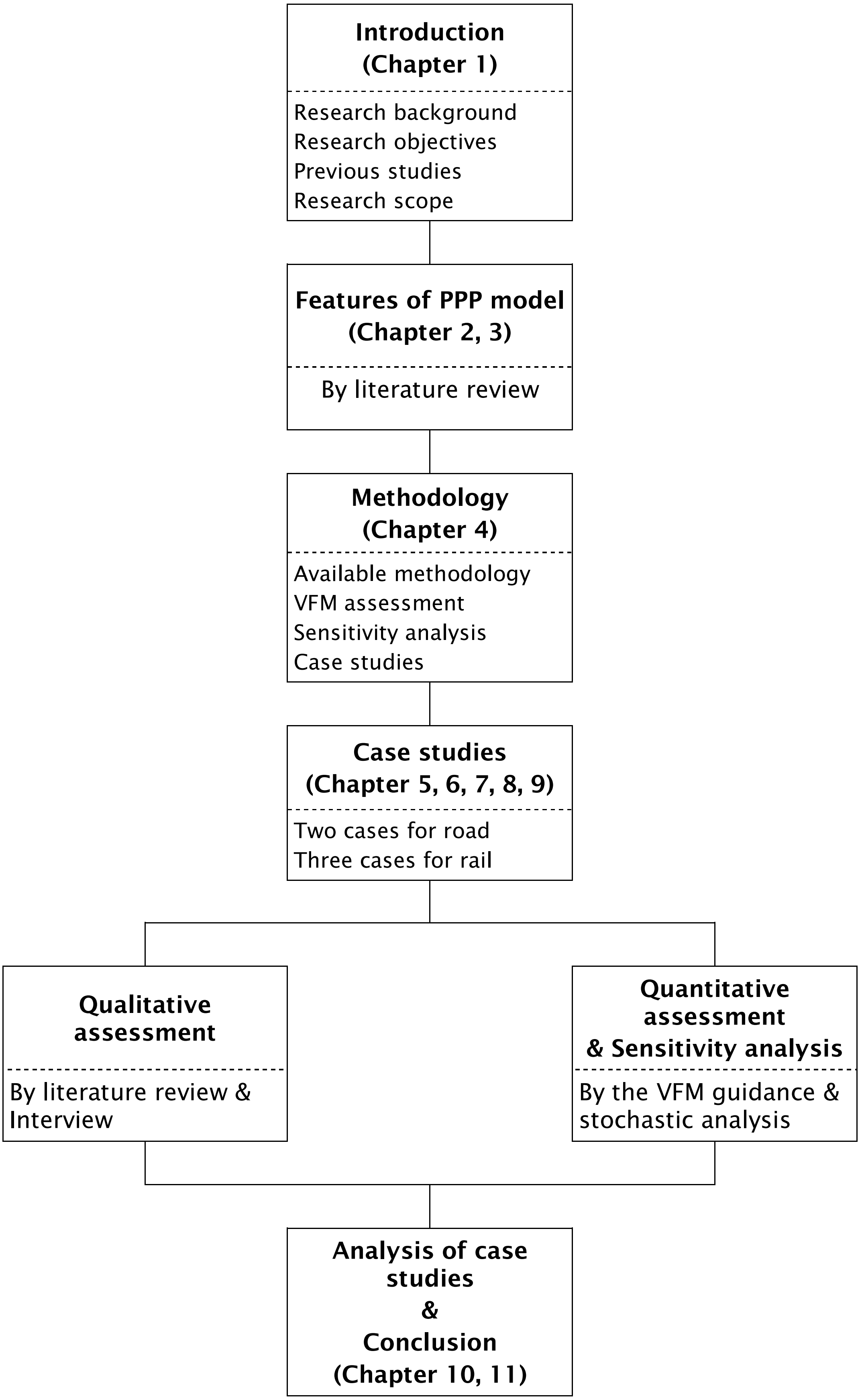
The second step reviews the general concept and models of the PPP. Definition, history, and the status of the PPP in the World including the UK, are mainly reviewed. The PPP models in the world are also introduced and classified. The trends in the PPP in transport are explored and the appraisal of PPP projects is reviewed. The regulation and models of the PPP in South Korea are also reviewed and the PPP projects for transport in South Korea are explored (Chapter 2 and 3).

The third step studies the methodology to determine the optimal PPP for road and rail in South Korea. In this step, the meaning of the "optimal PPP model" is clarified and available methodologies to find an optimal model are reviewed. The concept of the VFM (Value for Money) assessment, which is the most prevalent method to find whether the PPP is better than the direct public investment, will be studied. In addition, the case study as a research tool is reviewed and five cases are selected for further study (Chapter 4).

The fourth step is to determine the optimal PPP model that gives the highest VFM for different transport modes. This step takes five different cases in Korea which have already been implemented or are in negotiation. Through the VFM assessment and the sensitivity analysis, it will examine which PPP model is the most beneficial to government (Chapter 5 to 9).

In the fifth and final step, the results of the five case studies comparing the BTL and BTO models in South Korea are analysed. The optimal PPP model for road and rail in South Korea is concluded and the suggestions for the Korean government are explored. Lastly, the contributions and limitations of the thesis are discussed and a future study plan is added (Chapter 10 and 11).

Figure 1.1Research procedure



CHAPTER 2

THE PUBLIC PRIVATE PARTNERSHIP IN TRANSPORT

2.1 Introduction

The PPP has been broadly used in various public service areas in the World including transportation for a long time, though names and types of the PPP have varied by time and country (U.S. Department of Transportation, 2004). Historically, some of current public services were originated from the private sectors or included to the private service area such as the turnpike in the 17^{th} century in the UK and early rail industry in transport (Glaister et al., 2006). The PPP has become more prevalent since the PFI (Private Finance Initiative) of the UK was introduced in the 1990s. Many countries turned to PPP to seek higher efficiency and effectiveness in public service not only for budget savings but also for improved quality of service.

The broad context and variable types of the PPP make its concept and terms ambiguous. This ambiguity is a big obstacle to sharing the experience and knowledge of respective countries with researchers. Therefore it needs to clarify the concept of PPP models and to identify general characteristics of the PPP regarding the standardised model first.

In this chapter, general features of the PPP are reviewed for finding an optimal PPP model in transport. For this, the concept of the PPP which has many definitions and characteristics should be reviewed first. Then various PPP models in the World and their classification are explored. Lastly, the history of the PPP for transport infrastructure, PPP projects in transport and their appraisals are addressed in more details.

2.2 The Concept of the Public Private Partnership

2.2.1 Definition of the PPP

The Public Private Partnership

It seems difficult to define PPP clearly due to blurred boundary between the public and private sectors. In recent years, relations between the public and private sectors got more complicated and connected to each other. Also, there are too many different forms and variations in the PPP. Grimsey and Lewis (2005) said that "… (PPP is what) fills a space between traditionally procured government projects and full privatization". HM Treasury (2009) defined PPP as follows: "Public private partnerships (PPPs) are arrangements typified by joint working between the public and private sectors. In the broadest sense, PPPs can cover all types of collaboration across the interface between the public and private sectors to deliver policies, services and infrastructure."
Standard and Poor's (2005) defined that the PPP is a long-term relationship between the public and private sectors to deliver public service by sharing risks and using skills, expertise and finance of each sector. The European Commission (EC, 2004) also used the term as a form of cooperation between the public authorities and the private businesses of funding, construction, renovation, management and maintenance of a social or economic infrastructure.

According to an OECD report on the PPP (2008), these unclear definitions may be due to a broad space between the public and private sectors in a partnership or cooperation to deliver public services. Trying to clarify the meaning of partnership and the difference with the concession, the OECD defined that the PPP is an agreement between the government and private partners where the private partners provide the service in such a way that the service delivery objectives of the government are aligned with their profit objectives through a sufficient risk transferring to them.

Though the definition of the PPP is broad and sometimes it looks unclear, several common factors can be discussed. Allan (1999) found some common factors in various definitions of PPP as follows:

· A cooperative between the public and private sectors, built on the expertise of each partner, which best meets clearly defined public needs through the appropriate allocation of resources, risks and rewards.

· An arrangement between two or more entities that enables them to work cooperatively towards shared or compatible objectives and in which there is some degree of shared authority and responsibility, joint investment of resources, shared risk taking and mutual benefit.

Based on Allan's common factors, it seems that three factors are important commonly to understand the PPP clearly: Resource, Risk, and Benefit. The definition of Standard and Poor's and the European Commission shows the resources are skills, expertise and finance for construction, renovation, management and maintenance. Risks are transferred to the private sector by a contractual agreement and the public sector tends to transfer them as many as possible (OECD, 2008). Benefit of each sector looks different. In the view of the private sector, the benefit from the PPP is making a profit while the benefit to the public sector is to achieve high service quality and save the cost the public sector has to burden to provide the public service. In these three factors, the most important thing looks the benefit of each sector in that such benefit is the key factor to initiate and improve the partnership between the public and the private sectors. Resources and risks are just negotiated and shared between the public and the private sectors to maximise the benefit of each sector. It means that resources and risks are tools for the PPP to meet the interest of each sector in the PPP.

Therefore, the PPP can be defined as a cooperative working between public and private sectors to provide high quality public services which are affordable to the public sector and are profitable to the private sector by sharing skills, expertise, finance of each sector and risks from construction to operation.

The Private Finance Initiative

The Private Finance Initiative (PFI) was introduced by the Conservative government of the UK in 1992 (Allen, 2001). For the initial periods, the PFI did not boom. In 1997, the Labour government renovated the PFI to benefit all participants and transparently deliver better value for money. The basic motivation to introduce the PPP was to cope with increasing the government's investment demands for infrastructures (Chege and Rwelamila, 2001). However, the main reason for developing the PFI was to adopt private creativity and competition to public services (HM Treasury, 2009). This characteristic seems to stand for the PFI and impact many other countries trying to find more effective way to deliver the public service. In other words, the PFI focused not only on the efficiency in finance but also on the effectiveness in public service when compared to previous efforts to use private financing.

The definition of the PFI is quite clear, because this is created by the UK government with intentions as mentioned above.

Scottish Parliament defines the PFI as follows (1999);

PFI is a means of using private finance and skills to deliver capital investment projects traditionally provided by the public sector .... Instead of the public sector body directly procuring capital assets and subsequently owning, operating and regulating them, PFI generally involves the private sector owning and operating, but the public sector having a larger role in regulation.

However, in this definition, it is difficult to find the reason why the PFI got developed in the UK differently with previous private involvement in the public sector.

To this question, HM Treasury (2009) explains as follows:

The PFI is based on its commitment to efficiency, equity, accountability, and the PFI is only used where it can meet these requirements and deliver clear value for money. Where these conditions are met, PFI delivers a number of important benefits. By requiring the private sector to put its own capital at risk and to deliver clear levels of service to the public over the long term, PFI helps *to deliver high quality public services and ensure that public assets are delivered on time and to budget.*

Hence, the PFI mainly emphasizes on a process to guarantee these benefits compared with traditional procurement. In short, the PFI can be defined as a means of using private finance and skills for high quality public services to be delivered on time and to budget, based on the commitment to efficiency, equity and accountability.

Difference of the PPP and PFI

The PFI was a creation of the Conservative government of the UK in the early 1990s and the Labour government has expanded the PFI to the PPP from 1997 (McNulty, 2002, Higton, 2005). The PPP and PFI seem to be used interchangeably in the UK and other countries, although the PFI is also described as one of the PPP types in many papers (Cartlidge, 2006, Alshawi, 2009). HM Treasury (2009) also explained the PFI as the most common form of the PPP in the UK. More specifically, the PPP and PFI have the same aim to improve mutual benefits in public services through allocation of resources and risks. However, since the PPP has no regular formation, the process and scheme of each country or project can be different. The PFI has formatted process to deliver the public service effectively. Figure 2.1 shows the procedure of the PFI from clarifying the objectives of the PFI to awarding contracts and managing them. Especially, while project financing rests mainly on the private sector (Hardcastle and Boothroyd, 2003) and the Special Purpose Vehicle (SPV) is usually made to distribute high risks of the private sector in the PFI, it is more flexible in the PPP (see section 2.2.3). Therefore, the PFI can be understood as a particular method with a substantial process for the private sector to design, build, finance and operate facilities. The PPP is a generic term used to describe partnerships with more various methods (Hale et al., 2004).

For this reason, the PFI can be distinguished from various PPP models such as BOT, BLT, BOO, etc. The most common PFI model is a DBFO (Davies and Fairbrother 2006), but other models can be also used in the PFI scheme.

Figure 2.1Step by Step Guide to the PFI Process

Clarify objectives by establishing business need

↓

Appraise the options

↓

Produce outline business case and outline PSC (Public Sector Comparator)

↓

Assemble project team

↓

Decide tactics for selection Stage

↓

Invite bids by issuing contract notice in OJEU(Official Journal of EU)

↓

Prequalification of bidders

↓

Selection of bidders (short listing)

↓

Reappraise business case and refine the PSC

↓

Invitation to negotiate

↓

Receipt and evaluation of bids

↓

Selection of preferred bidder and final evaluation

↓

Award contract and financial close

↓

Manage contract

Source: Based on Treasury Taskforce, *Step by Step Guide to the PFI procurement Process*, November 1999; recited from House of Common, UK

2.2.2 Advantages and disadvantages of the PPP/PFI

Though the definition and spectrum of the PPP are not unified and the contents and terms are sometimes ambiguous, several common characteristics are discovered in the PPP. Specifically, five elements are shown in several researches as the general characteristics: two or more participants; the principal role in negotiation of each participant; enduring and stable relationship; resources able to be transferred to the partnership; and shared responsibility for outcomes (Li and Akintoye, 2003, Grimsey and Lewis, 2004).

By introducing the PPP having these general characteristics to the public service, the PPP has several advantages. Li and Akintoye (2003) described six benefits of the PPP: enhance government's capacity to develop integrated solutions; facilitate creative and innovative approaches; reduce the cost and time to implement the project; transfer certain risks to the private sector; attract larger, potentially more sophisticated, bidders to the project; and access advanced skills, experience and technology. However, these advantages can be controversial in other view points. Yescombe (2007) summarised debates about avoiding limitations on the budget of the public sector without additional demand on budget, risk transfer instead of higher financing cost of the private sector, the complexity of the PPP, the flexibility of the public sector, etc. The disadvantages of the PPP are also compared with advantages in many researches. Stainback (2000) explored advantages and disadvantages of the PPP based on respective views of the private and the public sectors. In the view of the public sector, there were such advantages as reduced risks on the ownership, development and operation, utilising the expertise and creativity of the private sector, reducing the investment of the public sector, generating long term investment of the private sector, etc. Disadvantages were the reduced level of control over the design and building quality, the possibility of inappropriate risk sharing and legal dispute, the economic return to the public sector depending on the private sector, the predevelopment process open to the public by media, etc. In the view of the private sector, advantages were the chance to use the government owned real estate, the shared risk with the public sector, etc. while disadvantages were the complicated process, more time in predevelopment process, the affection of the political stability, etc. Corner (2005) summarised the advantages and disadvantages based the PFI deals of the UK. There are many other discussions of the advantages and disadvantages of the PPP when compared with the direct investment of the public sector. They can be summarised by the stage of a project as seen in Table 2.1.

Table 2.1 Potential advantages and disadvantages of the PPP/PFI

Stage	Advantages	Disadvantages
Plan	• Greater price certainty • Integrated plan covering whole life cycle of facility	• Uncertainty of planning for long-term period (political risk, regulation change, etc.)
Contract	• Clear aim of delivering public service • Performance measurement and incentives for upgrading the quality of service • Competition among the private sectors for the public service	• Long (re)negotiation time to get an agreement • Late response to the demand for the change of the contract • Limitations of terms and conditions to allocate risks well • High transaction cost (consulting fee, more resources in the private and the public sectors)
Design	• Innovation and creativity in design • Design considering life cycle	• Possibility of overdesign to push up prices in construction
Finance	• Long-term investment of the private sector • Reduction of spending of the public sector for public service	• Restriction of future budget (depends on PPP model) • Financing at commercial rates which tend to be higher than government borrowing rates
Construction	• On time construction • On budget construction	• Existence of unexpected problems (e.g. natural disaster which cannot be forecasted)
Operation	• Timely delivery of service • No involvement of the public sector in none core service	• Inflexibility of operation for a long term period (20-30 years)

Source: (1 Stainback, 2000, 2 Herpen, 2002, 3 Li and Akintoye, 2003, 4 Yescombe, 2007, 5 Thomson and Goodwin, 2005)

2.2.3. Risks of the PPP and risk allocation

Risks of the PPP

Risks of the PPP are various and following lists are regarded as risks in the PPP: site acquisition risk, feasibility study risk, acquiring planning approval risk, design risk, construction risk, commissioning risk, operating risk, demand (revenue) risk, obsolescence/technology risk, residual value, legislative/regulation risk, taxation risk, bid process/complicated negotiation risk, political risk, corruption risk, consortium structure risk, local partners risk, project management ability, existing infrastructure risk, raw material (supply, availability, etc), financing risk, force majeure risk, market competition risk, inflation risk, and foreign exchange risk (Private Finance Panel, 1995, Birnie, 1999, Salzmann and Mohamed, 1999).

Risks can be classified by a different perspective and some risks are more relevant than others for each project (NAO, 1999). They are affected by the economical or political circumstances of each country. Thus, it is important to identify appropriate risks for a project. According to NAO (1999), in the case of transport (especially for road), key risks were expected to be demand, design, construction and maintenance.

Risk allocation

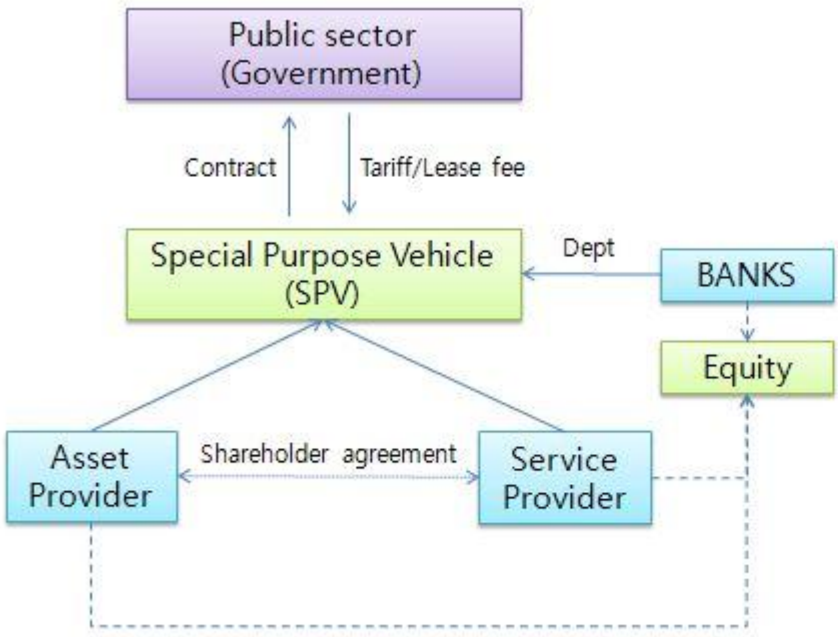
Risks should be allocated to the sector which is best able to control them (HM Treasury, 2008). The reason of using the PPP in the viewpoint of the public sector is to provide the public service effectively and efficiently, but it is for making a profit to the private sector (ADB, 2012). Thus, risks can be successfully allocated when it satisfies each sector and is agreed between two sectors (Li et al., 2005a). Some researchers prefer to allocate risks to three stakeholders: the public sector sponsor, the private sector and the end users (Arndt, 1998). However, the public sector covers the interest of the end users in most cases, so risks can be assigned to the public sector and the private sector or shared between the two sectors (NAO, 1999).

Risks should be allocated by a rational systematic manner, because some of them can be overlooked (Wang et al., 2002). Risk allocation is conducted through the negotiation process between two sectors and it is finally concluded by making a contract (Li et al., 2005a, NAO, 1999).

Contractual framework for risk allocation

Usually the private sectors make a Special Purpose Vehicle (SPV), which is a key feature of most PPPs, to share risks between private sectors (ESCAP, 2011). The SPV undertakes a project and negotiates contract agreements with the public sector. It is used for the PPP project implementation in limited or non-recourse situations, where the lenders depend on the cash flow and security over its assets to recoup its investment. An SPV has whole risks of the private sectors and each private sector is partly responsible for its shares. Thus, it is good to manage a mega project with high cost and risks.

Figure 2.2 Contractual structure of the PFI



Source: (Palmer, 2000)

2.3 The models of the Public Private Partnership

2.3.1 The PPP models in the World

A PPP project can be launched by making a contract through the agreement between the private and the public sectors and it is much affected by the characteristic of each project and circumstances of each country (ADB, 2008). There are a lot of ambiguity and difference in making a PPP contract and these increase transaction cost[1] which is one of the most significant negative factors (Li et al., 2005a, Ezulike et al., 1997). In here, transaction cost includes not only cost for negotiation between the private and the public sectors, consultant, and education for officers but also time to get an agreement (House of Lords, 2010). Many countries made their own PPP models having unique processes and standard forms to be suitable for their countries (see table 2.3 and 2.4), so the PPP model can be defined as the standardised form with a substantial process.

Every country has socially and economically different circumstances, so many PPP models are made and changed by the needs of each country. In South Korea, several PPP models are listed as examples in the PPP Act which was legislated in 1993, but the most predominant PPP models are the BTO (Build Transfer Operate) and the BTL (Build Transfer Lease) models. In the UK, the DBFO model is common in transport (especially in road). These PPP models can be diversified by the following functions: design; build; finance; operate; maintain; own; transfer; lease; develop; and buy (Menckhoff and Zegras, 1999, Zhang and Kumaraswamy, 2001). These combinations make many models of PPP and each function implies various levels of responsibility and risk of the private sector (ADB, 2008). However, these models are not exclusive and there can be many variations (Steinmann, 2007). It is also possible that each project can have their own model by selecting benefits from different models of PPP, and these models can be expressed by two ways. One is focusing on the stage of project such as a design (D), build or construct (B or C), rehabilitate (R), operate (O), maintain, and manage (M). The other way is focusing on the

[1] The cost in the process of negotiating contracts because of legal, financial, and technical issues

ownership of the facility, which is expressed as transfer (T), own (O), lease (L), etc. For example, the BOT, BTO, BOO, BROT, BTL, BLT, etc. are the most common models.

PPP models by the stage of project

Following PPP models are diversified by the stage of project where the private sector has a responsibility.

<u>DBO (Design-Build-Operate)</u>

In DBO model, the private sector is in charge of design, build and operate. The public sector owns and finances the construction of new facility. Generally, the private operator is taking no financing risk and is paid a sum for construction cost and operating fee by the procurement authority (PPP IRC, 2011).

<u>DBFO (Design-Build-Finance-Operate)</u>

DBFO is the PPP model where the private sector undertakes the design, build and operate a facility with its own finance for a contracted period, mostly 25 or 30 years. It is generally for the PPP/PFI roads (Scottish Future Trust, 2011).

<u>DBOM (Design-Build-Operate-Maintain),</u>

Under DBOM model, the private sector is responsible for the design, construction, operation, and maintenance of the facility for a contracted period. The private sector should meet all agreed performance standards relating to physical condition, capacity, congestion, and ride quality (U.S. Department of Transportation, 2007).

<u>DCMF (Design-Construct-Manage-Finance)</u>

This model is very similar to DBOM or DBFO and it is generally for the PPP prison projects. The main difference is that the majority of services are provided by private sector employees unlike PPP schools where the facility is maintained by the private sector, but the core teaching role remains within the public sector (Scottish Future Trust, 2011).

Table 2.2 PPP models by the stage of the project

PPP model	Design	Build	Finance	Manage		Example
				Operate (Core Service)	Maintain	
DBO	Private	Private	Public	Private/Public	Private	North Ballarat Wastewater Plant Upgrade (Australia)
DBFO	Private	Private	Private	Private/Public	Private	A1(M) Alconbury to Peterborough road (UK)
DBOM	Private	Private	Private/ Public	Public	Private	Hudson-Bergen LRT (USA)
DCMF	Private	Private	Private	Private	Private	DCMF prison, library (UK)

Source: (U.S. Department of Transportation, 2007, Scottish Future Trust, 2011), http://www.infrastructure.org.au

PPP models by the ownership of facility

Following PPP models are diversified by the ownership of facility in above mentioned functions of the PPP projects.

<u>BOT (Build-Operate-Transfer) and variants</u>

BOT(Build-Operate- Transfer) is one of the most preferred PPP model and a term that got coined by Turgat Ozal, prime minister of Turkey in the 1980s (Delmon, 2005). The private sector is in charge of financing, designing, building and operating the project (Grimsey and Lewis, 2004). BTO, BOT (Build-Operate-Transfer), ROT (Rehabilitate-Operate-Transfer), BROT (Build-Rehabilitate-Operate-Transfer) have the same scheme for returning private investment. After building or rehabilitating a facility, the private sector operates and gets revenues from end users directly for a contracted period. At the end of contract period, the facility is transferred to the public sector. BTO is different from BOT in the time of transferring the facility. ROT is used for the existing facility (Park, 2003). BOOT (Build-Own-Operate-Transfer) and ROOT (Rehabilitate-Own-Operate-Transfer) are models emphasising on the ownership of the constructed or rehabilitated facility. In the pure BTO model, the private sector does not have to own the facility (Outsourcing Law Global, 2011).

BLT (Build-Lease-Transfer) and variants

BLT is a model of PPP where the private sector designs, builds and operates an infrastructure facility and leases it to the public sector. BTL (Build-Lease-Transfer) is different from BTL just in the time of transferring. In the BTL model, the private sector uses its own funds to build infrastructure facilities and transfers ownership to the public sector. The public sector in turn grants the company "rights to manage and operate the facilities" to take charge of its operation. However, the public sector makes payments for the services rendered by the company which enables the company to recover its investment and operation costs (Park, 2003).

LDO (Lease-Develop-Operate) / LBO (Lease-Build-Operate)

In this model, the private sector is given a long-term lease to develop and operate an existing facility. The private sector invests in the improvement of the facility and recovers its investment and a reasonable profit. It is particularly appropriate when the public sector retains ownership of the existing facility and receives payments under lease agreement with the private sector. This model is well suited for developing airport, seaport or rail infrastructure, as due to strategic reasons government would like to retain their ownership (Mital and Mital, 2006, Davies and Fairbrother, 2003).

BOO (Build-Own-Operate) / BBO (Buy-Build-Operate) / LOO (Lease-Own-Operate)

BOO is a model of PPP where the private sector owns the facility for unlimited period, so it is the nearest to the privatisation. The public sector constrains the operation of the private sector by various regulations (Department of Education and Children's Services of South Australia, 2011). BBO (Buy-Build-Operate) is a model that the private sector buys an existing facility and after building or repairing, the private sector operates under the regulation of public sector (Park, 2003). LOO (Lease-Own-Operate) is similar to a BOO but an existing asset is leased from the public sector who takes ownership from that time (Arndt, 1999, Chege and Rwelamila, 2001).

Other models

Besides those mentioned above, there can be various similar models like BLOT(Build-Lease-Operate-Transfer), BOD(Build-Operate-Deliver), BOL(Build-Operate-Lease), BOOST(Build-Own-Operate-Subsidize-Transfer), BRT(Build-Rent-Transfer), DBOT(Design-Build-Operate-Transfer), FBOOT(Finance-Build-Own-Operate-Transfer), and RTL(Rehabilitate-Transfer-Lease) (Arndt, 1999, Chege and Rwelamila, 2001, Song, 2005, Grimsey and Lewis, 2004).

Table 2.3 PPP models by the ownership of facility

PPP model	Ownership	New / Existing	Operate	Main source of revenue
BOT	Private / Public (mostly private for a specified period)	New facility	Private	End user's tariff
BTO	Public (grant operation right)	New facility	Private	End user's tariff
ROT	Private / Public (depends on a case)	Existing facility	Private	End user's tariff
BROT	Private / Public (mostly private for a specified period)	Rehabilitate existing facility and add on new facility	Private	End user's tariff
BOOT	Private (for a specified period)	New facility	Private	End user's tariff
ROOT	Private (for a specified period)	Existing facility	Private	End user's tariff
BLT	Private	New facility	Private	Lease fee from public sector
BTL	Public	New facility	Private	Lease fee from public sector
LDO(LBO)	Public	Existing facility	Private	Collect end user's tariff and pay lease to public sector
BOO	Private	New facility	Private	End user's tariff
BBO	Private (Buy)	Existing facility	Private	End user's tariff
LOO	Private (for a leasing period)	Existing facility	Private	End user's tariff

Source: (Arndt, 1999, Chege and Rwelamila, 2001, Park, 2003, Mital and Mital, 2006, Delmon, 2005, Davies and Fairbrother, 2003, Outsourcing Law Global, 2011, Grimsey and Lewis, 2004)

2.3.2 Classification of the PPP models

The PPP models are various and they could be continuously made to reflect rapidly changing circumstances. It is not appropriate to say that one particular PPP model is universally better than another, because efficiency and effectiveness can be varied by given situations of project, sector, and country. Thus, it needs to classify various PPP models to identify relevant lessons from other projects, sectors, and countries. Delmon (2010) suggested five key parameters to classify many PPP models in the World. These parameters are business (New or Existing), construction obligation (Build or Refurbish), private funding (Equity contribution, Debt contribution, Subordinated contribution, Project finance), service delivery (Bulk or User), and source of revenue (Lease fee or End user tariff).

Song (2005) described that the PPP models could be classified by the way of proposal and the way of repayment. If the private sector proposes a project then it is called an unsolicited project while the public sector proposes a project then it is called a solicited project. The PPP models are classified as a “financially free standing” model and a “service sold to the public sector” model by the way of repayment. In the financially free standing PPP model, the source of repayment is the tariff from the end users and, in service sold to the public sector model, it is the fee from the procurement authority. Similarly Allen (2001) divided the PFI projects of the UK into three types: Financially free standing projects, Joint ventures, and services sold to the public sector. Financially free standing type is the PPP where the private sector builds and operates the facility by the fee from the end users without the financial support from the public sector. In the services sold to the public sector model, the public sector pays lease fee for the service provided by the private sector regardless of the fee. In the case of the joint ventures type, the public sector directly joins the project and provides various supports such as subsidy. However, joint venture can be used with any other types of PPP and it is very common in South Korea, so this type does not need to be classified independently for studying the cases of South Korea.

In this study, it looks better to classify various PPP models by the way of repayment as seen in Table 2.5. This study comparing the BTO and the BTL model of South Korea and these two models are 'financially free standing' model and 'services sold to the public sector' model. Thus, this classification of PPP models can help other countries to understand this study. Table 2.5 shows that the Queen Elizabeth II bridge project of the UK is a 'financially free standing' type and the M1-A1 motorway link DBFO project is a 'services sold to the public sector' type.

Table 2.4 Classification of PPP models by the way of repayment

Classification	Characteristics	Relevant PPP models[2]	Relevant transport projects
Financially free standing projects (Tariff base)	The private sector is responsible for a project and costs will be repaid through a charge to the end user. The Government may be involved in making an initial plan and procedure like determining the route of road. The role of public sector is limited to secure wider social benefits, such as road decongestion resulting from an estuarial crossing.	BOT, BTO, ROT, BOOT, BOO, etc.	Queen Elizabeth II (Dartford) Bridge (UK) Incheon Airport Expressway (Korea)
Services sold to the public sector (Fee base)	The private sector provides public services to the public sector and the investment of the private sector is recouped from the fee of the public sector. For example: a private sector firm selling kidney dialysis services to a hospital; the private sector providing accommodation and day-to-day care for the elderly; or the provision of prison places by the private sector through designing, building, financing and operating new prisons.	DBFO, BTL, BLT, etc.	M1-A1 Motorway Link, A1(M) Alconbury to Peterborough (UK) Daegok-Sosa Railway (Korea)

Source: Partnerships UK (2011), Allen (2001), Song (2005), MLTM

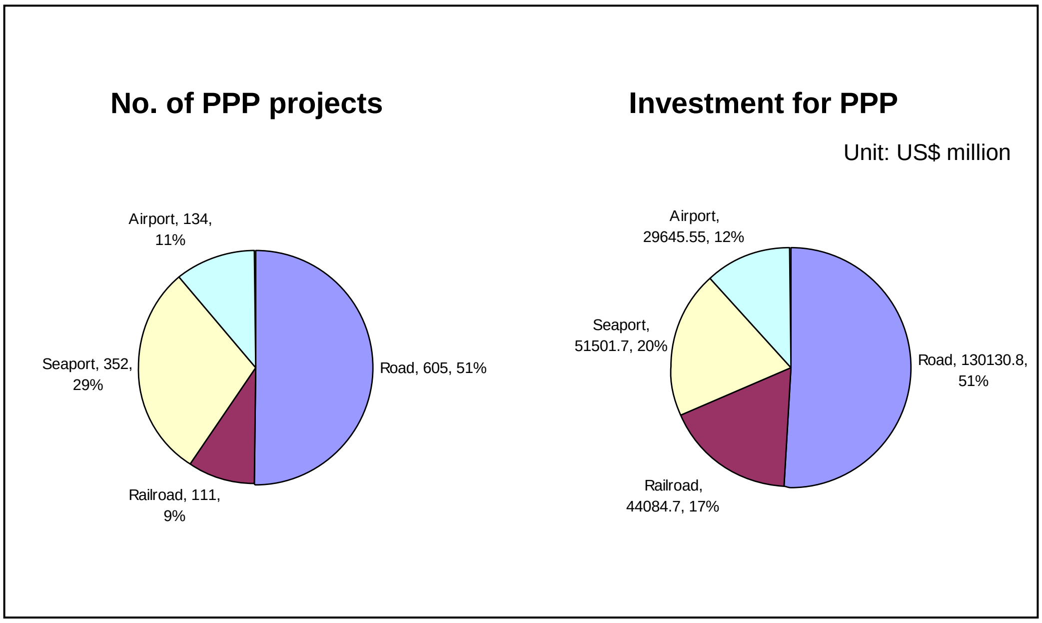
[2] Details of PPP models are varied by the situation of each project or country, so there can be exceptional projects. For example, M6 toll road (UK) is usually known as a DBFO project, but it is close to financially free standing project.

2.4 The Public Private Partnership in transport

2.4.1 The PPP projects for transport infrastructures

Road, railroad, seaport and airport are the most common transport infrastructures which can be constructed and operated by the PPP in the world. According to the World Bank, 81 countries have adopted a private sector involvement to build or operate transport infrastructure from 1990 to 2009. During the same period, the private sector has involved in 1,202 transport projects with the investment amount reaching more than US $ 255,363 million.

Figure 2.3 PPP projects by transport sector in developing countries



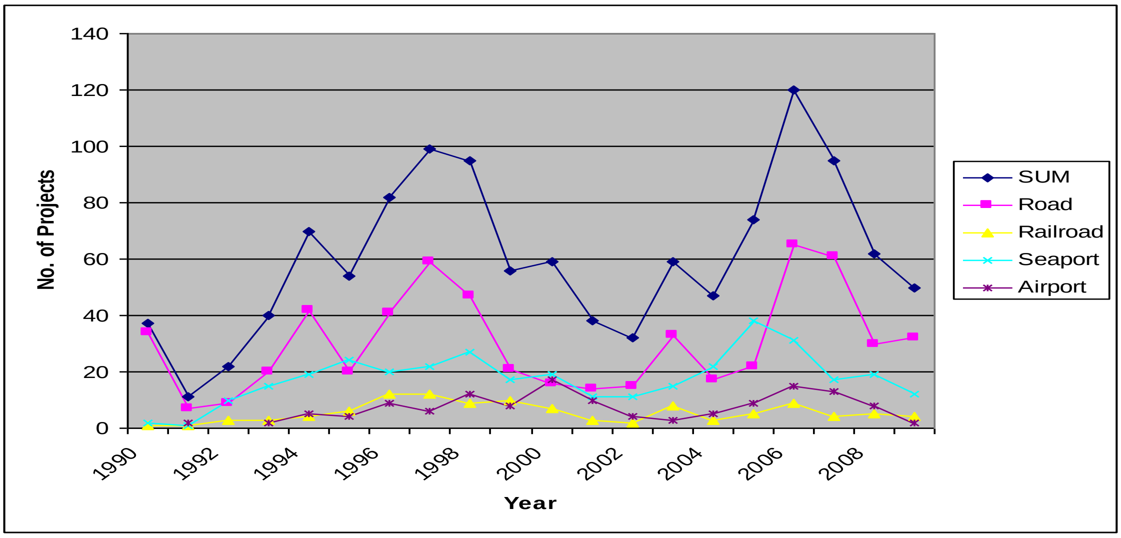
Source: World Bank and PPIAF, PPI Project Database. (http://ppi.worldbank.org)

Figure 2.3 shows that around half of them are road projects and the rest are for seaports, rails, and airports. The number of road PPP projects from 1990 to 2009 is 605, seaports 352, airports 134, and railroads 111. The amount of road investment is US $130,131 million, seaports $51,502 million, airports $29,646 million, and railroads $44,085 million.

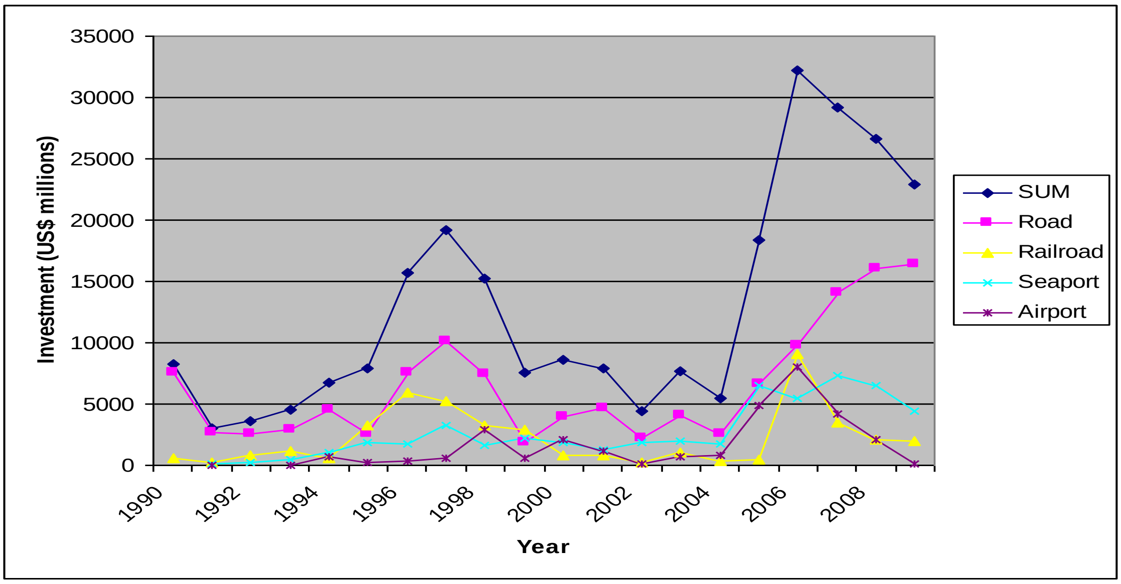
Since the PPP for transport infrastructures is likely to be for a mega project which needs much private investment, it is easy to be affected by the economic circumstances. As seen in the Figure 2.4, the number of PPP projects and the investment in them had increased until 1997 when the financial crisis hit Asian countries including South Korea. The economy recovered in a very short time and reached the peak in 2006. However, the investment has rapidly decreased since 2006 and it seems that the PPP market has been negatively affected by the global financial crisis (Liyanage, 2011, Thadden, 2009, Raisbeck, 2009, Burger et al., 2009).

Figure 2.4 Annual trends of PPP projects in transport in developing countries

< Number of PPP projects >



< Investment for PPP projects >



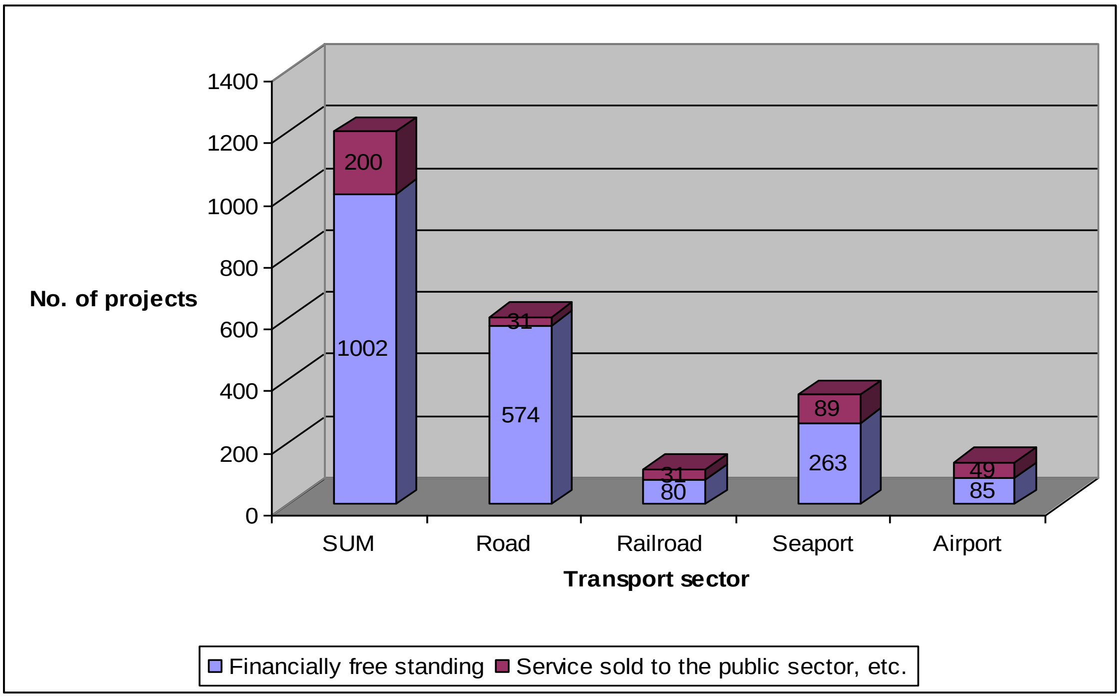
Source: World Bank and PPIAF, PPI Project Database. (http://ppi.worldbank.org)

2.4.2 The PPP models for transport infrastructures

In this study for comparing two different PPP models (BTO and BTL) of South Korea, the most effective way to classify the PPP models is based on the repayment method: financially free standing and services sold to the public sector model (see section 2.3.2). With regard to the PPP models for transport infrastructures, most of them are 'financially free standing' models except the cases of the UK.

Figure 2.5 shows that 83.4% (1,002 projects out of 1,202 projects) of transport PPP projects used the financially free standing model such as BOT, BROT, ROT, BOO, etc. The rest of them used lease contract, management contract, etc. Generally, transport PPP has incomes through charging end users, so it seems that the public sector prefers to use the financially free standing model.

Figure 2.5 The PPP models for transport infrastructures



Source: World Bank and PPIAF, PPI Project Database. (http://ppi.worldbank.org)

Especially, in the cases of road, non-financially free standing model represented only 7% of investment for PPP projects from 1985 to 2004 in the World[3] (Aecom Consult, 2007).

However, PPP models for transport in the UK are quite different from those in the above mentioned countries. The most predominant PPP model in transport in the UK is the service sold to the public sector model and few projects were done by the financially free standing PPP model.

The UK is the most advanced European country in terms of the private participation in the public service either through direct private provision or through the PPP as seen in Table 2.6 (Vickerman, 2003). A total of 898 PPP projects in the UK have been carried out since 1992, and of which 68 projects are for transport. While 22 of the transport projects are mainly about street lighting, shipping, bus service, the rest 46 projects are about transport infrastructure. Among the 46 projects, 29 projects are for roads 16 for rail including underground and tram or light rail, and 1 for an airport terminal. Total amount of investment for 43 transport infrastructure projects is ￡23,770 million: roads ￡3,615 million, rails ￡20,145[4] million and airport terminal ￡10 million (Partnership UK, 2011; see Appendix 1).

Table 2.5 The PPP of European countries

	No. of signed projects (%)	Value of signed projects (%)		No. of signed projects (%)	Value of signed projects (%)
Austria	0.2	0.6	Latvia	0.1	0.0
Belgium	0.7	1.1	Malta	0.1	0.1
Cyprus	0.3	0.4	Netherlands	1.0	1.7
Czech Rep.	0.2	0.4	Poland	0.4	0.9
Denmark	0.0	0.0	Portugal	2.3	5.8
Finland	0.2	0.2	Romania	0.3	0.1
France	2.8	3.9	Slovak Rep.	0.1	0.0
Germany	2.4	2.9	Slovenia	0.1	0.0

[3] Cases of USA were excluded.

[4] The most of them are for London underground(£17,594 million for 8 projects)

Greece	0.6	3.9	Spain	8.6	12.8
Hungary	0.8	2.7	Sweden	0.1	0.2
Ireland	0.7	0.7	UK	76.2	57.2
Italy	2.1	3.7	Total	100.0	100.0

Source : EIB, HM Treasury, Irish PPP Unit and various commercial databases : recited from Blanc-Brude et al (2007).

In these transport PPP projects of the UK, only three projects were done by the financially free standing model: Birmingham Northern Relief Road (M6 Toll), Second Severn Crossing, and Skye Bridge. Even including a partly subsided joint venture project, only four projects used financially free standing model (House of Commons, 2000, Partnerships UK, 2011).

2.4.3 The appraisal for the PPP in transport

Various efforts were made to use the finance, creativity and the competition of the private sector, and the PFI is the most controversial and best-known form of the PPP in the UK (Cartlidge, 2006). Therefore many of the experiences in the UK are based on the PFI scheme compared with the conventional public procurement scheme. Traditional procurement of transport project which is mostly large scale had problems of late delivery and overran the estimated cost (NAO, 1998). One of the most important reasons to use the PPP was to solve these problems. According to the Nation Audit Office of the UK (1998), the PFI had managed to keep the expected time and cost of construction.

As the investment in the PPP projects had gradually increased, however, some criticisms were also followed. These criticisms seemed to mostly focus on the risk allocation, efficiency and transparency of the PFI projects. Glaister (1999) listed five misused PPP instances. First, it was possible to evade from the political spending control such as a government change. Generally the period of the PPP contract lasted more over 20 or 30 years, so it could not be changed to spend money on that for the contracted period. Second, the interest rates were difficult to change, so it was hard to cope with flexible financial markets. Third, the process to make a contract was quite complicated and took a long time, so this mechanism obfuscated the public cost of investment decisions. Debande (2002) also pointed out this problem. The transaction cost such as staff costs, and consultant fee was relatively high regardless of the project size and the procurement model of the PPP. Fourth, the complexity of contract between the public and private sectors made it difficult to have a chance to criticize the faults in the construction and operation phases and to find the reasons. Lastly, though people frequently misunderstood that they did not have additional financial burdens to use the facilities which were funded by the private sector, the public sector had to repay the private sector by tax or other public fund. After all, though the government advertised the PPP as a new funding, actually it was just financing.

Vickerman (2002) analyzed some experiences of the UK from the fully privately financed Channel Tunnel project to the PPP in the provision of new urban public transit projects. In the Channel Tunnel case which was financially independent, the uncertainty of scale, construction costs, and traffic forecasts was a major problem. In the Railtrack case to upgrade the West Coast line, transaction costs, problem of complexity and risks were highlighted.

There were various attempts to induce the private sector to participate in the road projects, but many of them were executed by the DBFO scheme. As mentioned above, the DBFO scheme was generally beneficial in keeping to the planned construction period and cost, but the possibility that the government could pay more than 25% than the original construction cost was also raised. In other words, it was the complaint that the DBFO for roads was too expensive (Shaoul et al., 2006, NAO, 1998).

With regard to the financially free standing model like a BOT, the investment of the private sector is recovered through charging tariffs to the end users. Thus, the most attractive thing to the public sector was the possibility to spend little government budget on the project while the facility was procured in time.

However, the private sector has an exclusive right to operate the private funded facility, so it can lead to inefficiencies due to lack of competition (Herpen, 2002). In most cases, since the private sector has a right to operate in monopoly, high tariff level which the private sector was a big controversial issue in several countries using the financially free standing model.

2.5 Conclusion

The PPP covers various public service areas and the responsibility and risk of the private and public sectors depend on the agreement between both sectors. The variety of PPPs makes its definition difficult and the concept ambiguous. Confusing terminology and so many models were obstacles to exchanging knowledge and experiences between countries. Thus, it is needed to review the concept of PPP clearly and explore the PPP models broadly.

Through literature reviews, the PPP could be broadly defined as a cooperative working between public and private sectors to fulfil the public needs and maximize the mutual benefit by sharing skills, expertise, finance of each sector and risks in construction or operation. Especially, risks in PPP projects are complicated and high, so they are difficult to be managed well by only one private company. Therefore, in order to limit the risks of private sector within the shares they have, a SPV is broadly used as a contractual frame.

The PPP had broad spectrum and PPP models are also various, so it is needed to classify these models. Though several ways to classify the PPP models exist, the PPP models in this study are classified into the financially free standing model and the service sold to the public sector model based on the way of recoupment or source of revenue. This classification explains well the BTO and the BTL models which are the most predominant PPP models in South Korea. Joint venture, where the public and private sectors jointly invest, is often used not only in the UK but also in Korea. However, since it can be used in any PPP model, this type is not regarded as an independent classification in this study.

In the transportation field, the PPP has a long history and historically many transport services were operated by the private sectors. However, they became difficult to be fully delivered in the private arena as society and economies rapidly developed. However, the public sector did not have enough fiscal resources to fulfil public needs in transport. The private sector was also limited in its ability to satisfy various public demands given its own motive to make a profit. Thus, many countries introduce the PPP to the transport field while many of them preferred the financially free standing model. On the contrary, the UK mainly used the service sold to the public sector model.

CHAPTER 3

The Public Private Partnership in Transport in South Korea

3.1 Introduction

The PPP in South Korea was rarely used on a project before 1994. As the national economy was rapidly developed, the demand for the transport infrastructures was steeply increased. Though the government enlarged the investment in the transport such as road and rail, it was not enough to cope with the regional demand. Moreover, the economic crisis in Asian countries including South Korea in 1997 made the government decrease the financial expenditure. The Korean government was requested to save the budget for a large scale investment in transport infrastructures. Such circumstance made the Korean government expand the PPP urgently and focus on budget savings by using the BTO model. The government explained that the BTO projects mainly for road and rail could be constructed and operated without the financial burden of the government. However, it was not true because the government guaranteed the minimum revenue which was up to 90% of the forecast This Minimum Revenue Guarantee (MRG) scheme which was commonly shown in early BTO projects in South Korea was severely criticised.

This chapter explores the regulation and prospect of PPP mainly focusing on transport in South Korea. Firstly, it introduces the transport in South Korea focusing on the road and rail and provides an overview on the regulation of the PPP such as history, procedure, and the MRG regulation. Next, PPP models in South Korea are explored in detail. Especially, the features of the BTO and the BTL model, which are dominant in South Korea, are discussed. Advantages and disadvantages are deeply compared for both PPP models. Then, the PPP projects in road and rail in South Korea are reviewed. Lastly, the appraisal on the PPP for transport in South Korea is explored.

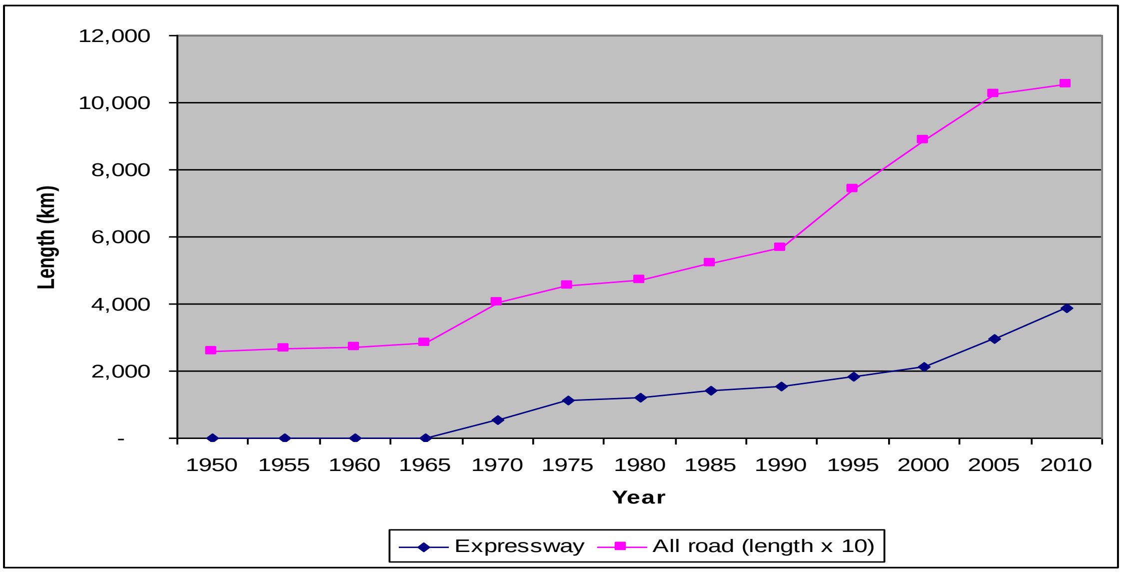
3.2 Transport in South Korea

3.2.1 Introduction to transport in South Korea

In the early 1900's paved road and rail were newly introduced to Korea, but most of them were destroyed during the Korean War from 1950 to 1953. Korea was divided into South and North Korea, and main road and rail networks disconnected. Development of transport infrastructure in South Korea was resumed from the 1970's with rapid economic growth.

In 1970, the Gyeongbu Expressway linking Seoul and Busan was opened. It was the first expressway and the first toll road in South Korea. South Korea, which was one of the poorest countries in the World until the 1960's, was suffered from the lack of budget to invest in SOC (Social Overhead Capital) like road and rail. Thus, most expressways were constructed as toll roads to lessen the financial burden of the government. Road pricing on expressways was widely regarded as necessary under the difficult fiscal situation in South Korea and the agreement of people on toll road policy became an important factor for the BTO project. In other words, a 'financially free standing' model was widely adopted by toll charging without the government direct investment. Figure 3.1 shows that expressways charging tolls have steeply increased and reached 3,860 km in South Korea in 2010 (MLTM, 2010a).

Figure 3.1 Length of road in South Korea

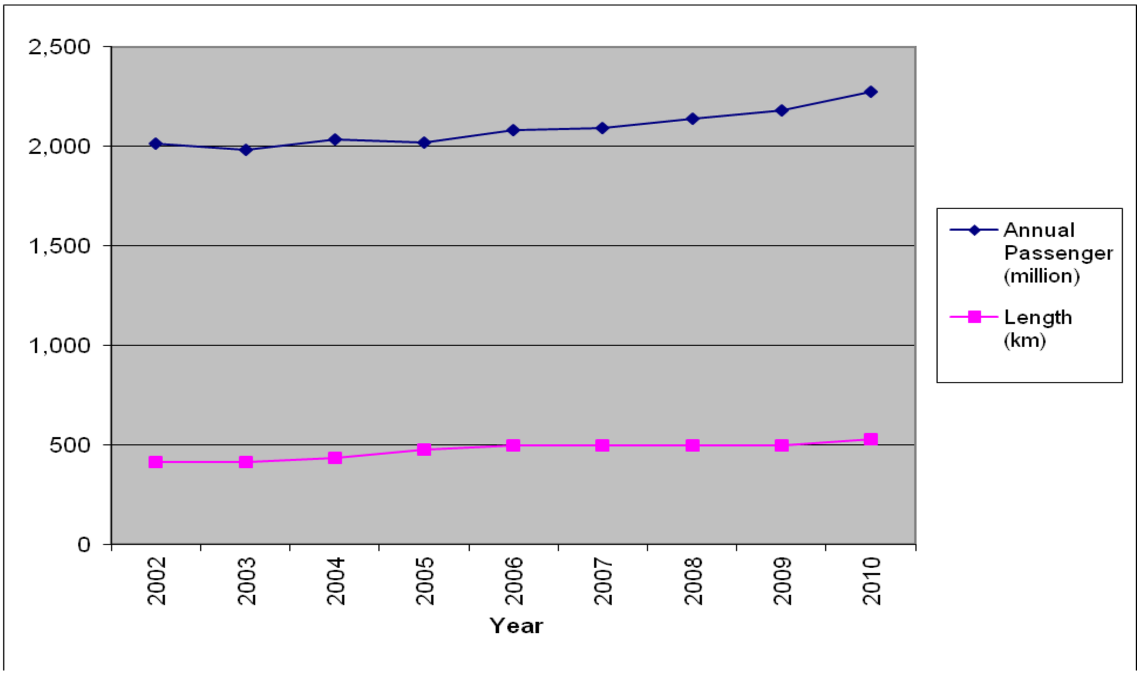


(Source: MLTM)

Most expressways except the PPP roads in South Korea are operated by KEC (Korea Expressway Corporation) which is owned by the government. KEC is in charge of not only operation but also construction. The MLTM provides land cost and 50% of construction cost to KEC for building new expressways. Then the rest of construction cost is financed by KEC with toll revenue. KEC is also in charge of maintenance and expansion of existing expressways with the operation right including charging a toll.

Rail had been a dominant transport mode until the 1960s since the Jemulpo-Noryangjin rail was firstly opened in 1899, though it was severely devastated during the Korean War. Some 88% of freight and 53% of passengers in South Korea had been carried by rail transport until the 1960s. This was gradually changed by the development of cars, and only 11% of freight and 15% of passengers were carried by rail in the 2000s (Lee, 2006). However, rail began to stand out in urban transport and high speed transport (Won, 2006). Since the Subway line no. 1 in Seoul opened in 1974, urban rail like a subway has become an important public transport mode carrying 2,273 million passengers per year in 2011 as seen in Figure 3.2. The total length of urban rail in major cities including Seoul increased to 549 km in 2011 (MLTM, 2011a).

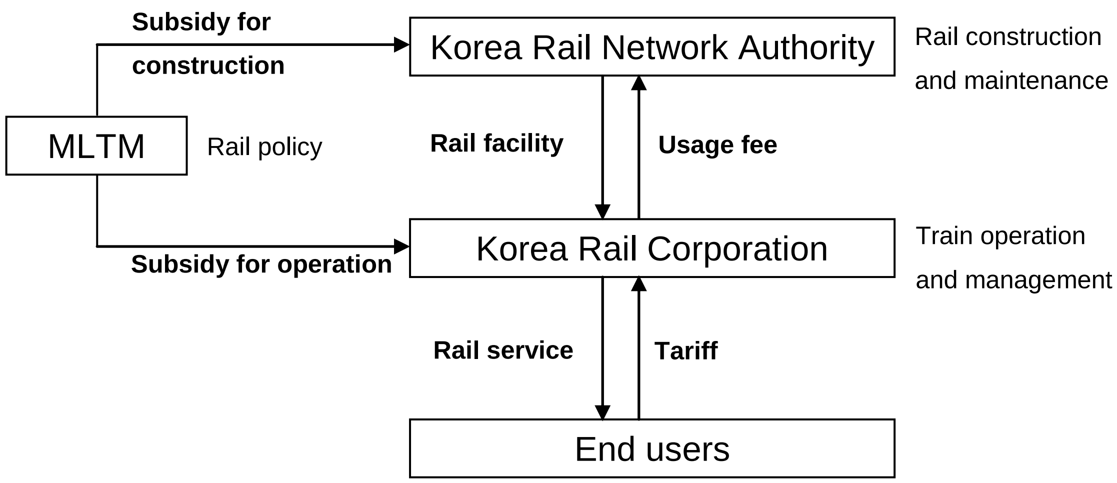
Figure 3.2 Passengers and the length of urban rail



Source: (Korea Transport Database, 2010, MLTM, 2011a)

Korean rail can be divided into two types: the national arterial rail including high speed rail and the urban rail. Figure 3.3 shows the national rail system in South Korea. In Korean national rail and the high speed rail, construction and operation are separated. The construction and maintenance of facility are done by KRNA (Korea Rail Network Authority) and the train and station operation are done by KORAIL (Korea Railway Company). The MLTM, which is a government department supervising two organisations, annually provides subsidies to them for compensating for construction cost of rails without profitability as well as the operation cost on sustaining low tariff level. Though KRNA charges usage fee to KORAIL, it is not enough to burden whole construction cost of rail. KORAIL also charges tariff to end users, but it is strictly restricted by the government.

Figure 3.3 National rail systems including the high speed rail in South Korea

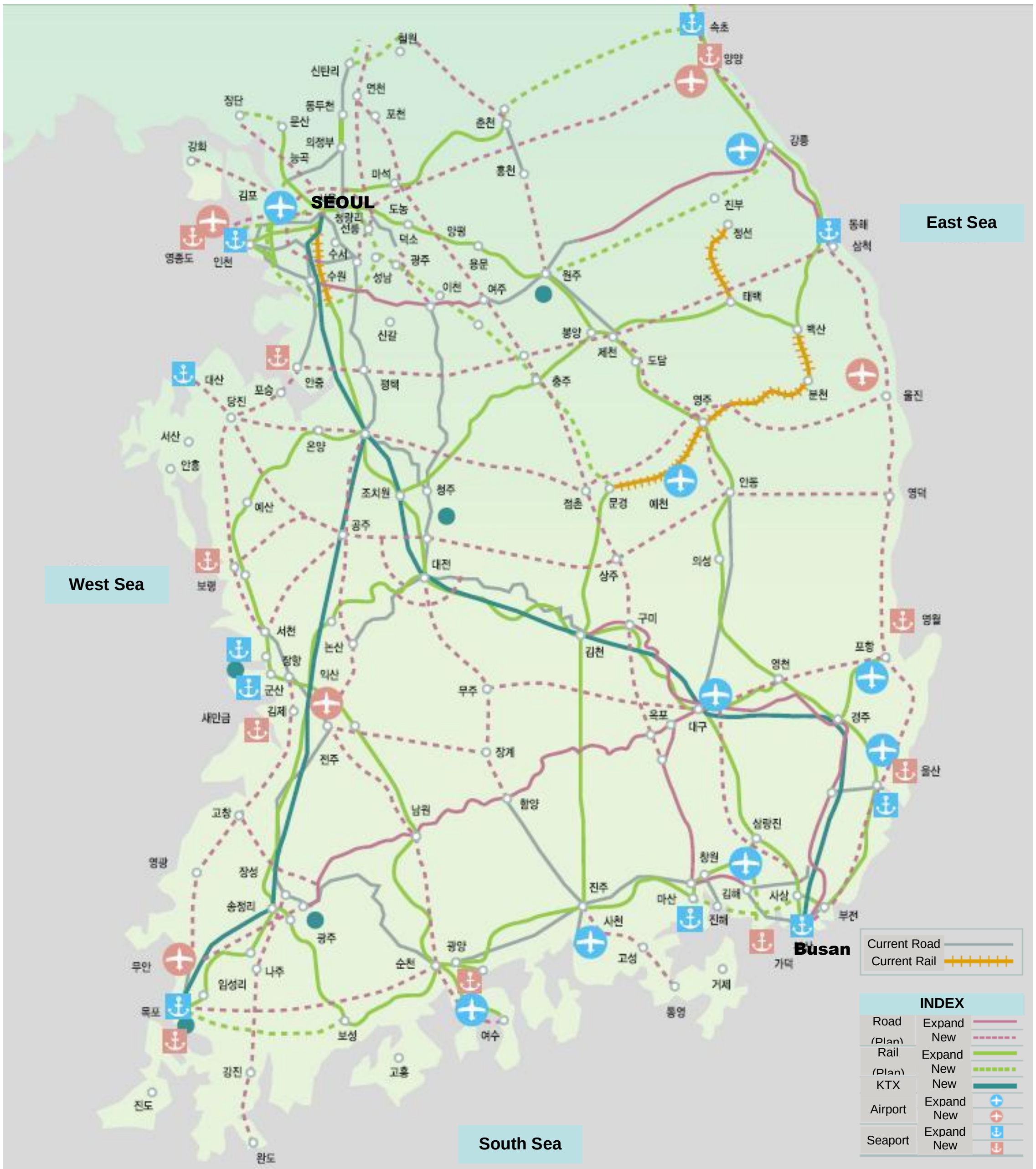


However, the urban rails are constructed and operated by different authorities. In Seoul, there are four public companies and one private company operating subways. Five other cities also have their own public operators and also other small cities are trying to construct several LRT (Light Rail Transit) projects. Urban rail can be constructed and operated independently, so most PPP projects in rail are for urban rails including the LRTs. In the case of national arterial rail, the BTL model was introduced to induce the private sector involvement to the construction of rail excluding operation, which is done by KORAIL.

3.2.2 Investment plan for the transport infrastructure in South Korea

Since the economy of South Korea was rapidly developed in a short period after 1970s, so infrastructures are still regarded as insufficient. Recently, the MLTM revised the master plan for national transport from 2000 to 2020 as seen in Figure 3.4 (MLTM, 2011b). According to this plan, expressway will be increased from 3,776km in 2009 to 5,470km in 2020 and rail including high speed rail will be increased from 3,378km in 2009 to 4,955km. Total investment in arterial road and rail is expected to be around ₩142 trillion (road 70/rail 72).

Figure 3.4 The plan for transport network in Korea in 2020



(source: MLTM)

3.2.3 Prospect of the PPP in transport in South Korea

Transport infrastructures like road and rail are still needed in South Korea, but the central and local governments cannot afford to meet all of the public demand. Thus, the MLTM suggests the project with high profitability should be considered ahead as the PPP (MLTM, 2011b). The Korean government has made an enormous effort to induce the private investment in the construction of infrastructures as seen in Table 3.1. These efforts gave a big contribution to increasing the quantity of infrastructure, and to reduce the financial burdens on the government by mostly using the BTO model where the private sector recoups its investment from end users directly (KDI, 2006a).

Table 3.1 Private investment in national infrastructures in South Korea

(Unit: trillion KRW)

	2000	2001	2002	2003	2004	2005	2006	2007
Private investment(A)	1.0	0.6	1.2	1.2	1.7	2.6	3.0	3.1
Government investment(B)	15.2	16.0	16.0	18.4	17.4	18.3	18.4	18.4
A/B(%)	6.6	3.4	7.5	6.6	9.8	14.2	16.3	16.8

Source: Ministry of Strategy and Finance, South Korea

Expressway is the most advanced transport field for the PPP. According to the MTLM (2011c), 15 projects with ₩18.1 trillion estimated cost are under planning. Five projects out of them were already signed while three projects are in negotiation with the preferred bidder. Five projects are in the VFM assessment by the MLTM. In the case of rail, two projects are under planning by the BTO model. 101 LRT projects which would cost ₩66.6 trillion are also under discussion at the level of local governments (Park, 2011a).

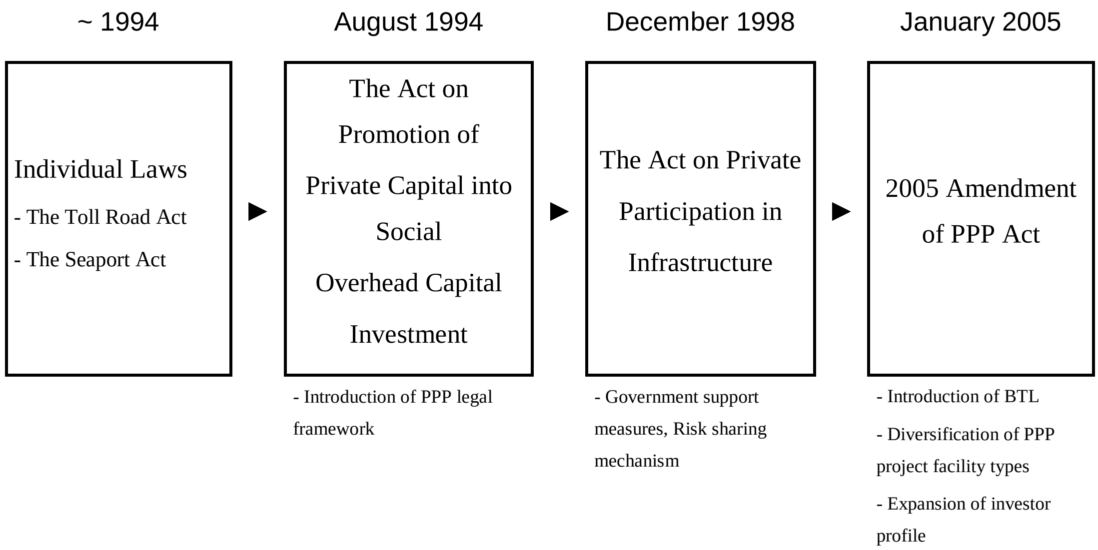
However, the PPP market seems to be depressed because of the low involvement of the private sector after the recent global financial crisis though necessity from the public sector is increasing. Uncertainty of national economy has been raised since the global financial crisis in 2008, and the private sector, especially the financial investors, have hesitated to invest in the PPP projects which usually need the long-term financial support and have high risks.

3.3 The Regulation of the PPP in South Korea

3.3.1 History of the PPP in South Korea

The history of the PPP in Korea can be divided into four stages according to the changes of PPP regulation. Figure 3.5 shows the history of the PPP regulation shortly. The first period was from 1960s to 1994 when “the Act for the promotion of private capital into social overhead capital investment” was legislated. The second period was from 1994 to 1998 when the regulation for the PPP got totally revised to “the Act for the private participation in infrastructure” for removing the obstacles in the previous regulation and introducing incentives to the private sector (Wang, 2005). The third period was from 1998 to 2005 and a risk sharing mechanism between the private sector and public sector was developed during that time. The last period is after 2005 when the BTL was newly introduced to various infrastructures.

Figure 3.5 History of PPP regulation of South Korea



Source: Wang (2005)

After the World War II, Korea has recovered the sovereignty from Japan, but was separated soon into the South and North. The Korean War from 1950 to 1953 between South and North Korea destroyed most of the infrastructure in Korea. The economic development was launched by the strong drive of the government from the late 1960s, and it was mainly funded by foreign loans. The main interest of the government for developing economy was to construct infrastructures like an expressway, power station and dam. There were not enough capital and ability for the private sector to do a big public project at that time. Though there was an attempt to use the private finance to the public service in 1968 by individual laws such as the Act for toll road, the Act for urban railway, and the Act for seaport, the PPP was just one of the financial resources to grow the stock of infrastructures backing up the economic development (Lee, 2003, Song, 2004).

However, the investment in the infrastructures decreased in the 1980s and many problems such as congestion occurred. Without expanding the government investment, the PPP was newly highlighted as an innovative tool for building the infrastructures and improving public services. The first systematic approach to the PPP started from 1994 by enacting "the Act for the promotion of private capital into social overhead capital investment". The background of adopting the PPP to Korea is explained by the following four factors: 1) the quick fulfilment of Infrastructure; 2) the creativity and efficiency of the private sector; 3) risk transfer; and 4) support for government (Wang, 2005). Though the early PPP project was difficult to be proceeded because of the lack of experience and the financial crisis in 1997[5], it was meaningful to try to induce the private sector to the public sector more systematically.

For the last period after 2005, the BTL scheme was introduced to the school, military accommodation, and sewage facility, and then recently expanded to the railway. This was a big change in the PPP history of Korea. In the BTO scheme, the government was mainly interested in how to save government expenditure and transfer risks to the private sector, but the BTL scheme started comparing the VFM (Value for Money) and the quality of the public service.

3.3.2 Regulation on PPP models

[5] The launched projects were only five for the second period from 1994 to 1998.

According to “the Act for the private participation in infrastructure”, although the BTO, BTL, BOO, BOT, BLT, ROT, ROO, RTL are representative PPP models in Korea, it is allowed for the procurement authority to use the different PPP models by its own decision. However, most PPP projects in Korea have been done by the BTO and BTL models. The MOSF regulates that the BTO model is for the project with the sufficient income to have enough the profitability like a toll road while the BTL model is for the project with insufficient income like the school or military accommodation (MOSF, 2009a).

3.3.3 Regulation on the Minimum Revenue Guarantee

The MRG (Minimum Revenue Guarantee) was a standard risk sharing method in BTO projects in South Korea between the private sector and the government (KEC, 2007). In 1998, the government expressed to expand the PPP projects by supporting the private sector in sharing the demand risk with the government. The MRG regulation, which was introduced in 1999, was the most attractive incentive to the private sector in the BTO model. The government promised to compensate for the gap with the contracted revenue when the income did not reach the expected level for a contracted period. For a transport BTO project, the most important risk was traffic demand which was the source of revenue. Thus it looked natural for the public sector to share the demand risk with the private sector by the MRG condition. The government did not have to worry about financing at the construction stage, because the government should pay the guaranteed revenue at the operation stage. It meant that the government could evade the early investment, and could save budget on operation only if demand was high enough for the private sector to recourse the construction and operation cost. However, the MRG became the most criticised PPP regulation after operation in the 2000s by providing too high level of compensation reaching 80% or 90% of the contracted revenue. Consequently, it was helpful to vitalise the PPP projects in early 2000s in South Korea, though it also raised the sceptical opinions on the PPP. Total investment of the private sector was ₩0.3 trillion from 1995 to 1997, but the investment in the BTO projects in 2008 was expanded to ₩3.4 trillion.

Considering the increasing criticism from people concerning the competitiveness of the private sector, the level of MRG regulation was reduced in the BTO scheme (MOSF, 2009c). Table 3.2 shows the change of MRG regulation well. At first, the guaranteed level was up to 80% (in the case of unsolicited project) or 90% (in the case of solicited project) for 20 or 30 years, but in 2003 not only guaranteed period but also guaranteed level was lowered. The MRG has not been provided to the unsolicited project suggested by the private sector since 2006 and to the solicited project since 2009. However, the government is considering a different type of revenue guarantee[6] for the private sector in difficult economic circumstances after the global financial crisis (MOSF, 2009b).

Table 3.2 Change of MRG regulation

<table>
<tr><th></th><th></th><th>Guaranteed period</th><th>Level of guarantee</th><th>Guarantee condition</th></tr>
<tr><td rowspan="2">Apr. 1999 ~ May 2003</td><td>Solicited projects</td><td>20~30 years</td><td>Up to 90%</td><td rowspan="2">-</td></tr>
<tr><td>Unsolicited projects</td><td>20~30 years</td><td>Up to 80%</td></tr>
<tr><td rowspan="2">May 2003 ~ Dec. 2005</td><td>Solicited projects</td><td>15 years</td><td>First 5 years 90%
Next 5 years 80%
Last 5 years 70%</td><td rowspan="2">No MRG below 50%</td></tr>
<tr><td>Unsolicited projects</td><td>15 years</td><td>First 5 years 80%
Next 5 years 70%
Last 5 years 60%</td></tr>
<tr><td rowspan="2">Jan. 2006 ~ Nov. 2009</td><td>Solicited projects</td><td>10 years</td><td>First 5 years 75%
Next 5 years 65%</td><td>No MRG below 50%</td></tr>
<tr><td>Unsolicited projects</td><td colspan="3">Abolition</td></tr>
<tr><td rowspan="2">Nov. 2009 ~ Present</td><td>Solicited projects</td><td colspan="3">Abolition</td></tr>
<tr><td>Unsolicited projects</td><td colspan="3">Abolition</td></tr>
<tr><td rowspan="2">Alternative after 2009</td><td>Solicited projects</td><td colspan="3">Guarantee of recovering the investment of the private sector with the minimum profit</td></tr>
<tr><td>Unsolicited projects</td><td colspan="3">Abolition</td></tr>
</table>

Source: Ministry of Strategy and Finance (2009)

[6] Korean Government announced a plan to guarantee the return of the private sector's investment with minimum profit rate, which is same with national bond interest, instead of abolishing the MRG in 2009.

3.4 The PPP models in South Korea

3.4.1 The BTO model

The BTO is the most prevalent PPP model in Korea and the Korean government has promoted BTO projects, focusing mainly on transport infrastructures such as road and rail since the enactment of the PPP Act in 1994. Under the BTO scheme, the private sector builds the infrastructure facilities, transfers the ownership to the government when the construction is completed. Instead, the government grants the operating right to the private sector for a contracted period and the private sector recovers its investment by collecting tariffs from the end users during the operation. The infrastructures using the BTO models are roads, railways, ports, sewage treatment facilities, complex cargo terminals, etc. (KDI, 2006).

Generally, the BOT is the one of the most common PPP models in the world because its concept that the private sector builds, returns its investment and an appropriate profit during the contracted operation period and transfers the ownership to the public sector, is easy to understand and relatively simple. However, the tax on the BTO, where the ownership is at the government, is less than that on the BOT, where the ownership is at the private sector, in Korea (Wang, 2005). Table 3.3 shows that the property tax, education tax and office tax are added to the BOT model, though they are free in the BTO model. Thus, the BOT model is rarely used in Korea though it is legally possible to choose.

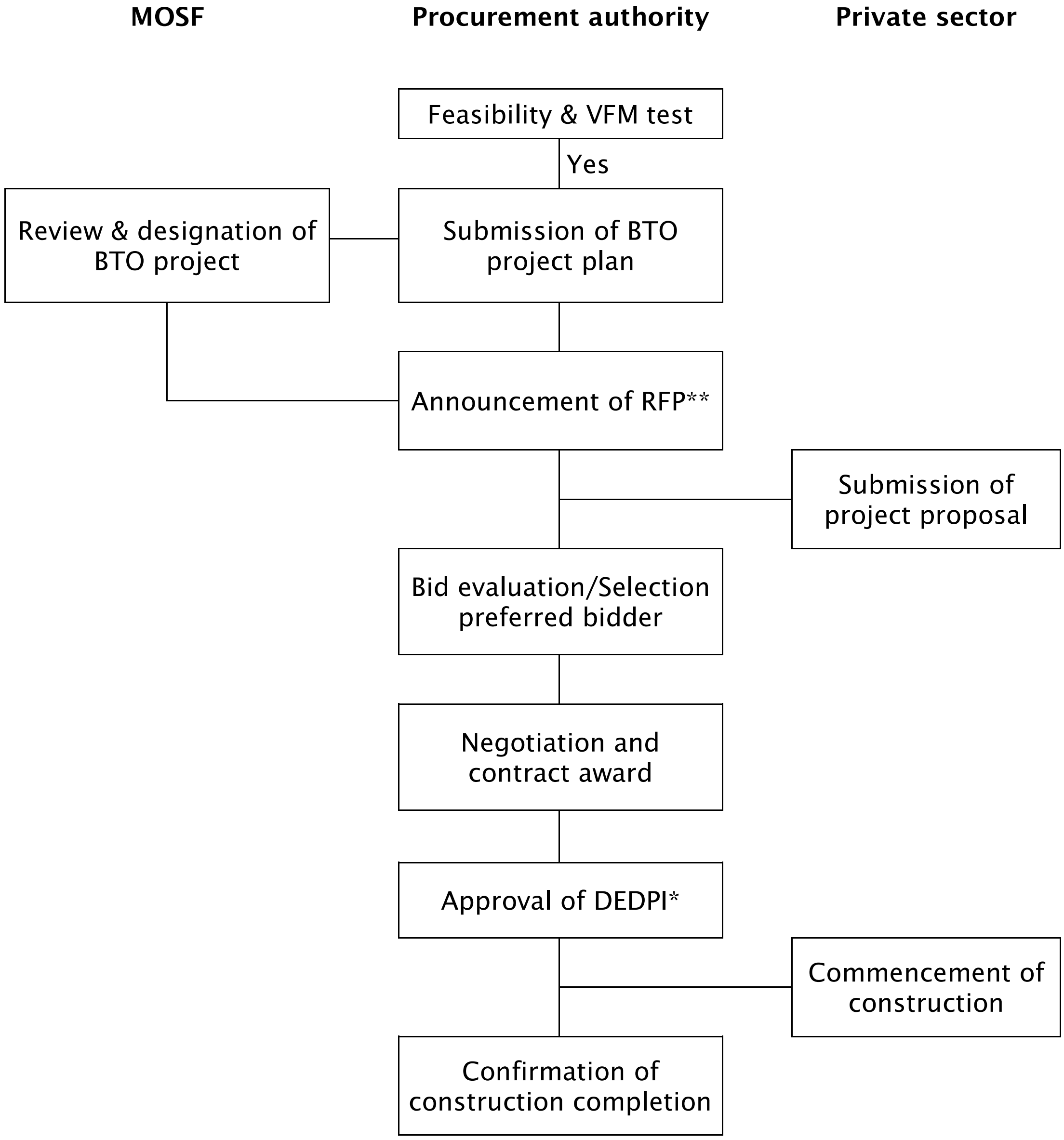
Table 3.3 Tax on the BOT and BTO model

Tax	BOT	BTO
Property tax	0.3% of reference market price	Free
Education tax	20% of the property tax	Free
Office tax	₩250/m^2	Free

Source: Wang (2005)

There are solicited and unsolicited projects in Korean BTO model. A solicited project is led by the government and an unsolicited project is suggested by the private sector. Figure 3.6 shows the procedure of solicited BTO project. The procurement authority executes the feasibility and VFM test and submits the project plan to the Ministry Of Strategy and Finance (MOSF) of Korea. MOSF reviews the project and designs the fiscal plan such as land cost provided by the government. The procurement authority announces the RFP, evaluates bids, selects the preferred bidder, negotiates and makes a contract.

Figure 3.6 Procedure of solicited BTO project



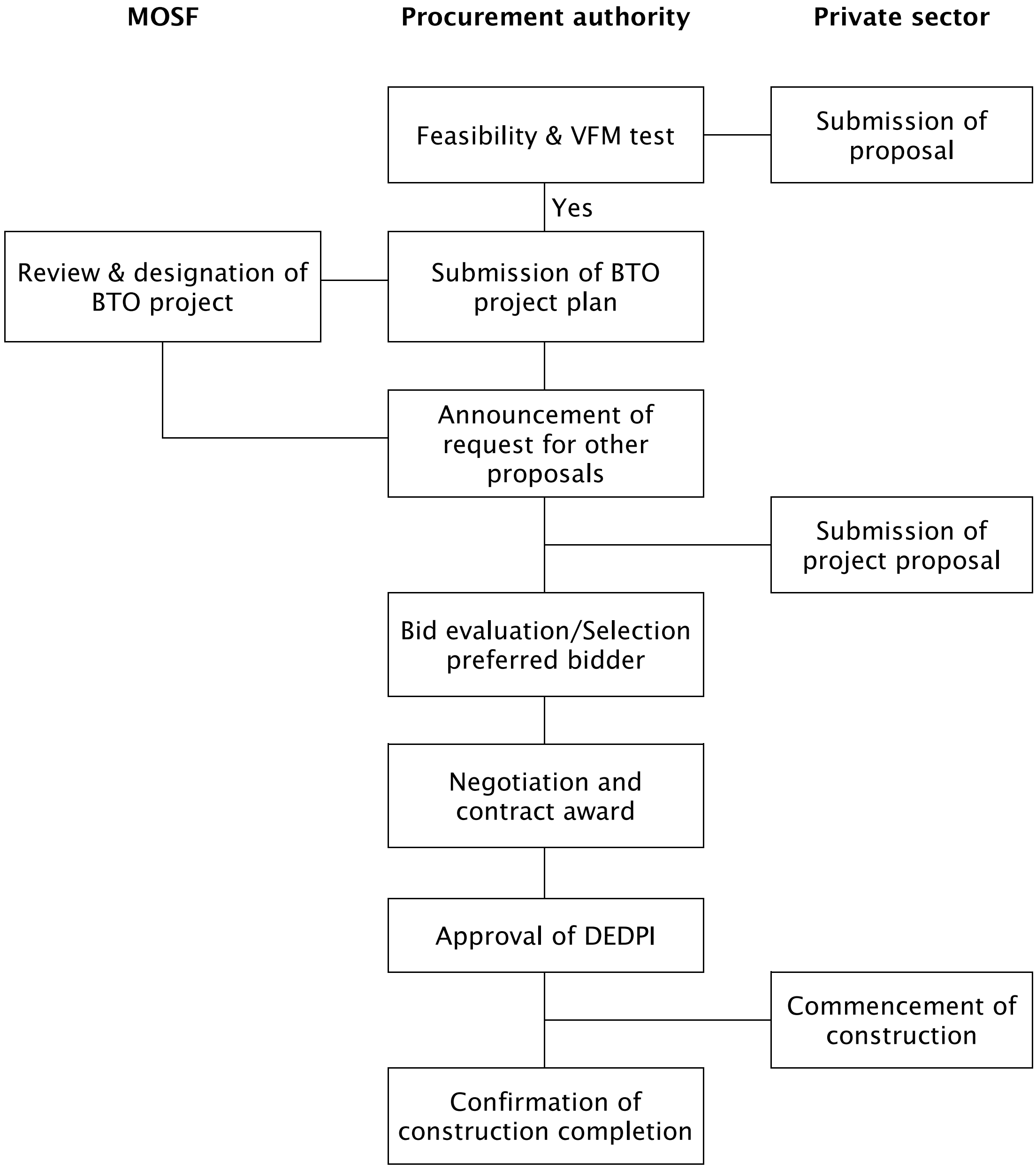
Source : KDI (2006)

* DEDPI: Detailed Engineering and Design Plan for Implementation

** RFP: Request for Proposal

Figure 3.7 shows the procedure of unsolicited BTO project. This procedure is almost same with that of a solicited project. However, an unsolicited project is proposed respectively by the private sector, so the government tests the feasibility and VFM of the project after receiving the proposal of the private sector.

Figure 3.7 Procedure of unsolicited BTO project

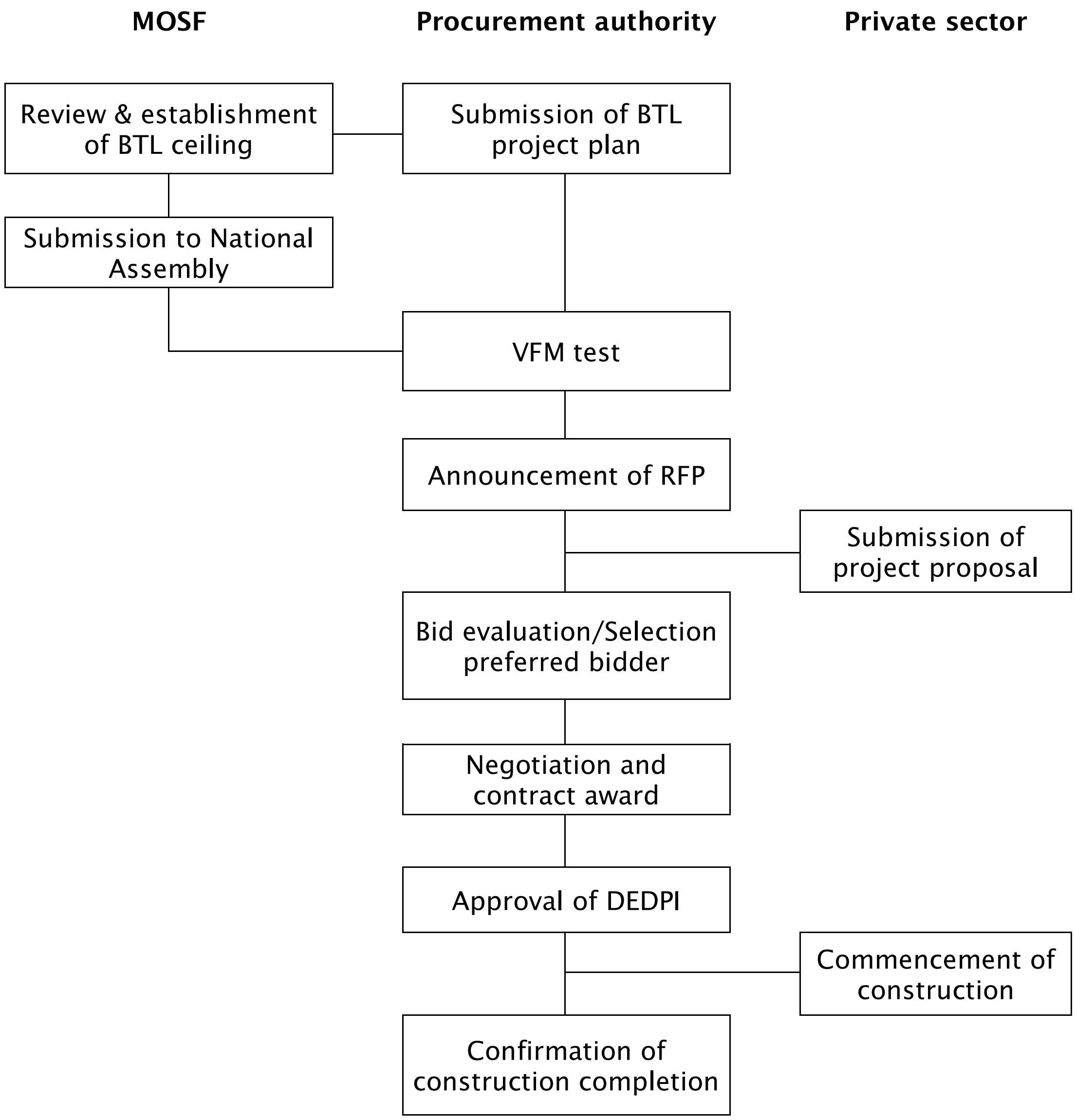


Source: KDI (2006)

3.4.2 The BTL model

The BTL model was introduced for the construction of social infrastructures which are difficult for the private sector to impose on user fees high enough to recover its investment and profit in 2005. Instead, the government pays for the lease of a facility during 10 to 30 years operation for which the operational right is granted to the private sector. Facilities eligible for the BTL scheme are schools, military housing, sewers, libraries and cultural/welfare facilities. Some railway projects which seem difficult to provide enough profit based on incomes collecting from user's tariffs are also under way as BTL projects (KDI, 2006). The procedure of the BTL model is as follows.

Figure 3.8 Procedure of BTL project



In Figure 3.8, after the announcement of RFP, the procedure of BTL project is same with the BTO project. But here, several procurement authorities submit a project plan then the MOSF reviews them and set up the maximum budget for them. Annual budget on the BTL project should be ratified by the National Assembly, because the BTL contract affects the future budget in the name of leasing fee during the 20 years of contracted PPP period.

According to the Allen's classification, the BTO is "the financially free standing" model and the BTL is "the service sold to the public" model (Allen, 2001). Many researchers in South Korea seem to confuse that the BTL of Korea is similar to the PFI of the UK (Joo, 2007, KDI and MOPB, 2005, Baek, 2005). However, this opinion appears not exactly correct, because the PFI looks like the scheme for the PPP procurement and it includes the financially free standing model. In other words, the PFI of the UK can choose any model between the BTO and BTL according to the project. The most important difference between the BTO and the BTL is who pays the fee for using a facility. The responsibility of payment in the BTO model is on the end users, but that of the BTL is on the government.

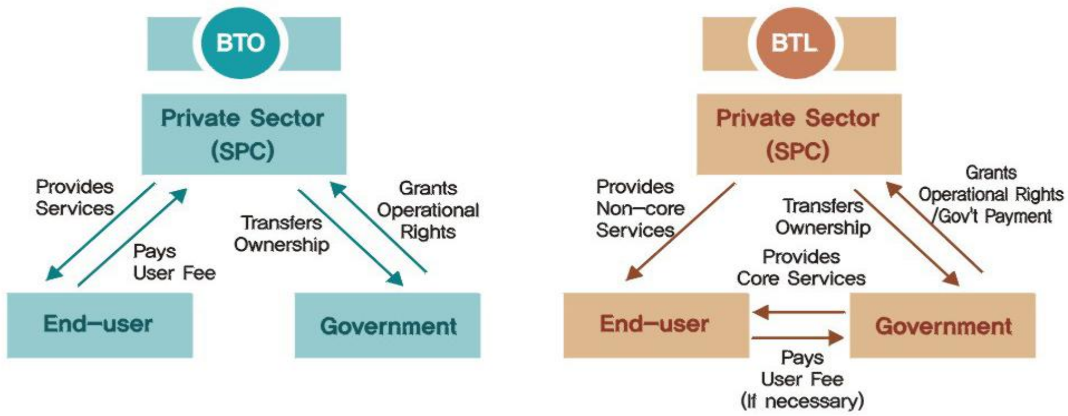
The BTL model is similar to the DBFO model of the UK in the point that the public sector pays fee to the private sector. However, the BTL model does not transfer the demand risk to the private sector as the DBFO did by shadow toll. According to STANDARD & POOR'S report (Bain and Wilkins, 2003b), now the DBFO model in the UK uses "active management payment mechanism" without demand risk sharing such as a shadow toll mechanism. The BTL model of Korea uses a payment mechanism based on the availability and performance assessment, so it can be thought that the BTL model is similar to the recent DBFO model without using demand risk sharing by a shadow toll.

3.4.3 Difference between the BTO and the BTL model

The BTO is almost same with the BOT model which is historically one of the oldest PPP model in the world. In the BTO, the Special Purpose Company (SPC) made by the private sector provides public services to the end user and recovers its investment and profit from the end user directly. The government grants operational rights to the private sector, and has little role in the operation of the SPC.

In the BTL, the SPC leases the facility to the government and the government pays a lease fee. The core public service like education in schools is provided by the government, and the non-core service like the maintenance of the facility is done by the private sector. The relationship between the government and the private sector is very important to operate the facility effectively.

Figure 3.9 Concepts of the BTO and BTL



Source: KDI

The differences of the BTO and BTL are clearly shown in the following table, but these are not fixed and can be changed by the negotiation between the government and the private sector in the form of a contract. For example, the railway PPP starts to use the BTL model recently, and core services in some facilities like a library can be provided by the private sector in the BTL.

Table 3.4 Difference between the BTO and the BTL

	BTO	BTL
Investment recovery	Private sector collects user fee to recover investment and make profit	The government makes unitary payments covering construction costs, profits and operating costs during contracted period
Facility types	Facility with income - Roads, railways, ports, environmental facilities, etc.	Facility with a little or no income - Schools, military accommodation, sewage pipes, cultural and welfare facilities, etc.
Operation	Full responsibility of the operation on the private sector	Responsibility of the core service on the government, the maintenance on the private sector
Project risk and return	Relatively more risks on the private sector, variable rate of return based on the demand	Allocated risks to each sector Fixed rate of profit

Source: KDI

The key factor discriminating between the BTO and BTL is who pays the private sector. The end user pays a tariff to the private sector in the BTO, but the government pays a lease fee in the BTL model. Though it is possible for the government to have some conditions on payment in a contract, basically the government guarantees the steady income to the private sector in the BTL model. The incomes in transport infrastructures like a toll road and rail depend on traffic and passengers which are variable in different social economic circumstances. Traffic and passengers can be understood as demand in transport, so the demand risk in the BTO model, in which the private sector collects tariff from the end user, is on the private sector. The demand risk in the BTL model, in which the government collects unsteady tariff from end user and pays steady lease fee to the private sector, is on the government. Consequently, the difference between the BTL and BTO in transport infrastructures is made by where the demand risk is. The demand risk is on the private sector in the BTO model, but it is on the government in the BTL model.

A particular problem is the BTO with MRG model. The MRG introduced in 1999 is the tool for the government to share the demand risk with the private sector. It can make little difference between the BTO and BTL. The level of MRG in early PPP projects in Korea was 80 to 90%, but the rate of profit of the BTO with MRG project was not modified at all. It is true that the MRG regulation made the BTO invigorated, but it seems to weaken the strength of the BTO model.

3.4.4 Advantage and disadvantage of the BTO and the BTL model

This section is to compare the advantages and disadvantages between the BTO and BTL from a different view of each sector. The government should consider other views than just those of the private sector and the end user for the success of the PPP project. The government is not only one of the partners of the PPP but also a decision maker who is responsible for providing the public services, so it needs to make an effort to include other views. Mostly, the government seems to be interested in budget savings which can be expressed as the affordability[7]. If the affordability of the government is enough, the PPP

[7] The affordability does not mean only financial capacity to do the PPP but also includes the efficiency of the investment, which is expressed by the Value for Money.

projects can be achieved by the participation of the private sector. Hence, the view of the private sector decisively affects the achievability of the project. The focus of the common end users is on the public service itself whoever it is provided by, so the view of the end user represents the serviceability of the project. Considering these three factors of affordability, achievability and serviceability is essential to the process of the PPP procurement, so the qualitative VFM assessment in the UK includes the analysis of these factors. The qualitative VFM assessment in the following case studies deals with things related to the project itself, so the general characteristics of the BTO and BTL from these three views are reviewed whatever the project is. Also, the BTO model in this section is the “free standing model” without the financial support from the government, though it can vary when the construction subsidy and minimum revenue guarantee regulation are applied to a concession contract.

The most important interest in the view of the Korean government seems to be the budget savings. It is easily seen in the VFM guidance for the BTO and BTL. The quantitative VFM assessment, which is the decisive factor to choose the PPP, is comparing the life cycle costs measured by the government capital expenditure in both BTO and BTL (KDI, 2007a, KDI, 2009a). The qualitative VFM assessment does not affect anything on deciding the PPP scheme- the reason being that the qualitative experiences are not thought to be sufficient though the simple guidelines are suggested by KDI (Korea Development Institute). Based on this status, the advantage of the BTO model (without any subsidy from the government) is to eliminate or minimize the direct financial investment from the government. It is changeable according to a construction subsidy or minimum revenue guarantee condition, but the government expenditure is expected to be smaller than that of most BTL projects with little income from the end user. Instead, the private sector in the BTO may be more affected by the end user paying the tariff than the government paying nothing when it is operated, so the managing role of the government in operation stage in the BTO seems weaker than in the BTL. It means that the flexibility of the government policy for such public service can be restricted during 20 to 30 years of operation in the BTO. The BTO model is more independent from the government. Instead, it financially burdens the private sector more. Also, the competition is relatively high in BTL because the revenue is given by the government. So the government has more benefit in negotiation with the private sector. The following two tables show the percentage of projects with only one bidder. Average percentage of the BTO projects with one bidder is 60%. By contrast, the percentage of the BTL projects with one bidder is only 28%, less than half of the percentage of the BTO project. Although there is an opinion that a project with fewer competitors would be appropriate for the PPP such as infrastructure, power transmission or network, and water and gas supply (Chan et al., 2008), it is not deniable that more competition incentivises the private sector to make an effort to improve their performance.

Table 3.5 Bidding status in BTO projects

	Road	Rail	Seaport	Environment	Logistic, etc.	SUM
No. of project (A)	41	9	17	54	33	154
No. of project with one bidder (B)	31	4	14	33	11	93
B/A	76%	44%	82%	61%	33%	60%

* This result came out from the 154 projects having data of bidder in KDI until 2007.

Source: Kim et al (2008b)

Table 3.6 Bidding status in BTL projects

	Education	Rail	Library & Culture centre	Environment	Science centre, etc.	SUM
No. of project (A)	155	3	15	60	6	239
No. of project with one bidder (B)	56	0	1	10	0	67
B/A	36%	0%	7%	17%	0%	28%

* This result includes data until 2009, but several programmes without data of bidder such as military accommodation are excluded.

Source: NABO of Korea (Program Evaluation Division, 2009)

In the view of the private sector, the most important interest is the profit and risk. Since demand risk in the BTO is on the private sector, it is financially more risky than the BTL, in which the government guarantees the income only if the private sector fulfils the agreement with the government. However, the BTL provides relatively low rate of profit instead of guaranteed incomes from the government. It means that the BTO project has high risk and high return, while the BTL project has low risk and low return. The private sector decides to participate in the PPP project through comparing the risk and rate of return. Therefore, the government tries to minimize the disadvantage in each model for increasing attractiveness of the project. In the BTO model, it is possible for the Korean government to provide the MRG for sharing the demand risk. In the BTL model, the rate of profit is decided at the level of national bond plus an additional rate considering the risk of the project despite the relatively low rate of profit. It means that the rate of profit in the BTL is steady while that in the BTO is variable and risky.

The view of the end user affects serviceability of the project. One of the most important reasons for introducing the PPP to the public service is to improve the quality of service by using the creativity and competitiveness of the private sector. If the service including the level of tariff cannot fulfil the expectations of end users, the PPP can be criticised for its unsatisfactory delivery compared with the public sector. Also it can affect the long term PPP policy, as shown in the criticisms of the early PPP cases in the Korea. It is not easy to compare the quality of service between the BTO and BTL, because there is no experience in similar projects using different PPP models. However, it can be easily expected for the BTO to be sensitive to the needs and complaints of the end user, because the revenue comes from the choice of the end user[8]. There is the government between the private sector and the end user in BTL model when the public service is provided. It makes the private sector in the BTL more sensitive to the government than to the end user. On the other hand, the possibility that the end user gets discounted tariff in case of BTL model with user fee seems higher, because the government role as an arbiter between the private sector and the end user is easily affected by the complaints on the price of the public service. The government has little right of interference with changing the contracted tariff because of the complaints of users in the BTO model. Above mentioned advantages and disadvantages between the BTO and BTL from different viewpoints are summarised in the Table 3.7.

[8] It is only right when the private sector does not have the monopoly on the public service through the BTO project. The environmental facility for sewage works which does not need to attract customers can have little difference between the BTO and BTL in the view of end user.

Table 3.7 Advantage and disadvantage between the BTO and BTL

Viewpoints		BTO	BTL
Government Main interest : Budget	Advantage	Minimum direct financial burden[9] Low risk in demand	Continuous inspection through the payment mechanism Relatively high competition Chance to have profit[10]
	Disadvantage	Hard to manipulate the plan or project during operation Relatively low competition	Long term burden of budget High risk in demand
Private sector Main interest : Profit	Advantage	High rate of return	Low risk in demand
	Disadvantage	High risk in demand	Low rate of return
End user Main interest : Service	Advantage	Sensitive to the end user's needs and complaints	Relatively low tariff
	Disadvantage	Relatively high tariff	Less sensitive to the customer

Through this analysis about the advantages and disadvantages between the BTO and BTL, it is found that the way to maximize the creativity and competitiveness of the private sector is different in the BTO and BTL models. In specific, it can be achieved by an effort to earn more incomes from the end user in the BTO while it can be attained by the the private sector competition in bidding for the project in the BTL.

[9] Theoretically, financial burden of the Government in the BTO model should be very small or nothing, but the Government provides subsidy or shares the demand risk through the minimum revenue guarantee in many real cases.

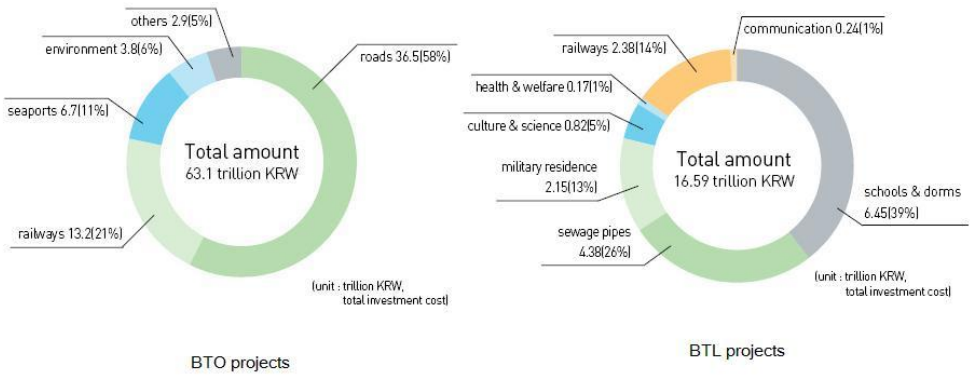
[10] The BTL projects with revenue from the end user can provide opportunity for the Government to have profit if the demand is enough to cover the lease and operation cost.

3.4.5 PPP projects by model in South Korea

In South Korea, 426 PPP projects have been carried out or under negotiation since 1994, among which 82 projects are for the transport infrastructures as seen in Figure 3.10. Among these, 33 projects are for roads, 15 for rail, 17 for seaports, and 7 for airports. The total amount of investment in these 82 transport projects is ₩60,910 billion: ₩19,606 billion for roads, ₩37,074 billion for rail, ₩3,722 billion for seaport, and ₩508 billion for airport (Source: Korea Development Institute PPI centre; see Appendix 2).

The BTO model is mainly used in transportation services including roads, railways and seaports. Road projects account for more than half of all investment. The BTL model is used for building or rehabilitating old educational facilities like elementary schools and vocational colleges, making a great contribution to sewage systems and military residences.

Figure 3.10 Investment for PPP projects in Korea



Source: KDI(2009)

3.5 Financial and organisational support for the PPP

3.5.1 Financial support for the PPP in South Korea

With regard to the financial issues, there are several supports from the government in South Korea.

Firstly, the private sector is granted land acquisition rights as well as the right to use national and state / public land free of charge. In order to maintain an appropriate user fee level, the government usually provides land acquisition costs and may give construction subsidies to the private sector, if necessary (KEC, 2007).

Secondly, the government takes over the management and operation rights of the facility, and offers a certain amount of termination payment to the private sector when PPP projects are terminated for unavoidable reasons during construction or operation. The private sector may request the government to buyout the project in the case of termination of construction or operation of facility due to unavoidable incidents including force majeure (KEC, 2007).

Thirdly, various tax benefits granted for PPP projects include the following: 0% tax rate is applied to value added tax for construction services of revertible infrastructure facilities; and acquisition and registration taxes for BTO projects are exempt (KDI, 2006a).

3.5.2. Organisational support for the PPP in South Korea

The Public and Private Infrastructure Investment Management Center (PIMAC) is a supporting organization for the government. It was established in 2005 in order to provide professional support for PPP projects and to conduct research on PPP policies. PIMAC provides professional services throughout the entire PPP procurement process such as carrying out feasibility studies and VFM tests, formulating RFPs, evaluating proposals, and supporting negotiations. At the same time it works on promoting PPP projects in Korea by offering training programs for government officials, and exploring cooperation opportunities with international organizations and foreign countries (KDI, 2006a).

3.6 The appraisal for the PPP in transport in South Korea

The PPP has been appraised to play an important role in the construction of social infrastructures during the rapid economic growth of South Korea. In 2010, the investment in the SOC (Social Overhead Capital) through the PPP was ₩7.7 trillion, which was 30.7% of the government SOC investment of ₩25.1 trillion (MOSF, 2010). According to the MOSF (2010), 100% of the PPP projects were constructed on time among which 36% in rail was constructed by the public sector and 76% was in road. The operation cost was also expected to be cut by 20~30%.

The reliable construction cost in the PPP was also appraised positively. The construction cost in the PPP is not basically allowed to be changed. One of the most serious problems of construction cost in the public sector project is increase in the cost even during the construction for various reasons such as the change of design. In the case of national arterial roads, average construction cost was increased by 12% compared to the first signed cost, excluding an inflation factor (Shim et al., 2006).

However, many criticisms have risen from the National Assembly, press and NGO. Lee (2005) described the major problems in the PPP projects could be classified with 5 parts as follows: excessive guaranteed revenue; low competition among private sectors, high charge to the end user; expensive construction cost in the sewage facility; and insufficient maintenance after construction. In these problems, the first three problems seem directly related to the transport PPP projects. Recently, the long delay in negotiation is also pointed out (Park, 2009).

High inaccuracy of traffic forecast and excessive MRG

Early PPP projects in South Korea were done by the BTO model with the MRG of the government. The main purpose of introducing the BTO model was to lessen the financial burden on the public sector to construct infrastructures, which mainly focused on transport facilities. The revenue in the transport BTO projects was based on the toll charged to traffic. Generally, the inaccuracy of traffic demand forecast and over-optimism were broadly pointed out for road and rail (Flyvbjerg et al., 2005, Bain and Polakovic, 2005). These problems were discovered in many countries and lead to overbidding for a PPP project (Bain et al., 2012). The traffic demand risk is difficult to be managed by the private sector alone, so the Korean government decided to share the traffic demand risk through the MRG scheme. The MRG regulation affected on the views that the traffic could be forecasted optimistically (Shim et al., 2006). NGOs doubted that the excessively optimistic forecast might be due to the intentional exaggeration in traffic forecast by the moral hazard of the private sector. Consequently, this caused the scepticism on the PPP itself.

Table 3.8 Traffic forecast and MRG in transport PPP projects of the MLTM

Project	Open	Length	Traffic (cars or persons/day)*			MRG (Max)
			Forecasted (A)	Actual (B)	B/A (%)	
Incheon Airport Rd.	12/2000	40km	110,622	51,939	47.0%	90%
Cheonan-Nonsan Rd.	12/2002	81km	55,624	32,390	58.2%	90%
Daegu-Busan Rd.	01/2006	82km	52,000	29,300	56.3%	90%
Incheon Airport Rail	03/2007	40km	207,421	13,312	6.4%	90%
Seoul Outer Ring Rd.	12/2007	36km	72,068	55,512	77.0%	90%
Busan-Ulsan Rd.	12/2008	47km	66,000	28,000	42.4%	100%
Seoul-Chuncheon Rd.	07/2009	61km	44,953	30,153	67.1%	80%
Incheon Grand bridge	10/2009	21km	34,779	25,549	73.5%	80%
Seosuwon-Pyeongtaek Rd.	10/2009	39km	37,480	14,269	38.1%	80%

* It is the average daily traffic for the first one year after operation. Source: MLTM

High charge to end users

Much higher tariff level in the BTO projects than in the public sector projects was severely criticised. In case of the Incheon Grand Bridge, toll was up to 3.47 times higher than the public operating case. Some of them were parts of national arterial transport network, so there were few alternative choices to the users. It evoked the problem of equity by regions. In some regions, the public sector provides the transport service with low tariff, while in some other regions, the end users have to pay more for the same kind of transport service.

Table 3.9 Tariff level of the PPP (BTO) expressways

Expressway	Open	Length	Tariff level for a car (KRW)		
			PPP (A)	Public standard(B)	A/B
Incheon Airport	12/2000	40km	7,500	2,800	2.68
Cheonan-Nonsan	12/2002	81km	8,400	4,100	2.05
Daegu-Busan	01/2006	82km	9,300	4,200	2.21
Seoul Outer Ring	12/2007	36km	4,300	2,600	1.65
Busan-Ulsan	12/2008	47km	3,500	3,100	1.13
Seoul-Chuncheon	07/2009	61km	5,900	3,500	1.69
Incheon Grand bridge	10/2009	21km	5,200	1,500	3.47
Seosuwon-Pyeongtaek	10/2009	39km	2,800	2,000	1.40

Source: Korea Expressway Corporation (KEC)

Delay in negotiation

One of the strengths of the PPP is the on-time construction, but in many cases, it takes much time to get an agreement between the private and the public sectors before construction. According to Lee (2008a), the negotiation period for the BTO projects was from 36 months up to 92 months after the announcement of the project with the average period being 60 months. Considering that it takes around 6 years for the public sector to make a master plan including a design for an expressway before starting the construction, a long negotiation period can make PPP's advantage of the on-time construction less meaningful.

Low competition among the private sectors

Early PPP projects in transport were mostly done by the BTO model, so most risks in construction and operation were on the private sector. It made the private sectors hesitate to bid for the project, and the competition among the private sectors was low as seen in Table 3.5. Considering that high competition among the private sectors is an important factor to make the private sectors competitive and creative, low competition was unbeneficial to the public sector.

3.7 Conclusion

The economy of South Korea has grown rapidly since the 1970s, and the transport infrastructures have been developed to support the economic growth. However, a large amount of investment was needed to construct transport facilities in a very short period and the government struggled to provide the required budget. Charging tolls to transport infrastructure was a good alternative to expanding the investment. The PPP was also introduced with this reason, and the BTO model which is financially free standing PPP became prevalent in Korea.

The Korean government introduced the PPP to other fields like schools, environmental facilities, military facilities, etc. in 2005. Since these facilities did not have enough income from the end users, the BTL model was introduced. The most important thing discriminating the BTL from the BTO model is who has the demand risk. In the BTL model, whole demand risk is on the public sector and the public sector pays a unitary lease fee to the private sector, which therefore is called “service sold to the public sector” model. It is similar to the DBFO model of the UK, but the revenue risk is often shared with the private sector in the UK by a shadow toll. The advantages and disadvantages of each PPP model are different based on three viewpoints. The main interest of the government is in saving budget and the BTO model is better to lessen the financial burden. On the other hand, the interest of the private sectors is in making a profit. The BTO model is high risk and high return while the BTL model is a low risk and low return structure. The end users are interested in the service quality including tariff level. In this regard, the BTO model can be better because the private sectors recoup their investment through charging the end users.

In Korea, the BTO model has been predominant for the transport PPP. Recently, the BTL model was introduced to a few railway projects for the first time. Thus, the appraisal on the transport PPP was mainly on the BTO model. Regardless of several achievements like on-time and on-budget construction, problems such as inaccurate traffic forecast, excessive MRG, high tariff levels, long negotiation periods, and low competition emerged and dominated the discourse concerning PPPs.

CHAPTER 4

Research Methodology

4.1 Introduction

The objective of this thesis is to suggest an optimal PPP model between the BTO and the BTL to save the governmental expenditure and to provide higher quality of service to the end users for road and rail in South Korea. Also, the examination of appropriate demand risk sharing, which is a key issue in a BTO project in South Korea, is an important objective of the thesis.

For these examinations, multiple method approach is necessary. Quantitative method is needed to calculate the government expenditure between the BTO and the BTL cases. Qualitative method is needed as well to compare the quality of service provided. Appropriate demand risk sharing also should be examined quantitatively. In the BTL case of South Korea, demand risk is on the public sector, while is shared with the public sector in the BTO case by the MRG condition. Thus, these examinations are done by the case studies of BTO and BTL projects in South Korea rather than the theoretical approach, because the PPP is much affected by the circumstances of a nation and the characteristics of the projects.

This chapter consists of three sections: 1) the available methodology, 2) VFM assessment, and 3) the case studies. Firstly, in the available methodology section, several tools to evaluate the feasibility of PPP project will be explored and it is critically discussed why the VFM assessment is the most appropriate method. Next, quantitative and qualitative VFM, are introduced and the modified VFM method will be newly suggested to compare the BTL with the BTO model. The sensitivity analysis of various input factors to the VFM will be explored. Lastly, the case study as a methodology is explored.

4.2 Available methodology

Traditionally, public sector which constructs the infrastructure usually[11] undertakes the economic appraisal, tests of affordability, etc. Cost-benefit analysis (CBA) and net present value (NPV) analysis are the most common ways to evaluate the economic feasibility of projects. IRR (Internal Rate of Return) is also used as a sub tool to decide the project by analysing more feasible option (MLTM, 2007, Adler, 1987, Cole, 2005). These methods represent the interest of the government which is in analysing the social benefit of a project.

However, above mentioned analyses are mainly used in traditional public procurement procedure through the direct investment of the public sector. South Korea government published the guideline for the financial feasible test for the transport PPP projects, and regularly upgrades it. According to this guideline (2007), three kinds of analysis are mainly used for the feasibility of the PPP project: FNPV (Financial Net Present Value), FIRR (Financial Internal Rate of Return), and Revenue/Cost Ratio. These methods are used after the general feasibility of a project is tested by the traditional CBA, so it represents the interest of the private sector through analysing the profitability of a project based on the revenue. Thus, these methods are used for transport PPP projects with revenue, which are mostly the financially free standing BTO projects. It means that if only a project has an economic feasibility and is proved to be financially sustainable, the government allows the private sector to participate in the project. The government mainly aims to save the budget for the investment in infrastructures and to prevent the project failure by the private sector which causes the government subsidies. These methods mainly reflect the interest of the private sectors, so the PPP model having higher FIRR, FNPV and R/C can be optimal to the private sector. The FIRR, which is mainly used for the BTO projects in Korea, is the discount rate making the NPV of revenue equal to the NPV of cost as shown in the following formula (KEC, 2007).

$$\sum_{i=0}^{n}\frac{R_i}{(1+r)^i}=\sum_{i=0}^{n}\frac{C_i}{(1+r)^i}$$

* Here, R is the revenue (cash income), C is the cost (cash outcome), r is the FIRR

[11] In South Korea, infrastructure projects of which cost is over 10billion KRW have to pass the economic evaluation (National Finance Law, Korea).

However, it is difficult to be optimal to the public sector and the end users as well because the PPP model providing high profit to the private sector may not be beneficial to the public sector and the end users. Especially, in the “service sold to the public sector” model such as the BTL of South Korea and the DBFO of the UK, these kinds of analysis, which just examine the profitability of the project, are less useful because the revenue, which is the source of the profitability, is decided not by the market but by government policy.

Medda (2004) suggested a model to analyse the optimality of PPP from a welfare-economic point of view. However, it does not look appropriate to analyse the standardised PPP models of South Korea, because it is not applicable for the specific PPP model of Korea and empirical data are not enough to examine the cases of South Korea with this model.

The VFM assessment analysing the life cycle cost (LCC) of the PPP option compared with the public sector comparator (PSC)[12] option is more common. The VFM assessment in the PPP is to examine whether the private investment in the public service is more efficient and effective than public direct investment (see section 4.3.1). The Korean government is also using the VFM assessment for the BTL projects based on the guidance of KDI from 2005. There are quantitative and qualitative methods in the VFM assessment. The quantitative method is calculated by the comparison of the LCC between the PPP option and the PSC option. Here, the LCC is analysed in the view of the public sector, so the cost in LCC means the capital expenditure of the public sector. The quantitative VFM assessment basically reflects on the interest of the public sector which wants to save budget. However, the interest of taxpayers using the public service as end users is not considered enough in this assessment, though the public sector should not think of only taxpayers who do not use the public service but also taxpayers who are end users. Consequently, there are many criticisms on the VFM assessment which does not cover such interest as service quality for end users (Lee, 2005, NABO, 2007). The VFM assessment has distinct problems, and recently, the UK government launched Private Finance 2 (PF2) to reform the PFI and is trying to replace the existing VFM guidance (HM Treasury, 2012).

[12] PSC is a public funded option to compare with a private funded PPP option.

However, the limitation of VFM assessment is another big issue which should be dealt with independently. The VFM assessment is a very effective method to compare the LCC and it is commonly used in the world. This study needs to focus on comparing the different PPP models in South Korea and this comparison can be acceptable to the government when its method is based on the current assessment way. Therefore it seems effective to use the VFM assessment in this study. Instead, the qualitative VFM is more deeply tested in this thesis, because the qualitative method deals covers the interests of the private sector and the end user.

After the introduction of VFM assessment to South Korea, the Korean government started to use the concept of the VFM assessment to the BTO cases. Generally, the BTO is a kind of financially free standing PPP model where the public sector does not have to pay the private sector, so it was thought that the VFM assessment for comparing the public expenditure is unnecessary (Allen, 2001). However, since large projects like new road and rail construction needs much investment, it is difficult to fund entirely by the private sector. In South Korea, the government gives subsidy for the land acquisition cost to the private sector and, sometimes provides construction subsidy. Thus, KDI (2007a) suggested using the VFM assessment in the BTO model to compare the public expenditure in the BTO option and the PSC option. It means that the VFM assessment is able to be used for the BTO cases.

This study is to compare the BTL with the BTO model, so the detailed method may be different from the general procedure to compare the PPP with the PSC option. However, the concept of the VFM assessment analysing the LCC of different procurement options can be used. Especially, this is the practical research for supporting the PPP policy decision of the government. Currently, the Korean government uses the VFM assessment to decide the feasibility of the PPP in both models. Thus, the VFM assessment is the only method used in both PPP models to test the feasibility of the PPP projects while the R/C, FNPV, and FIRR analysis are only for the BTO projects. Table 4.1 summarised the assessment methodology of the feasibility of the PPP in South Korea shortly.

Table 4.1 Assessment methodology of the feasibility of the PPP in South Korea

PPP model (comparing with the PSC option)		BTO	BTL
Assessment Methodology (before 2007)	View of the public sector	-	VFM assessment
	View of the private sector	R/C, FNPV, FIRR analysis (Financial decision)	VFM assessment (qualitative)
	View of the end user	-	VFM assessment (qualitative)
Assessment Methodology (after 2007)	Views of the public, private & end user	VFM assessment	VFM assessment

* The feasibility of a project itself is done by the CBA, NPV, IRR analysis commonly in both PPP models.

In this thesis, the optimal PPP model between the BTO and the BTL model in South Korea means the PPP model saving government expenditure and upgrading the quality of the public service (see Chapter 1). The VFM assessment in South Korea basically focused on comparing the PPP option with the PSC option through the LCC analysis. Thus, it reflected the interest of taxpayers who did not use the service, but it did not cover enough the interest of taxpayers who used the service as end users enough. It was also insufficient to examine whether a project is attractive enough to induce the investment of the private sector. In the UK, the VFM assessment deals with these issues by a qualitative method (HM Treasury, 2006b). The qualitative VFM assessment was introduced to South Korea for the same reason, but it does not look enough to deal with the issues related with the end users and the private sector (see section 4.3.3).

Consequently, the VFM assessment can be the best method in this thesis to find the optimal PPP model saving the government expenditure and upgrading the quality of service only if the qualitative VFM assessment can cover the issues of the end users and the private sectors. Thus the qualitative VFM assessment needs to be discussed and an appropriate method needs to be suggested to compare the BTO with the BTL option (see details in the section 4.3.3). If the VFM assessment satisfies this condition, then the optimal PPP model in this thesis can be shortly defined as the PPP model having better VFM.

4.3 The Value for Money Assessment

4.3.1 The concept of VFM assessment

The VFM of a PPP project is generally examined by the public sector to choose a PPP option instead of a direct investment option. The VFM can vary according to the views of the public sector (in many cases, the government). The government should consider not only taxpayers but also end users as well as their interests in saving budget and improving the quality of service (if the quality of service is same, then lower user tariff). Thus, the concept of VFM in a project is related to the efficiency and effectiveness of the project (Heald, 2003). For the government, efficiency means to provide the public service with lower budget while effectiveness means to upgrade the quality of service for end users. Shortly, the VFM assessment is to examine whether the PPP option is more efficient and effective than direct public investment. This is the process to choose the best combination of the cost and serviceability for fulfilling the public demands by comparing the VFM of the PPP option with the VFM of the PSC (KDI, 2009b).

There are quantitative and qualitative assessment to compare the cost and serviceability. Quantitative assessment is for the VFM to taxpayers and qualitative VFM is for the VFM to end users. Many parts of the serviceability cannot be assessed by a quantitative method while the cost of each option can be measured exactly by a countable method. Therefore, most countries using the PPP such as Korea and the UK recommend considering not only the quantitative assessment but also the qualitative assessment which covers non quantitative but definitely existent factors before deciding on the PPP option. Of course, the VFM assessment at the country level can be different from other countries because the social and economic circumstances of respective countries are quite different. Therefore, each country seems to have its own procedure and method to assess the VFM, although the basic concept for the VFM assessment looks same.

According to the UK HM Treasury (2006b), the procuring authorities should execute the VFM assessment respectively in three stages; programme level, project level, and procurement level. This seems to be the case because the UK government started the PFI widely as the alternative procurement model not for each project but for general public programme such as the rehabilitation of hospital, school, military accommodation, etc. to improve the efficiency and quality of the public service.

In the case of South Korea, the PPP started to cope with the lack of budget to implement a huge construction project, so the VFM assessment guidance is mainly about such project. It looks that the VFM assessment program level is not needed because the PPP cases for transport infrastructures in Korea was launched not as part of a general PPP programme but as an independent project. Especially, since this study is about the case of Korea, the VFM assessment should be based on the social and economic circumstances of Korea. Thus, the basic procedure to assess the VFM will follow the VFM guidance of Korea, but it needs to be modified for comparing the BTL with the BTO option. Especially, the qualitative assessment was criticised for the reason that it was too slightly dealt with despite its importance. In following two sections (4.3.2 and 4.3.3), the VFM assessment method is fitted to compare different PPP models instead of comparing the PPP option with the PSC option.

4.3.2 Quantitative VFM assessment

According to the Korean VFM guide (2009a) to calculate the quantitative VFM test in transport infrastructures, it needs to compare the LCC of each procurement model. The Korean VFM guidance suggests calculating the present value of total capital expenditure of government in each factor of the PSC and PPP as seen in the Table 4.2. These expenditure factors can be diversified into two parts: one is the investment to build a facility, and the other is the investment to operate and maintain the facility. These can be said as building cost and operating cost. In building cost, there are facility part and financial part; facility part consists of construction cost, land acquisition cost, utility cost, operating reserve and other cost such as feasibility test, insurance cost, etc. Here, the construction cost includes surveying cost, examining cost and design cost. In operating cost, there are management cost, maintenance cost and supervising cost.

Total capital expenditure in the PSC is the sum of building cost and operating cost, but in the BTL model, an appropriate profit to a private sector should be added. The BTL model is for the public sector to lease the facility built by the private sector, so the whole lease fee compensating for a building cost and an appropriate profit is the governmental expenditure for building the facility. Consequently, total capital expenditure in the BTL model is the sum of total lease fee from the public sector and operating cost. In the BTO model which has revenue collected from end users, there is no lease fee but there can be a subsidy for construction from the government. Therefore, the expenditure of public sector is just measured by a subsidy for construction (KDI, 2009a).

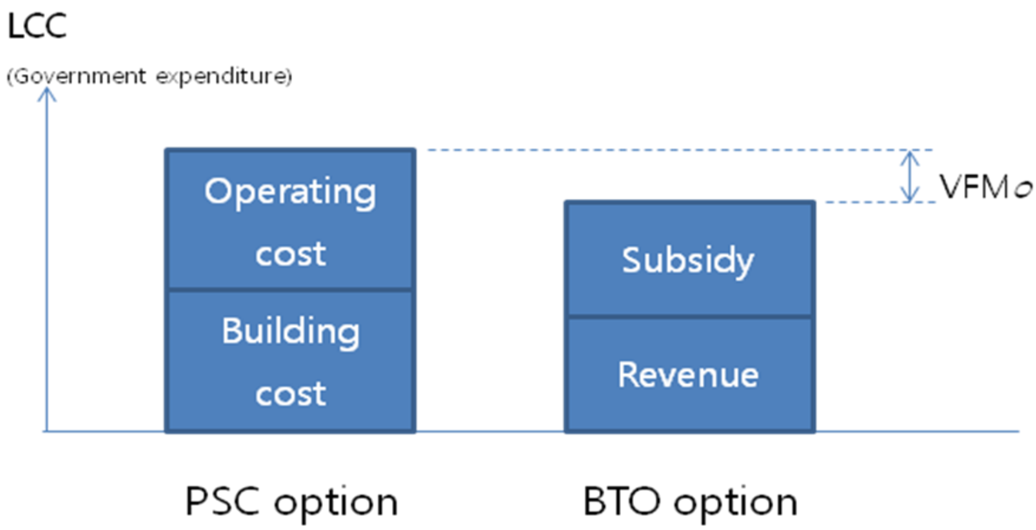
Table 4.2 Summary of capital expenditure

		PSC	**PPP**
Building Cost	**Facility Part**	1) Construction & Design - surveying & examining - design - construction	1) Construction & Design - surveying & examining - design - construction
		2) Land acquisition	2) Land acquisition*
		3) Utility	3) Utility
		4) Operating reserve	4) Operating reserve
		5) Other cost - feasibility test - environmental effect test - traffic effect test - insurance	5) Other cost - feasibility test - environmental effect test - traffic effect test - insurance
	Financial Part	6) Tax and financial cost	6) Tax and financial cost
Lease(in BTL)		-	Building cost with profit
Subsidy(in BTO)		-	Subsidy for construction
Operating cost		7) Management	7) Management
		8) Maintenance	8) Maintenance
		9) Supervising	9) Supervising
Total expenditure (in BTL)		Building cost + Operating cost	Lease + Operating cost
Total expenditure (in BTO)		Building cost + Operating cost – Revenue	Subsidy
LCC (Life Cycle Cost)		Calculated by considering nominal financial discount rate and inflation	Calculated by considering nominal financial discount rate and inflation

Source KDI (2009)

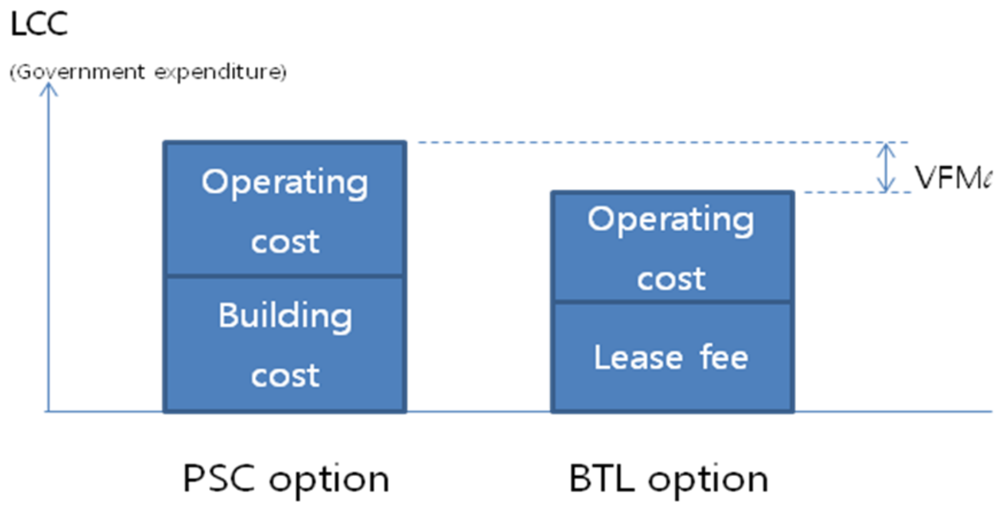
The quantitative VFM of a PPP project is measured by comparing the LCC of the PPP with the PSC. The LCC of the PSC is the NPV of the sum of building cost and operating cost. It is also the same with the government expenditure in the PSC option. However, the LCC in the PPP option means the capital expenditure of the government and it does not mean project cost which is invested by the private sector. In the BTO model, the government expenditure is subsidy for land acquisition cost or construction subsidy (KEC, 2007). Revenue collected from end users can be understood as a kind of subsidy from the government because the government granted the right to charge tariffs instead of giving subsidy. Consequently, the LCC in the BTO option is the NPV of total revenue and subsidy if it is provided by the government as seen in Figure 4.1. In this thesis, the VFM in the BTO model is written as the VFM*o.*

Figure 4.1 Basic concept of the VFM in the BTO model



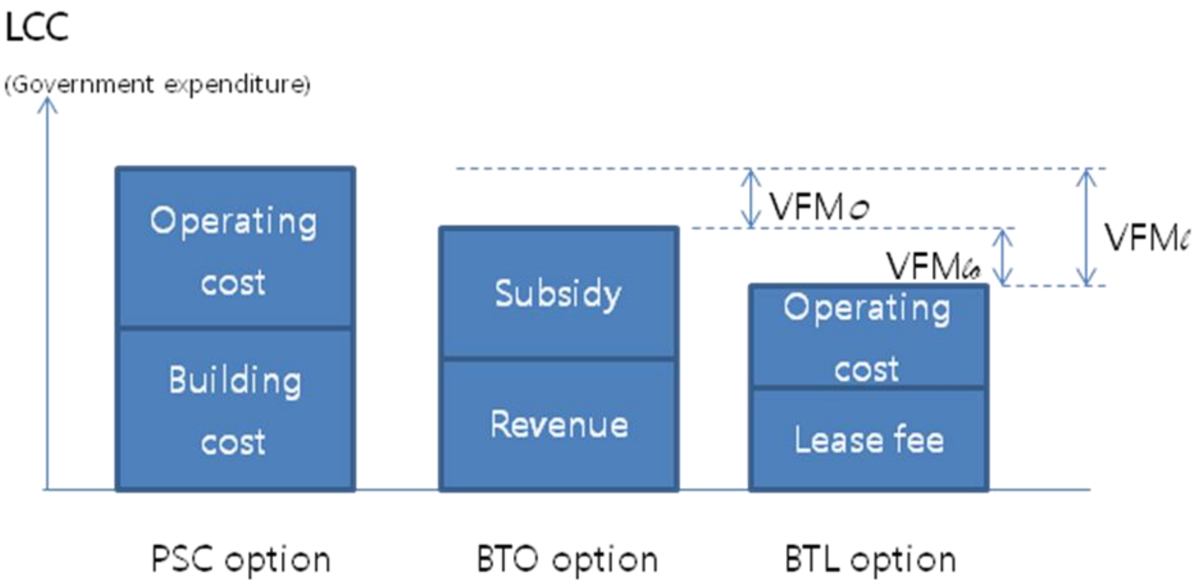
In the BTL model, the LCC of PSC option is the same with the case of the BTO model, but the LCC of BTL option is the same as the NPV of total lease fee covering whole contract period and operating cost. The lease fee paid by the government is decided to compensate for building cost with an appropriate profit to the private sector. Operating cost is separately provided by the government. The Figure 4.2 shows the basic concept of the VFM in the BTL model. In this thesis, the VFM in the BTL model is written as the VFM*l*.

Figure 4.2 Basic concept of the VFM in the BTL model



The VFM should be modified to compare the BTL with the BTO model. The quantitative VFM of the BTL to the BTO can be analysed by calculating the difference of the LCC between the BTL and BTO option as seen in Figure 4.3.

Figure 4.3 Basic concept of the VFM for comparing the BTL with the BTO option



The LCC of the BTO option is same as the NPV of the sum of governmental subsidy and revenue. The LCC of the BTL is the same as the NPV of the lease and operating cost.

Hence, the VFM of the BTL model compared with the VFM of the BTO is newly suggested as follows;

(Equation 1)

$$VFM_{\ell} - VFM_{o} = BTO\ (LCC) - BTL\ (LCC)$$
$$= BTO\ (Subsidy + Revenue) - BTL\ (Lease + Operating\ cost)$$

Here, VFM_{o} is the VFM of the BTO model compared with the PSC and VFM_{ℓ} is the VFM of the BTL model compared with the PSC. In case that both BTO and BTL model have revenue like a toll from the end users, the revenue is assumed as same in the BTO and BTL.

Then,

(Equation 2)

$$VFM_{\ell} - VFM_{o} = BTO\ (Subsidy) - BTL\ (Lease + Operating\ cost - Revenue)$$

This formula shows that the VFM can be measured by the capital expenditure of the government, because the subsidy in the BTO model and lease, operating cost in the BTL are paid by the government. If there is no subsidy from the public sector like the Incheon Airport Expressway, then the formula can be simplified as follows;

(Equation 3)

$$VFM_{\ell} - VFM_{o} = BTL\ (Revenue - Lease - Operating\ cost)$$

Shortly, $VFM_{\ell o}$ is substituted for $VFM_{\ell} - VFM_{o}$.

(Equation 4)

$$VFM_{\ell o} = BTL\ (Revenue - Lease - Operating\ cost)$$

4.3.3 Qualitative VFM assessment

Qualitative VFM assessment is to analyse the factors, like a service quality, which are not easy to quantify but are likely to have value of risk transfer (HM Treasury, 2006a). Especially the quantitative assessment between different PPP options can be less decisive than between the PPP and the PSC options, because the BTL and the BTO options share more common factors in the quantitative assessment than the PPP and PSC options. It means that the role of the reasonable qualitative assessment is important to find better PPP option. According to the Korean VFM guidance (KDI, 2009b), considering that the result of the qualitative assessment can be different with the result of the quantitative assessment, the methodology for the qualitative VFM assessment should be clear also.

Various methods for the qualitative assessment can be used, but there are three common methods; observation, interviews, and documentary analysis (Berg, 2007, Patton, 2002). Observation can be divided into participant observation and direct observation, but both are not suitable for this research, because the qualitative VFM assessment for the PPP projects has been cursory until now. Documentary analysis is very limited, because the comparison of the BTL with the BTO option was tried for the first time in this thesis, so there is no document directly related with the choice of the PPP models. Interviews are useful for getting the opinions based on experiences of interviewees and particularly, in-depth information around the topic can be obtained (McNamara, 1999). Qualitative VFM assessment for comparing the BTL with the BTO option needs to be done by the experts who understand two PPP models and have enough experiences. Therefore interviews seem to be appropriate for the qualitative VFM assessment based on the assumed situation comparing the BTL with the BTO option.

Usually, there are three types of interviews (Arksey, 2004, Yin, 2009): an open-ended interview, where the interviewer asks the interviewee for facts or opinions on the subject without any pre-organised questions; a semi-structured interview, where the interviewer asks prepared questions as an interview guidance, but the direction of response can be taken by the interviewee; and a structured interview, where the interviewer follows structured list of questions like a formal questionnaire and responding of the interviewee is limited to the questions.

Considering the qualitative VFM assessment for transport PPP in South Korea has been cursory, it is thought that the semi-structured interview is appropriate. This research tries to compare the BTL with the BTO model for a project for the first time in South Korea, so interviewees may not understand the comparison concept only based on a questionnaire. Thus, a set of questions can be helpful to proceed to interview not only for the investigator but also for the respondent. Also, the PPP has quite different characteristics by transport mode, project, and details of contract, so the result of interviews can be quite different by the personal experience of the interviewee. Therefore, it needs to allow the respondent to lead the direction of the interview and the list of questions is used only for the interview guidance.

The VFM assessment guidance of Korea gives an example of issues and questions for the qualitative VFM assessment comparing the PPP option with the PSC option through interviews as follows;

Table 4.3 Issue and questions in the qualitative VFM assessment for the PPP

Issue	Question
Service quality	▪ Can the service quality be improved by the creativity of the private sector and the competition with the public sector?
Contract & Management	▪ Is it appropriate to make a contract with the private sector under the current regulations in construction and operation? ▪ Does the procurement authority have enough ability and capacity to manage and supervise the project? ▪ Can the efficiency of the public work be risen by transferring the construction and operation to the private sector?
Risk management	▪ Is the risk management clear enough to operate the project continuously and stably?
Effect to other industry	▪ Can the technology and the management skill of the private sector affect the public sector in a positive way? ▪ Can the financial market be developed through the advanced financing tool?
Special condition	▪ Is there any limitation to the project because of the national security? ▪ Is it appropriate for the private sector to provide the public service without the dispute about fairness?

Source: KDI (2009)

However, this is comparing the PPP with the PSC, so these are not enough to compare the PPP models with each other. It is not easy to find the meaningful difference between the BTL and the BTO model in these questions. The VFM assessment guidance of the UK shows more specific issues and questions in each of the programme, project and procurement level. There are 10 issues and 49 questions including the overall question in three categories (viability, desirability, achievability) in the project level on which this study focuses (HM Treasury, 2006b). Hence, new qualitative VFM guidance focusing on comparing the BTL and BTO model needs to be suggested based on these issues and questions of Korea and the UK's qualitative assessment guidance.

Basically, the issues for the qualitative assessment to compare the BTL with the BTO are similar to compare the PPP with the PSC, because it needs to be compared with the PSC whether the BTL or the BTO is chosen. Questions need to be modified also to fit to compare the PPP models with each other. Based on the guidance of the UK (HM Treasury, 2006b), there are four issues which are appropriate to compare the BTL with the BTO. These are operational flexibility, risk management, incentives and monitoring, and market interest. They are related with three issues (service quality, contract and management, risk management) of Korean guidance. The issue about the incentives and monitoring is for increasing the service quality. The issue about the market interest is for checking the possibility of making a contract. This study is mainly about Korean cases, so three issues of service quality, contract and management, and risk management based on the Korean VFM guidance are used (KDI, 2007a, KDI, 2009a). In addition to that, the issue of operational flexibility in the guidance of the UK is added. Consequently, detailed questions in these issues in the qualitative VFM assessment for comparing the BTL with the BTO option are listed in Table 4.4.

Basically, the qualitative assessment in this thesis is based on the assumed case comparing the BTL with the BTO option in a specific PPP project. Thus, the semi-opened interview is selected and the questionnaire is a tool for leading the in-depth discussion. It means that the interviewee can discuss qualitative factors freely regardless of questionnaire, and suggested issues and questions in Table 4.4 are only for the referral purpose and they look enough to do the interview without deeper discussion on the questionnaire.

Table 4.4 Issue and questions in the qualitative VFM assessment for comparing the BTL with the BTO option

Issue	Question
Service quality	▪ Is it possible to use an incentive through the payment mechanism for improving the quality of the public service?
Contract & Management	▪ Does the procurement authority have enough ability and capacity to manage and supervise the project? ▪ Does the private market have enough experience and knowledge to deal with the PPP? ▪ Is it possible for the government to have a supervising tool through the payment mechanism on the contract to monitor the project?
Risk management	▪ Can the payment mechanism and contract terms incentivise good risk management?
Operational flexibility	▪ Is there a practical balance between the degree of operational flexibility that is desired and long term contract?

Source: VFM assessment guidance of Korea and the UK

However, more important thing in the qualitative assessment is the selection of interviewee rather than the questionnaire. The qualitative assessment has not been tried to compare the BTL with the BTO option before, so interviewees should have enough experiences and expertise on two PPP models. The problem is that the PPP experts understanding two models broadly in South Korea are very limited and few of them have experiences in a real PPP case. Thus, 8 general PPP experts who deeply understand both PPP models were selected as interviewees (see details in APPENDIX 3). They are from the government, a financial investor and institutes researching the PPP issues on transport. 15 interviewees are also selected from 5 PPP projects in which they were involved. They have direct experiences on a specific PPP model which was used in the project, but they are difficult to answer the different PPP cases.

Consequently, 3 people from each project and 8 general PPP experts execute the qualitative assessment on 5 case studies. Considering the number of PPP experts is very limited and around 3 to 5 experts usually do the qualitative VFM assessment in South Korea, 11 experts look enough to examine the VFM.

4.3.4 Sensitivity analysis

Basically, the result of the quantitative VFM assessment in this study is driven by the single point estimation. It is not easy for the procurement authority to have the confidence that the PPP is better than the PSC based on the result of the quantitative VFM only once assessed. To deal with this kind of uncertainty, the sensitivity analysis to various input factors in the quantitative assessment is widely used.

Sensitivity analysis is variously defined in different area such as engineering, economics, physics, social sciences, etc., but the main concept looks almost same. According to the IMF (2007), the sensitivity analysis is “a what-if type of analysis to determine the sensitivity of the outcomes to changes in parameters. If a small change in a parameter results in relatively large changes in the outcomes, the outcomes are said to be sensitive to that parameter”. It can be defined as “the study of how the uncertainty in the output of a model (numerical or otherwise) can be apportioned to different sources of uncertainty in the model input” (Saltelli et al., 2004).

To do the sensitivity analysis, it needs to decide the appropriate input parameters. For the PPP of the transport infrastructures, the MLTM (2007) recommends the input parameters should be analysed as follows; construction and operation period, toll price, traffic volume, construction cost, operation cost, government subsidy. However, this study is to find the optimal PPP model through the VFM assessment, so it needs to examine the sensitivity of the quantitative VFM to the input parameters which are used to test the VFM.

There are various sensitivity analysis methods and they can be classified in different ways. Saltelli *et al.* (2000) classify them as : (1) mathematical; (2) statistical; and (3) graphical. Mathematical methods analyse the sensitivity of outputs to the variable range of inputs. In most cases, the output is calculated with a few values of a possible range of the input. Statistical methods assess the effect of variance in inputs, which can be expressed in the type of probability distribution, on the output distribution (Neter et al., 1996). There are regression analysis, analysis of variance, response surface method, Fourier amplitude sensitivity test, mutual information index, etc. in the statistical method, and the range of inputs can be determined by using various techniques such as Monte Carlo simulation (Cullen and Frey, 1999, Frey and Patil, 2002). Graphical methods are to do the sensitivity analysis in the form of visual indication like graphs, charts, etc. These are possible to be used as a complementary tool for the mathematical and statistical methods for better representation (Baird, 1989, Treasury Board of Canada Secretariat, 1998).

The MLTM (2007) suggests using the deterministic nominal range sensitivity analysis in the reason that there are not enough experiences and accumulated data of the PPP in Korea for the stochastic analysis. Thus, this study which is focused on Korean cases basically follows the suggestion of the MLTM. About the items for the sensitivity analysis, Woodward (1995) said that variables which should be examined were inflation, revenue, construction costs, interest rate, operating costs, the construction time, the project life, etc. through his survey. The MLTM (2007) also gives a guideline for the input factors of the sensitivity analysis: construction and operation period, toll, demand, construction cost, operation cost, government subsidy. This study is for Korean cases, so it needs to follow the guidelines of the MLTM.

However, the inaccuracy of traffic forecast is one of the most important factors which can affect the quantitative VFM. This factor is usually tested by the sensitivity analysis, but actual traffic was frequently out of test ranges because of the high inaccuracy of forecast. However, accumulated traffic data in transportation by now is likely to make it possible be expressed by the probability. Most countries have their formal procedure to forecast the traffic by using the common factors such as the O/D data, forecast model, etc. It means that the inaccuracy of traffic forecast can have a tendency which is statistically meaningful in the level of country or region. Thus, the stochastic analysis on the traffic factor is done based on the probability of the traffic forecast, and it can be calculated by the random process such as the Monte Carlo simulation.

The Monte Carlo simulation is a methodology to simulate the phenomena or formula with high uncertainties of input factors by randomly iterated runs based on the probability distribution of input factor (Glasserman, 2003). Many areas such as finance, engineering, physics, etc are using the Monte Carlo method or simulation. In this study, traffic demand risk is the most decisive but highly risky. Also, the formula calculating the quantitative VFM assessment has various input factors, and the Monte Carlo simulation easily deals with these factors having high uncertainties at the same time by the computer based random iteration. Consequently, the Monte Carlo simulation can be used to assess the sensitivity of VFM to traffic demand based on the probability of accuracy of traffic forecast in road and rail in South Korea.

There are several software packages for the Monte Carlo Simulation such as “at Risk” and “Crystal Ball”, but this thesis deals with only one input factor (traffic demand), so the Excel of Microsoft is enough to find out the result (see APPENDIX 5).

4.4 Case studies

4.4.1 The purpose of the case study

The optimal PPP model was defined as the PPP model providing better VFM. At the level of transport mode, the optimal PPP model means the PPP model giving higher VFM in each transport mode. However, the VFM is varied by the social and economical circumstances of each project and transport mode, which are complicated and changeable. Thus, it seems to be effective to be analysed by the empirical research rather than theoretical research.

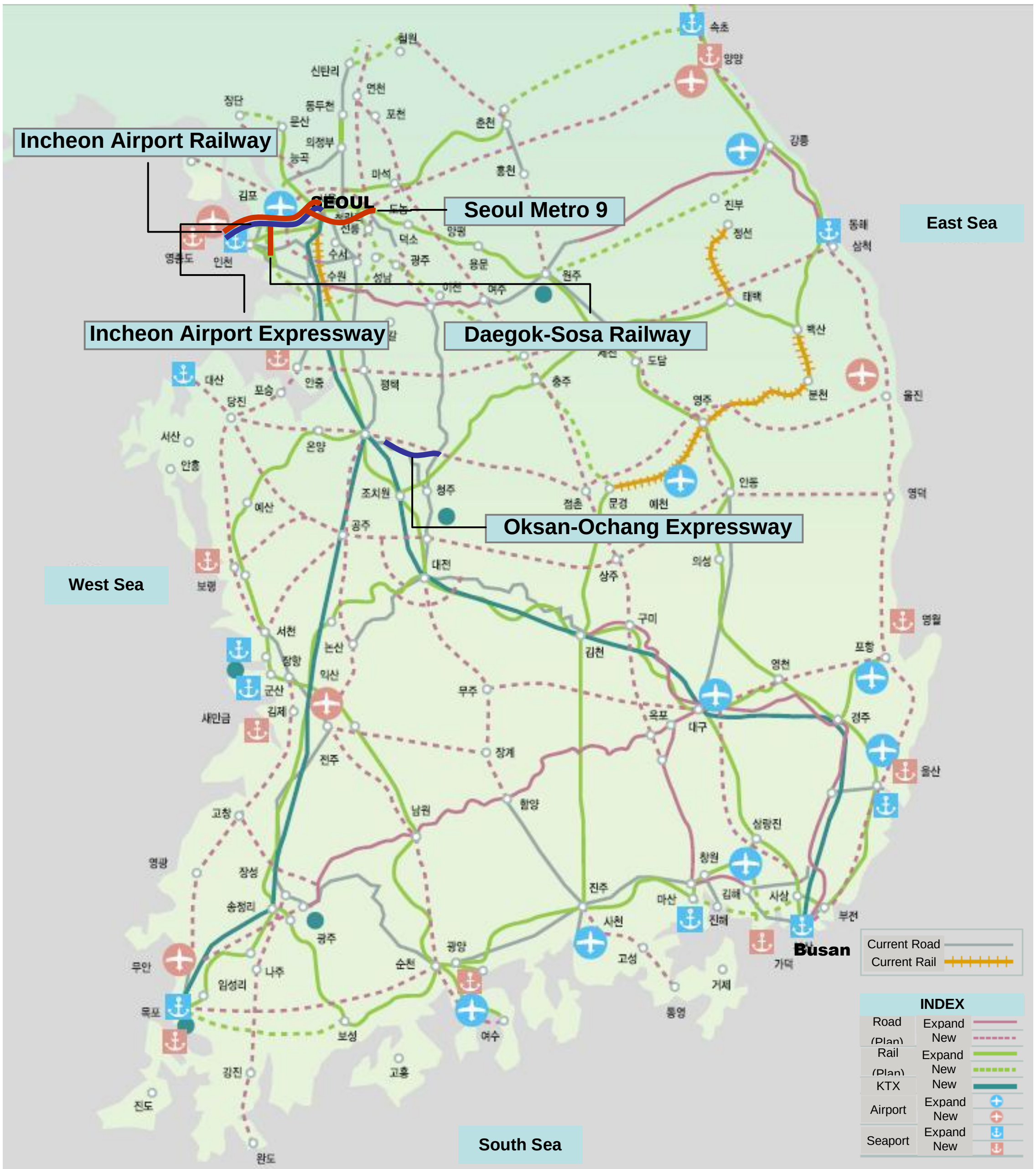
There are many strategies for an empirical research: an experiment, archival analysis, historical analysis, survey, case study, etc. (Yin, 2009). An experiment is not possible in a real PPP project and archival analysis and historical analysis do not look enough to find a general conclusion on the optimal PPP model though the general features can come out. Using the BTL instead of BTO for transport PPP is unusual in South Korea, so a survey can mislead the opinions under the situation that the research concept is not understood clearly to the respondents. A case study is suitable for the investigators to find out holistic and meaningful characteristics of real-life events such as organisational and managerial process, maturation of industries, school performance, etc. (Yin, 2009) To find the optimal PPP model in transport, it is necessary to research the PPP process, situation of transport field, the performance of PPP. Therefore, a case study looks useful for the optimal PPP model research.

Consequently, a case study as a main research methodology is used to find out the optimal PPP model for road and rail in South Korea, though archival and historical analyses through the literature review are partly used for general features of the PPP models. The VFM assessment and the sensitivity analysis are methodologies are used at a project level, and case studies of several PPP projects helps the optimal PPP model at the general levels of road and rail.

4.4.2 The selection of the case study

There are many PPP projects for road and rail in South Korea, so a case for research needs to be selected for reflecting various characteristics of PPP models. For the rational appraisal of the PPP models, not only successful cases but also failed cases should be studied. The role of the public sector in the PPP is also an important factor to affect the choice of the optimal PPP model. Cases need to cover various roles, which have such types as the subsidy from the public sector, MRG, etc., of the public sector. Thus, five cases are selected in this thesis; two cases (Incheon Airport Expressway, Oksan-Ochang Expressway) are for road and three cases (Incheon Airport Railway, Daegok-Sosa Railway, Seoul Metro9) are for rail.

Figure 4.4 Location of case studies



Source: MLTM

The most representative BTO project in road is the Incheon Airport Expressway. This expressway is the first BTO project in South Korea, and many other projects followed this case in making the PPP contract as the example of the BTO project. Also, it was already opened from 2000 and there are many evaluations and debates on the project. Especially, the public sector shared traffic demand risk with the private sector in this project by the MRG condition which was 90% at first. Thus, the Incheon Airport Expressway is studied for analysing the road PPP case with the MRG condition.

The second case for road is the Oksan-Ochang Expressway using the BTO model where the MRG condition is not included. This expressway is an unsolicited project suggested by the private sector and is in negotiation between the MLTM and the preferred bidder for making a contract. The suggestion of the private sector was assessed to be inappropriate at first, and the private sector changed its suggestion. However, the project has been delayed for several years because the private sector was difficult to finance the project without MRG condition. The construction cost in the BTO option is higher than the PSC option, and almost doubled toll level is supposed to be charged. It shows current problems of the BTO model in road, so it is good to assess the BTL model as the alternative of the BTO road.

Rail has many different characteristics with road. Construction and operation are much more complicated than road and cost is also higher. Though toll level is limited by the government, but tariff in rail is much more regulated by the government because rail is a dominant public transport. Thus, the contents of PPP are easy to be more complex and various than road. In this thesis, the Incheon Airport Railway which is the first railway PPP project in South Korea is studied first. This project followed the PPP scheme of the BTO with MRG model for road cases, but now, it was severely criticised because of the excessive MRG and most equities of the private sectors were sold to the public sector. This case shows the appropriateness of the BTO with MRG model to rail.

The second case for rail is the Daegok-Sosa railway using the BTL model including the operation for the first time in transport in South Korea. The project is a part of national arterial rail, so the level of tariff is strongly limited by the government and the BTO model is difficult to be chosen. This case can show the possibility of using the BTL model for the construction and operation of transport infrastructures.

The third case for rail is the Seoul Metro line no. 9 using the BTO model with MRG and construction subsidy. In fact, the urban rail in a metropolitan city shows different characteristics with the nation arterial rail connecting local regions. The public needs are various and much in urban rail and the construction and operation are more complex not only than road but also than any other common rail.

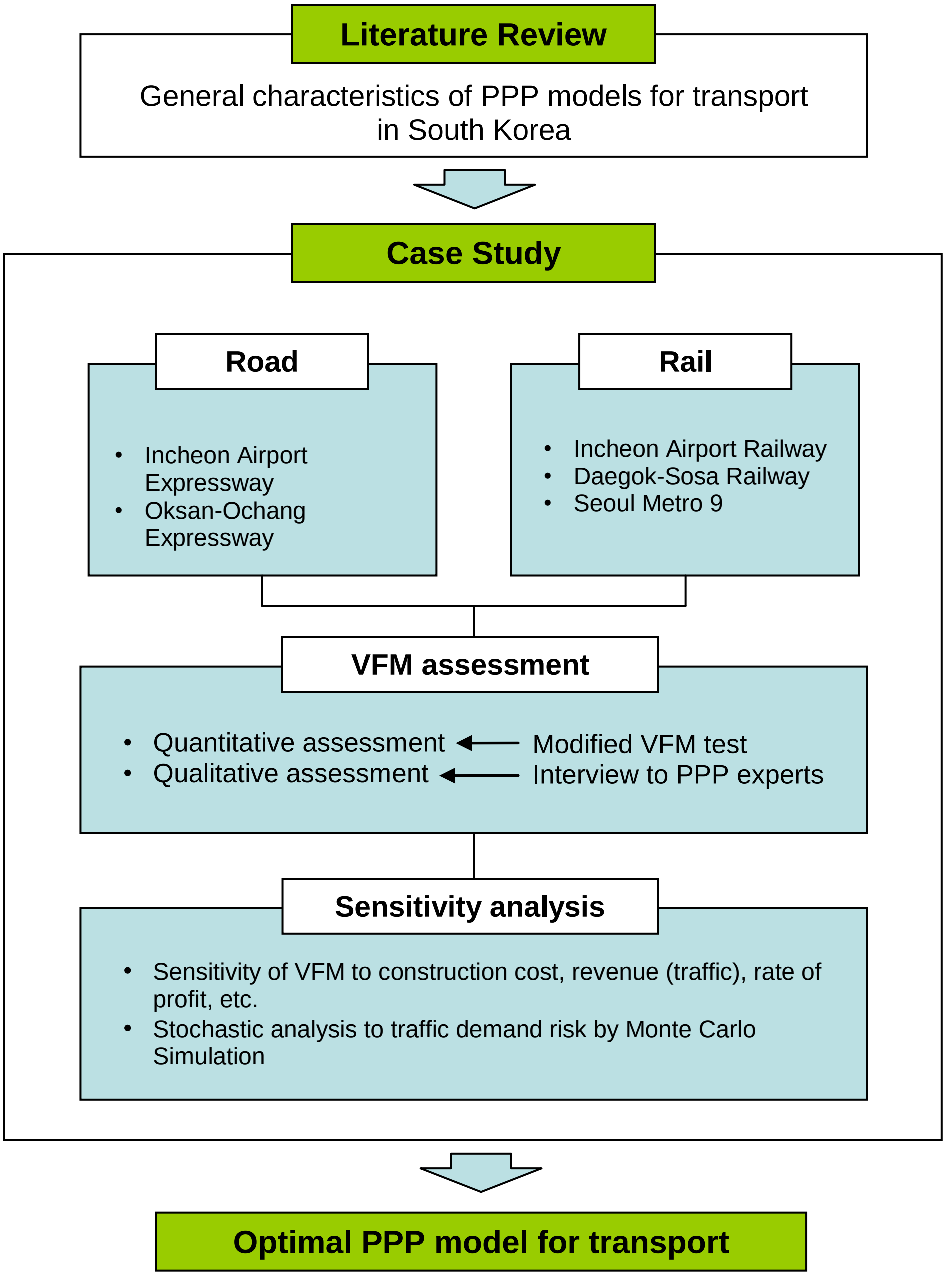
Table 4.5 Main features of five case studies

Mode	Project	Current PPP model	MRG	Subsidy from the government	Progress
Road	Incheon Airport Expressway	BTO	O	X	Operation
	Oksan-Ochang Expressway	BTO	X	O	Negotiation(Delay)
Rail	Incheon Airport Railway	BTO	O	O	Operation (sold to the public sector)
	Daegok-Sosa Railway	BTL	-	X	Negotiation
	Seoul Metro 9	BTO	O	O	Operation

4.4.3 Methodological framework

An optimal PPP model was defined as a PPP model having higher VFM in this chapter, and it needs several methodologies to assess the VFM and to know the characteristics of the BTL and the BTO model in different transport mode. Figure 4.5 shows the methodological framework to explore the optimal PPP model in road and rail in South Korea.

Figure 4.5 The methodological framework



4.5 Conclusion

The PPP research is a very practical area which is much affected by social and economic circumstances and is therefore variously regulated by each country. Thus, this chapter explored the research methodology based on the regulations of the BTO and the BTL model in South Korea. The literature review demonstrated that for Korea these were the two most important options

The available methodologies were reviewed, and the VFM assessment which can be used for both PPP models was chosen to evaluate the optimal PPP model for road and rail in South Korea. Thus, the optimal PPP model could be defined as the PPP model having higher VFM between the BTL and the BTO model. In this case, optimal refers to the best financial option for the government.

The VFM assessment was divided into the quantitative assessment and the qualitative assessment. Quantitative VFM assessment was calculated using the LCC analysis in the Korean VFM guidance, but this thesis modified the VFM guidance so that it could compare the PPP options with each other instead of the PSC option. To date, qualitative VFM has been cursory in Korea, but it was important to cover the interest of the private sector and the end users who are key participants in the PPP. Thus, it was decided to be assessed by the in-depth interview of over 20 PPP experts in South Korea. This permits consideration of the financial impacts on the private sector of wider social benefits. The alternative of detailed economic modelling of the impacts on end users was precluded by the lack of data.

However, the VFM assessment was done by the point estimation and it did not consider variable input factors. Thus, the sensitivity analysis of VFM to various input factors was chosen to increase the fidelity of the VFM assessment. In particular, in various input factors to the VFM assessment, traffic was found to be the most risky, and the main difference between the BTO and the BTL model was due to who bore the traffic demand risk. Thus, stochastic analysis is added to the sensitivity analysis of the VFM to determine the impact of traffic demand risk.

Though the VFM assessment shows the optimal PPP option for a project, the different features of a project and transport modes such as road and rail need to be studied. Thus, the case study approach was thought to be appropriate as a methodological strategy, and five cases having specific characteristics for road and rail in South Korea were selected. The Incheon Airport Expressway and the Oksan-Ochang Expressway was chosen for road PPP and the Incheon Airport Railway, the Daegok-Sosa Railway, and the Seoul Metro 9 were chosen for rail PPP.

CHAPTER 5

Case study in the Incheon Airport Expressway

5.1 Introduction

The Incheon Airport Expressway is the first BTO road with MRG condition to connect Seoul with the Incheon International Airport under the current PPP regulation. This project affected not only the public sector but also the private sector as the first PPP example. Other transport BTO projects including rail and seaport followed this project in deciding a rate of profit, MRG, etc. However, this project was severely criticised because the actual traffic was much lower than expected, so the government had to pay the guaranteed revenue. It made people sceptical about the PPP itself, though it was due to the guaranteed revenue in the BTO model.

This road was only way to link Seoul to the Incheon International Airport when the airport was opened in 2001. The issue on the Incheon Airport Expressway was not to decide whether to do but to decide how to do. However, the Korean government chose the BTO model without any specific assessment like a current VFM test. The main interest of the government seemed to do the project on schedule without excessive burden on the budget.

This chapter, firstly, summaries details, history, and appraisal of the project. Secondly, it conducts a quantitative VFM assessment for comparing the BTL with the BTO option. Thirdly, it executes a qualitative VFM based on interviews from the PPP experts of South Korea. Lastly, the sensitivity of VFM to important input factors is analysed. Also, in this section, it explores whether the level of MRG, which reached 90% of expected revenue, was appropriate.

5.2 Summary of the project

5.2.1 Details of the project

The Incheon Airport Expressway is the first transport infrastructure linking the Incheon Airport to Seoul as a part of new international airport construction project for Seoul. The Incheon International Airport was officially suggested in 1989 by the Ministry of Transportation of Korea, and its construction was launched from 1992. The Korean government aimed to complete in 2000 and to open from 2001. It was planned as an exclusive expressway with toll to minimise the travel time (IIAC, 2001).

It was only way to the Incheon Airport until the Incheon Bridge, which is the second way to link the airport and Incheon Songdo International city, opened in 2009. The government invested ₩284 billion for connecting road and the private sector invested ₩1,460 billion for main road constructed by the PPP. It has a total length of 40.2km and four to six lanes. Main bridge to connect Yeongjong-Do, which was reclaimed from the sea between two islands, with land was designed to have two layers for road and rail. The construction period was from November 1995 to November 2000, but a part of main bridge was constructed from 1993 by the government.

Figure 5.1 Incheon Airport Expressway route map

Source: MLTM

5.2.2 History of the project as a PPP

The Incheon Airport Expressway was supposed to be built by the public sector and the construction of the bridge was partly started in 1993 by the government. However, the Korean government made a decision to change the traditional direct investment procurement way to the BTO model in 1994. Main reasons were relieving the financial burden of the government and introducing the efficiency of the private sector to transport service. According to Yeo et al (2003), the minimum demand of the investment for transport infrastructures in South Korea was expected to be ₩364 trillion during 1996~2011, but the Korean government was anticipated to be able to afford to ₩241 trillion.

In 1995, the Ministry of Construction and Transportation (MOCT, now MLTM) requested proposals of the private sector, and there was only one bidder which was a consortium consisted of major construction companies in Korea[13]. The government made a contract and the construction resumed again in November 1995 and the partly constructed part by the public sector was agreed to be paid by the private sector (MOCT, 1996).

The operation period of the private sector was 30 years and there was no MRG regulation when the contract was made at first. However, the Asian financial crisis in 1997 made it difficult for the private sector to continue the project, so the government decided to share the demand risk with the private sectors without decreasing the rate of profit in 1999. Also, the private sector had to make a contract based on traffic forecast suggested by the MOCT in June 1994 as a solicited project already in progress (Yeo et al., 2003). Thus, the MOCT guaranteed 90% of the expected revenue to the private sector for 20 years in 30-year operation period. However, the government confronted criticisms on the excessive MRG after operation and the private sector which was consisted of construction companies wanted to sell their equity. Thus, the MRG condition got changed from 90% to 80% instead of allowing refinancing of the private sector and selling equities of construction companies in 2003 (MOCT, 2003).

[13] Equity holders of the Incheon Airport Expressway: Construction companies (76.57%, Samsung, Donga, Posco, Kolon, LG, Kumho, Gukdong, Lotte, Punglim, Doosan)

5.2.3 The appraisal of the project as a PPP

The Incheon Airport Expressway is the first BTO project under the current PPP regulation and its appraisal is distinctively divided. Proponents think the project was successful in the point that the facility was constructed on time, on budget (Kim et al., 2004). This project was an essential facility for the Incheon International Airport located in a small island, so it was very important to complete the construction before opening the airport. Especially, major structures such as Yeongjong Grand Bridge needed the high technology which was newly introduced in South Korea at that time. Yeongjong Grand Bridge is the main bridge to connect the airport to land and it is a suspension bridge which has double decks for a six-lane expressway on upper deck and four-lane expressway and double rail on lower deck (New Airport Hiway Co., 2002).

Figure 5.2 Yeongjong Grand Bridge

Source: MOCT, NAVER encyclopaedia

However, opponents criticise that there are many problems as the first PPP case. The most serious problem is an excessive financial burden of the public sector differently with the original expectation. They think the purpose of the PPP, to lessen the financial burden of the public sector by inducing the private investment, was not achieved (Kim, 2006). It is due to the MRG condition under the situation that the traffic forecast is inaccurate. The government guaranteed 90% of expected revenue to the private sector for 20 years in 30-year operation period. However, the actual traffic was around 50% of the forecasted because of overestimated accompanied persons, delayed land development in Yeongjong Island, incorrect modal split, increase of average occupancy, etc.

(Lee, 2005, Kim et al., 2004, Yeo et al., 2003). According to Lee (2008b), subsidy for the guaranteed revenue is estimated up to more than ₩1,500 billion for 20 years.

Table 5.1 Traffic volume of the Incheon Airport Expressway

Unit: cars per day

Year	2001	2002	2003	2004	2005	2006	2007	2008
Forecasted traffic (A)	110,622	121,496	133,438	146,554	119,026	125,322	131,965	138,930
Actual traffic (B)	51,939	54,244	55,323	59,780	62,831	65,571	68,711	64,956
B/A (%)	46.9%	44.6%	41.5%	40.8%	52.8%	52.3%	52.1%	46.8%

Source: MLTM (2009)

End users also complained the higher toll charge than the public sector operating expressway. Toll price of the Incheon Airport Expressway is 2.38 times of the public expressway though the government guarantees 90% of the expected revenue (Kim, 2006).

Table 5.2 Toll prices of Public Expressway and the Incheon Airport Expressway

	Public Expressway (A)	Incheon Airport Expressway (B)	Rate (B/A)	Note
Toll	₩2,686	₩6,400	2.38	40km(Eight-lane)

Source: MOCT, recited from Kim (2006)

Consequently, the Incheon Airport Expressway has problems about inaccurate traffic forecast, excessive MRG by which most risks were transferred to the public sector, and high toll price although it was successfully constructed before opening the airport and has been operated. Especially, the Incheon Airport Expressway was the first PPP case in South Korea and many other PPP projects followed this case in making a MRG, rate of profit, etc. Thus, problems in this case were also seen in other PPP cases for transport infrastructures.

5.3 Quantitative VFM assessment

5.3.1 Basic assumption

For a rational comparison between the BTL and the BTO option, social and economic circumstances when the contract got made should be considered. This BTO project started from 1995, but its contract was revised in 2003 for refinancing of the private sector. Most data collected from the MLTM was value in 1999 to analyse the finance of the project, so the year for calculating life cycle cost is 1999.

The quantitative VFM is assessed through the analysis of the discounted cash flow of the project, so it needs to assume a financial discount rate to calculate this. According to the financial report of the Incheon Airport Expressway (MLTM, 2009), a nominal financial discount rate in 1999, which was used in analysing the cash flow of this project, was 8.87%. A financial discount rate is decided by the financial circumstances of each country, and the Korean VFM guidance for the BTO model (KDI, 2007a) recommends using 6% (real) based on the WACC (Weighted Average Capital Cost) method. However, the financial discount rate in the BTL option should be equal to the value around 1999, so the nominal financial discount rate in this case study will be used as the same value, 8.87%.

In the VFM assessment of the BTO model, generally real value is used in calculating cash flow to adjust the level of toll regularly by inflation. On the other hand, in the case of the BTL model, nominal value is used to calculate lease fee which is annually paid for operation period in general. It helps the government to predict the financial burden on future budget. Thus, the inflation needs to transfer these different values into one kind of value. The inflation used in the financial report of the MLTM was 5.0%, so the same value is used in this case study.

The rate of profit in the BTO model is determined by the FIRR (Financial Internal Rate of Return) which is based on the discounted cash flow of the project (KEC, 2007). In this study, the contracted real FIRR (Internal Rate of Return) of the BTO option is 9.70%, which is calculated by the cash flow of the

Incheon Airport Expressway. Thus, the rate of profit in the BTO case is 9.70% in nominal and it is 15.19% when the inflation is 5.0%.

The nominal rate of profit of the BTL option is assumed as 9.37%. Generally, the rate of profit of private sector in the BTL model of which revenue paid by the government seems lower than that of the BTO model where revenue is collected directly from the end user. Furthermore, a revenue risk in the BTL model, which is usually used for facilities without incomes from the end users, is on the government. It means that the government guarantees revenue to the private sector in the BTL model, although the government can put some conditions like serviceability on this revenue. The Korean VFM guidance suggests an appropriate rate of profit in the BTL model is the sum of the interest of five-year Korea national bond and mark-up including premium interest for long term investment, construction and operation risks. In a recent railway BTL project, the MOCT(2007c) suggested 0.77% as an appropriate mark-up rate which was calculated by the long term investment premium, the construction risk and the operation risk. In addition, there are two more BTL cases of rail in Korea, and mark-up rates are suggested as 0.76% and 0.70%, so the highest 0.77 will be used in the BTL option of the Incheon Airport Expressway as a common mark-up rate. In 1999, the mean value of interest of five-year Korea national bond was 8.60%, so an appropriate rate of profit in BTL option is assumed as 9.37%. The real rate of profit is 4.16% when the inflation is 5%.

5.3.2 Construction subsidy

There was no construction subsidy for this BTO project. This project was already started and partly constructed by the public sector. However, partly invested expense by the public sector was repaid by the private sector. Generally, there is no construction subsidy in the BTL model, so it is not considered in the BTL model either.

5.3.3 Lease fee

Lease fee is the payment of the public sector to compensate for the total investment for construction of facility and the appropriate profit of the private sector. If there is any additional income through the granted commercial right by the public sector, it should be excluded to the total cost because the profit for the private sector is already considered. Mostly, the public sector pays lease fee annually, so the annual lease fee equation can be shown as follows (KDI, 2009a);

$$\sum_{t=1}^{N} \frac{Annual lease\ fee}{(1+k)^t} = Total\ investment - the present value of the additional incomes$$

$$Aunnal lease\ fee = \frac{Total invesment - the present value of the additional incomes}{PVIFA(n,k)}$$

* Here, PVIFA is the present value index for annual lease fee.

$$PVIFA(n,k) = \sum_{t=1}^{N} \frac{1}{(1+k)^t}$$

N is operation (lease) period

k is the rate of return and it stands for the profit of private sector

This is same with the annually equal payment equation as follows.

$$Annual\ lease\ \ fee = (Total\ \ investment - the\ \ present\ value\ of\ \ the\ additional\ \ incomes) \times \frac{k}{1-(1+k)^{-N}}$$

There is little additional income in the Incheon Airport Expressway, so what should be considered is to calculate the present value of the total investment or cost through the life cycle of the Incheon Airport Expressway.

In this case, N which is the operation period of this project is 30 years. The k means the rate of profit, so the k value in this case is 9.37%. Total investment of the private sector for construction is building cost and it is ₩1,460.2 billion. Consequently, the PVIFA (30, 9.37%) is 9.9457 and the annual lease fee is ₩146.8 billion in nominal price.

$$PVIFA(30,9.37\%) = \sum_{t=1}^{30} \frac{1}{(1+0.0937)^t} = 9.9457,$$

$$Annual\ lease = \frac{(total\ investment - additional\ income)}{PVIFA} = \frac{1460.2}{9.9457} = 146.8\,billion\ \ KRW$$

5.3.4 Operating cost

Operating costs are assumed the same in both models. This project was transferred to the BTO projects from the government direct investment project just before starting main construction with the completed design. Therefore, there was no advantage of private sector for operating this expressway in design. On condition that there is no additional incentive or penalty for operation, it is thought for operating costs to be the same in both models.

According to the financial report of the MLTM (2009), operating cost for 30 years in the BTO model is ₩2,169.8 billion (real price). This chapter uses the same cost in the BTL model.

5.3.5 Revenue

Revenue is decided by the toll level and traffic demand and they are much related with each other. If toll rises, traffic volume is decreased. On the contrary, if toll drops then traffic volume is increased. In the BTL model, the public sector pays lease fee, so it can be difficult to increase toll price higher than other expressway operated by the public sector. It means that there is possibility that the toll in the BTL case is lower than the BTO case, and traffic volume might be increased. However, revenue in the BTL case is assumed the same in the BTO case, because expressway toll is a very political issue and it seems better to be dealt with qualitatively. The expected revenue for operation period is ₩6,844.9 billion in the BTO case, so the same revenue is assumed in the BTL case.

5.3.6 Summary of the analysis factors

- Building cost: ₩1,460.2 billion (nominal)
- Operating cost: ₩2,169.8 billion (real) / ₩5,938.8 billion (nominal)

- Operation period: 30 years
- Annual lease fee: ₩15.1 billion (nominal)
- Rate of profit

  Nominal: 9.37% in the BTL, 15.19%[14] in the BTO

  Real: 4.16% in the BTL, 9.70% in the BTO
- Real financial discount rate: 8.87%
- Inflation: 5.0%
- Revenue: ₩6,844.9 billion (real)

5.3.7 Result

In this case, there is no construction subsidy from the government, so the VFM can be calculated by following formula.

$$VFM_{\ell o} = BTL\ (Revenue - Lease - Operating\ cost)$$

The calculated data of 30 years and the sum of them are listed in Table 5.3. The quantitative VFM of the BTL model in this project compared with the BTO model is ₩693.4 billion.

Table 5.3 Quantitative VFM assessment in the Incheon Airport Expressway

Unit: billion KRW

Year	Revenue (Real)	Lease		Operation (Real)	VFM	
		Nominal	Real		Real	NPV
Sum	6844.9	4404.0	2149.2	2169.8	2525.9	693.4
2001	192.0	146.8	133.2	23.1	35.8	30.2
2002	210.9	146.8	126.8	19.1	64.9	50.3
2003	231.6	146.8	120.8	28.0	82.8	58.9
2004	254.4	146.8	115.0	44.2	95.1	62.2
2005	206.7	146.8	109.5	43.9	53.3	32.0
2006	217.6	146.8	104.3	58.4	54.9	30.3
2007	229.1	146.8	99.4	51.4	78.4	39.7
2008	241.3	146.8	94.6	57.8	88.8	41.3

[14] Rate of profit in the BTO model means FIRR (Financial Internal Rate of Return).

2009	254.0	146.8	90.1	65.6	98.3	42.0
2010	181.6	146.8	85.8	57.5	38.2	15.0
2011	187.1	146.8	81.7	54.5	50.8	18.3
2012	192.1	146.8	77.9	74.9	39.3	13.0
2013	198.9	146.8	74.1	64.4	60.3	18.3
2014	205.0	146.8	70.6	70.1	64.3	18.0
2015	211.4	146.8	67.3	90.7	53.5	13.7
2016	217.8	146.8	64.0	74.3	79.5	18.7
2017	224.9	146.8	61.0	77.0	87.0	18.8
2018	232.0	146.8	58.1	95.3	78.7	15.7
2019	239.4	146.8	55.3	82.3	101.7	18.6
2020	247.0	146.8	52.7	94.8	99.5	16.7
2021	247.0	146.8	50.2	86.9	110.0	17.0
2022	247.0	146.8	47.8	86.1	113.1	16.0
2023	247.0	146.8	45.5	86.7	114.8	14.9
2024	247.0	146.8	43.4	102.8	100.9	12.1
2025	247.0	146.8	41.3	97.2	108.5	11.9
2026	247.0	146.8	39.3	88.1	119.6	12.1
2027	247.0	146.8	37.4	88.5	121.0	11.2
2028	247.0	146.8	35.7	90.2	121.2	10.3
2029	247.0	146.8	34.0	89.4	123.7	9.7
2030	247.0	146.8	32.3	126.5	88.1	6.3

This result shows that if the Incheon Airport Expressway had been done by the BTL model, it could have more VFM than the BTO model which was used in the real case. This result seems reasonable because the difference of the construction and operation cost between two models is not so big, so the rate of profit is a decisive factor to affect the VFM. The rate of profit of the BTL model seems lower than the BTO model, because the revenue in the BTL model of Korea is guaranteed by the government only if the private sector does not have any problem in providing the service.

It is an important clue to demonstrate that if the traffic volume is close to an expected value, then the BTL can have more VFM than the BTO in general because of its lower rate of profit.

5.4 Qualitative VFM assessment

This section examines four issues of the qualitative VFM assessment suggested in Chapter 4; service quality, contract & management, risk management, and operational flexibility. This is assessed based on the opinions the PPP experts gave through the face to face interview which was done in South Korea from the 6th November to the 21st November 2010.

5.4.1 Service quality

Services in expressway can be assessed by various criteria. The MOCT (2007b) evaluated a service quality of expressway only by the traffic volume to road capacity. However, this does not look enough to deal with other important factors in service quality. Son (2006) divided service quality into two: quantitative factors such as speed, congestion, and the geometric structure of road and qualitative factors such as cleaning road, environmental effect, and driving manner. Kim (2007b) suggested including some factors such as driving circumstance, safety, and traffic information to service quality index. Hostovsky et al (2004) argued that density could be a measure to cover quality of service generally. Washburn et al (2004) presented more factors affecting service quality such as speed variance, pavement quality and driver etiquette. In addition to these studies, it needs to consider toll level to achieve a requested service quality. Even if the quality of service is same, the assessment on VFM can be different by how much end users pay.

With respect to the service quality, several interviewees said that this project was done by the BTO with MRG model, and the level of MRG was 90% at first introduced, so it was difficult to expect for the private sector to make an effort to improve the service quality (Ⓐ in section 3.1 in APPENDIX 4). The profit of the private sector was guaranteed regardless of end users complaint in service quality. A government officer who was in charge of this project argued that even if the BTL model had been used, there had been little difference with the BTO model in the service quality (Ⓑ in section 3.1 in APPENDIX 4). He argued that most factors in service quality such as speed, physical condition, driving etiquette, etc. seemed to be decided not by the effort of the private sector but by the geographic route, a physical standard of expressway, and transport culture. He pointed out that the service factor which can be managed by the private sector looked to affect little for the end users to choose the road even in the BTO case without MRG condition. An officer of BAI (Board of Audit and Inspection) of Korea added that people would be more interested in toll price than general service quality (© in section 3.1 in APPENDIX 4). The toll price could be lower in the BTL model in which the government pays lease fee to the private sector. In addition, this road is only way to the Incheon Airport and there is no other choice to users. Thus, considering difference between the BTL and the BTO model in the service quality is subtle regardless of MRG condition, the BTL model could be better to the end users in terms of toll. Especially, the BTL model can have several conditions in a contract to improve the service when the government pays lease fee to the private sector as seen in the PFI, which is similar to the BTL model in the view that the government pays for the private sector, road cases of the UK. The PFI road projects in the UK can use "the active management payment mechanism" where the payment of the government is made by the congestion management, safety performance, etc. (Bain and Wilkins, 2003a). Thus, the BTL model can be expected to have this kind of payment mechanism to improve the service, and the BTL seems better in this case than the BTO regardless of MRG condition.

5.4.2 Contract and Management

This issue is about the ability and experience of the public and private sectors for supervising and managing the PPP project. The Incheon Airport Expressway was the first BTO project in South Korea, so it took much time to negotiate because of the lack of experience of the private and public sectors (Kim et al., 2004). Also, the MRG condition was not included when the contract was made at first. A rate of profit was a key issue that prolonged negotiation time and it was much affected by high traffic demand risk (MOCT, 1996). The MRG condition can be thought as an important factor to make a contract in the BTO model, considering that many BTO projects are struggling with the financing problem after the government abolished the MRG regulation in 2009 (Park, 2011a).

On the other hand, the BTL model looks easier in financing, because whole demand risk is on the public sector. An interviewee pointed that if the BTL model had been used at that time, negotiation time could have been reduced (Ⓓ in section 3.1 in APPENDIX 4). He explained that a rate of profit depended on a risk of the private sector and the risk could be much lower in the BTL model. Therefore, the BTL model where the public sector has demand risk looks easier to make a contract.

With regard to management and supervision, it has little difference between both PPP models in a construction stage because both models have the same regulation on construction (KDI, 2006a). This factor is mainly related in the operation stage. The management of road in operation stage is mainly about the maintenance of the facility (KEC, 2007). The BTO model is basically simpler than the BTL in payment mechanism, so the BTO has a benefit in management and supervision in the viewpoint of the public sector. However, the management of road was relatively simple, so it was difficult to find any evidence that the BTO option is better than the BTL option for the Incheon Airport Expressway.

5.4.3 Risk management

One of the most important reasons to use the PPP is to allocate risks to the sector which can manage it better (HM Treasury, 2008). This issue is about the incentivising good risk management through the payment mechanism and contract terms. Incentivising good risk management is available to both PPP models through the conditions of contract. The difference between PPP models in risk management does not look big.

The difference between two models is which sector has a traffic demand risk (KDI, 2006a). All interviewees said that there was no incentive to the good risk management of the private sector in the Incheon Airport Expressway which used the BTO model because it had the MRG condition up to 90% (Ⓔin section 3.1 in APPENDIX 4). They argued that it was also difficult to say the BTL model was better to incentivise the good risk management, but it had more opportunities to incentivise through the performance assessment. Consequently, the difference between the BTO and the BTL model does not look big, but the BTL model can have an advantage in demand risk management for the Incheon Airport Expressway.

5.4.4 Operational flexibility

With regard to the operational flexibility, opinions of the private sector and the public sector were quite different. The interviewee from the private sector said that the private sectors would react to the change of circumstances by the public sector's request in the BTL model (Ⓕin section 3.1 in APPENDIX 4). They argued that the public sector could not be more sensitive to this kind of change than the private sector because of bureaucracy. However, an interviewee from the public sector pointed out that the private sector was only interested in the change which was beneficial to the private sector (Ⓒin section 3.1 in APPENDIX 4). For example, in this case, it looked to take longer for the private sector to introduce the electronic toll charging system than cases of public operated expressways (MLTM, 2010a). In particular, he criticised that the private sector was difficult to expect to earn more revenue than the guaranteed level in this BTO with MRG case even if they had made an effort to attract users or cut the operating cost through new technology.

Thus, the BTL seems better than the BTO in operational flexibility in the view of the public sector. However, the public sector needs to monitor the operation to give the lease fee correctly according to the conditions of payment in the BTL model (Baek, 2005). It means that more resources and time are needed to check the performance and necessity of operational change in the BTL model.

Consequently, an operational flexibility is a controversial factor between the private and the public sectors. However, the public sector has little right for the operational change in the BTO model, so the BTL model can be more attractive to the public sector.

5.5 Sensitivity analysis

Many factors in the quantitative VFM assessment such as construction cost, operation cost, and the rate of profit are possible to be changed. The VFM assessed in the previous section is based on the point estimation, so it needs to review the sensitivity of an important input factor.

The MOCT (2007a) recommended analysing the sensitivity of operation period, level of toll, traffic demand, construction cost, operation cost and subsidy from the public sector. The Level of tariff and demand are related with each other, and they can be considered at the same time by the revenue factor. However, the sensitivity was not analysed in the real case, because there was no guideline in 1995 when the contract was made.

This chapter compares the BTL with the BTO option in the Incheon Airport Expressway, but the construction cost, operation cost and profit rate is already fixed. The most differently forecasted factor with real value was the traffic demand which was a direct source of the revenue. Level of toll is difficult to change only because actual traffic demand is different with the expected, so the sensitivity of traffic to the VFM can be analysed through the analysis of revenue. Thus, this chapter examines the sensitivity of revenue. In addition, the excessive inaccuracy of traffic forecast is not only problem in this project but easily seen in many other projects, so the stochastic analysis based on accumulated inaccuracy of traffic forecast in road is undertaken.

5.5.1 Revenue

The Incheon Airport Expressway is being criticised because of much lower traffic than forecasted and excessive minimum revenue guarantee covering 90% of the expected revenue for 30 years, so the most important sensitivity analysis is about the revenue which comes from charging a toll on traffic. After the operation of the Incheon Airport Expressway, the actual traffic was around 50% of the expected. Thus, the range for the sensitivity analysis is from 50% to 90% of the expected revenue.

Table 5.4 Sensitivity of VFM to traffic in the BTO without MRG option

Unit: billion KRW (NPV)

Actual traffic	Revenue	Lease	Operation	VFM
100%	2111.3	881.0	537.0	693.4
90%	1900.2	881.0	537.0	482.2
80%	1689.1	881.0	537.0	271.1
70%	1477.9	881.0	537.0	60.0
67.2%	1418.0	881.0	537.0	0.0
60%	1266.8	881.0	537.0	-151.2
50%	1055.7	881.0	537.0	-362.3

Above table shows that if the actual traffic is over 67.2% of the contracted, the BTL option has higher quantitative VFM than the BTO without MRG option. It also means that if the actual traffic is below 67.2%, then the BTO without MRG option is better. Demand risk is on the private sector in the BTO model, which can have higher profit rate because of high risk, so if the real demand is getting lower than the expected then the BTO model can be beneficial to the government if there is no demand risk sharing with the private sector such as a MRG condition. However, this project has the MRG covering 90% of the expected revenue for 20 years from 2001[15], and the difference with 90% of the contracted revenue is compensated for by the government.

Table 5.5 Sensitivity of VFM to traffic in the BTO with MRG option

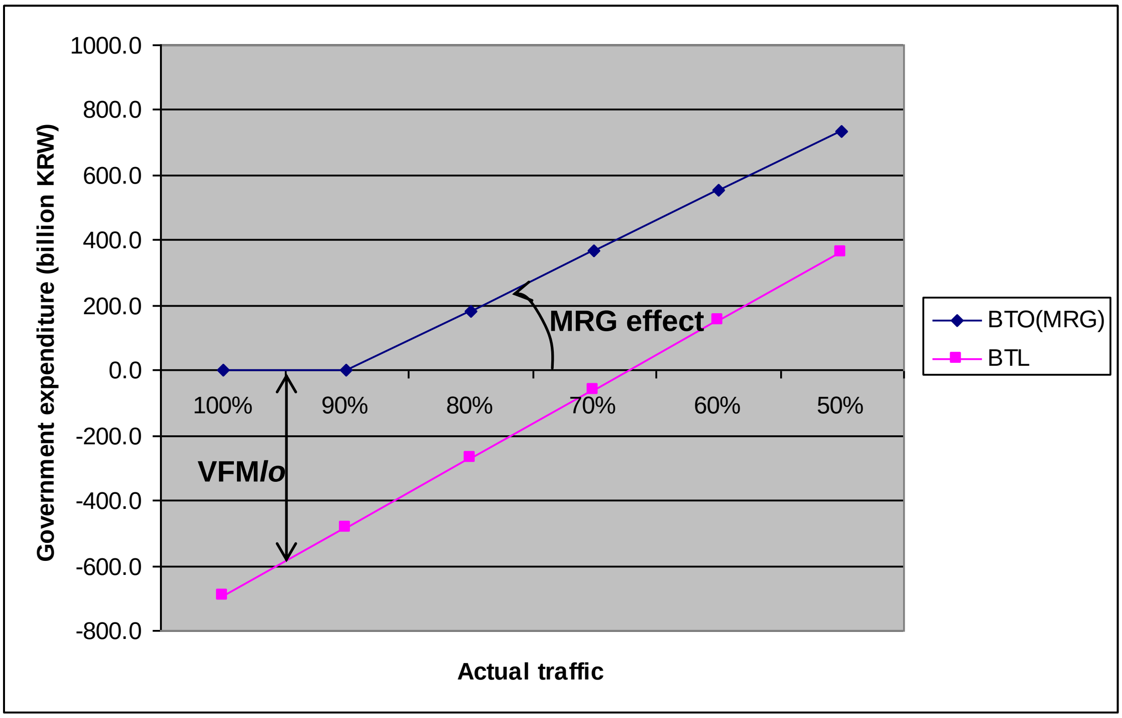
Unit: billion KRW (NPV)

Actual traffic	BTO	BTL			VFM
	Subsidy for operation	Revenue	Lease	Operation	
100%	0.0	2111.3	881.0	537.0	693.4
90%	0.0	1900.2	881.0	537.0	482.2
80%	184.4	1689.1	881.0	537.0	455.5
70%	368.7	1477.9	881.0	537.0	428.7
60%	553.1	1266.8	881.0	537.0	401.9
50%	737.5	1055.7	881.0	537.0	375.2

[15] Operation period is 30 years and the Government guaranteed revenue for the first 20 years from 2001.

Considering the MRG, the quantitative VFM can be affected if the actual revenue is different with the anticipated. As shown in Table 5.5, because of the MRG in the BTO option, the quantitative VFM of the BTL is always higher than the BTO in this case. The following graph shows the result of sensitivity analysis and the effect of the MRG.

Figure 5.3 Sensitivity analysis of the VFM to traffic



The Incheon Airport Expressway was the first BTO project under the current PPP regulation. The level of MRG provided by the government for this project was 90% for 20 years. There was no rational reason or data to decide the MRG as the 90% of expected revenue. The government had to negotiate the level of the MRG with the only one bidder, and it seems to be disadvantageous to the government under the circumstance that the exclusive way should be opened before opening the Incheon International Airport.

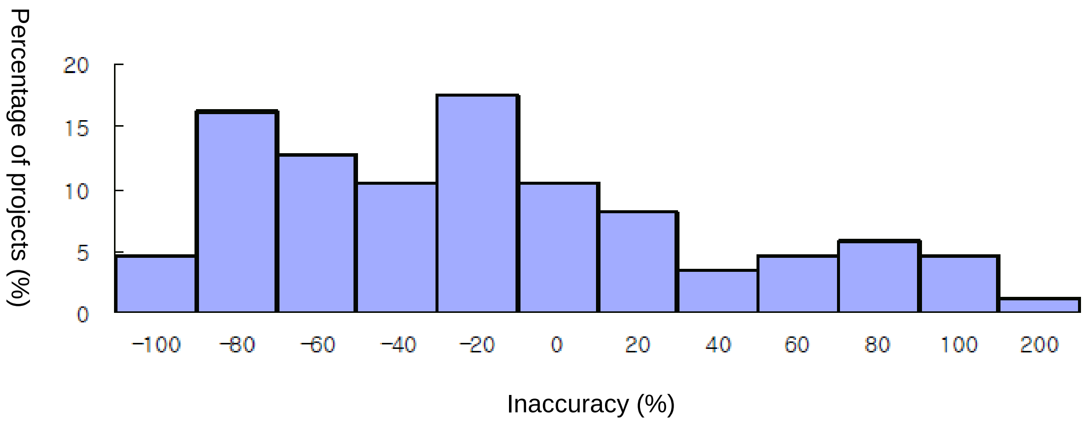
This sensitivity analysis shows that the level of MRG of the Incheon Airport Expressway BTO project was too high. The reason why the profit rate of the BTO was high was that the demand risk was on the private sector, but the government had 90% of demand risk in this case. The private sector had little risk in operation or demand because of the MRG from the government.

5.5.2 Stochastic analysis

The biggest issue in this BTO project is much lower traffic volume than forecasted and the excessive guaranteed revenue based on this traffic. It is doubted that traffic forecast was exaggerated by the private sector on purpose because of the MRG condition. According to the report of the Standard & Poor's (Bain and Polakovic, 2005), overestimated traffic could be generally seen in global toll road cases and there seems to be systematic errors in traffic forecast of toll road by the optimism bias.

Thus, this section examines a stochastic sensitivity of traffic demand based on accumulated data of traffic forecast about toll road. Kim (2007a) researched on the inaccuracy of road traffic forecast in South Korea based on 171 projects in operation since 2000. 86 projects of them are expressways with toll including PPP roads and 85 projects are arterial roads without toll. This case is an expressway with toll, so the statistics on 86 toll expressways are used. Figure 5.4 shows the probability of inaccuracy of expressway in South Korea which has been operated since 2000. The mean value is -5.32% and standard deviation is 52.61,

Figure 5.4 Inaccuracy of traffic forecast in expressway of South Korea



Cited from Kim (2007a)

Inaccuracy was calculated by the following equation.

$$I = \left(\frac{Ta - Tf}{Tf} \right) \times 100(\%)$$

Here, I is the inaccuracy of traffic forecast, *Ta* is an actual traffic, *Tf* is a forecasted traffic

As explained in the methodology chapter, the Monte Carlo simulation was done for the stochastic analysis with the Microsoft Excel and the iteration was undertaken 10,000 times. This project was done by the BTO with MRG model, so the result of stochastic analysis can be changed by the MRG condition.

In the case of comparison with the BTO with MRG option, the mean value of VFM is ₩593.6 billion and standard deviation is ₩672.3 billion. Guaranteed revenue by the government is 90% of the expected for 20 years, and the private sector has to return an additional profit to the government when the traffic is over 110% instead of guaranteed revenue below 90% of the expected.

Figure 5.5 VFM by the probability of traffic forecast in the BTO with MRG option

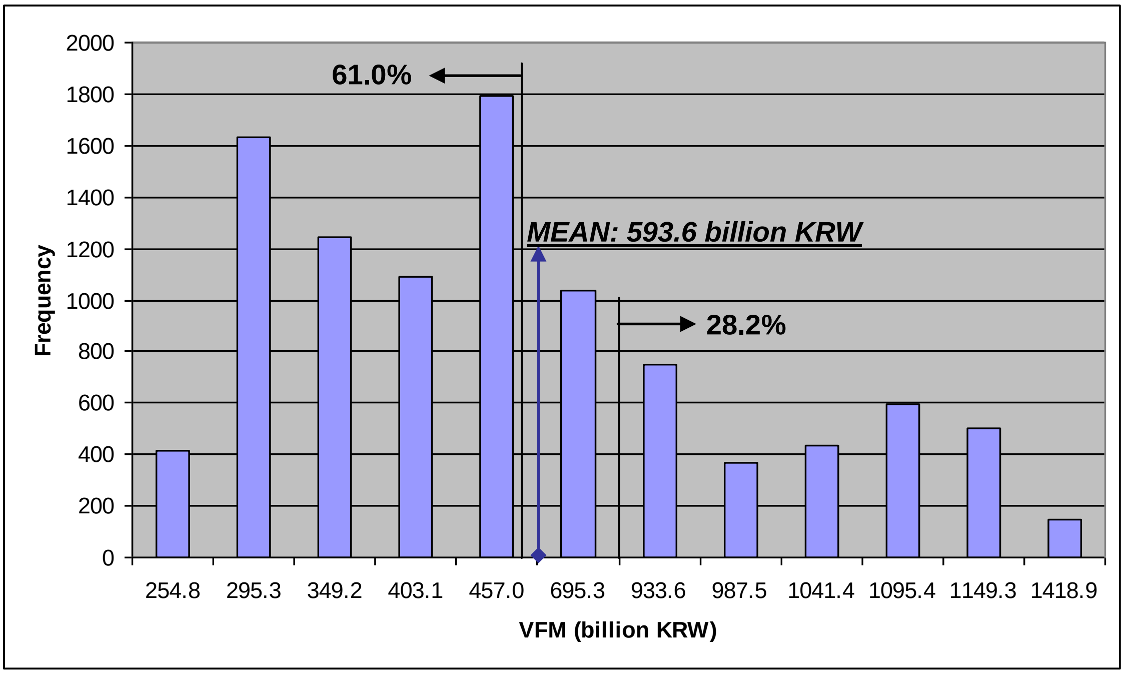


Figure 5.5 shows that the BTL case always provides better VFM than the BTO with 90% of MRG case. The probability the government pays the revenue subsidy by the MRG is 61.0%, and the probability the government be paid back by the profit is 28.2%. It means that sharing traffic demand risk was inappropriate. In real contract, the government guaranteed 90% of the expected revenue instead had a right to get the revenue over 110% of the expected. Considering traffic forecast risk, the level of guaranteed revenue should have been lowered.

In the case of the BTO without a MRG condition, the mean value of VFM is ₩379.2 billion and the standard deviation is ₩1,245.2 billion. Considering the average probability of traffic forecast of expressway in South Korea, this project can have more VFM in the BTL option than the BTO option.

Figure 5.6 VFM by the probability of traffic forecast in the BTO without MRG

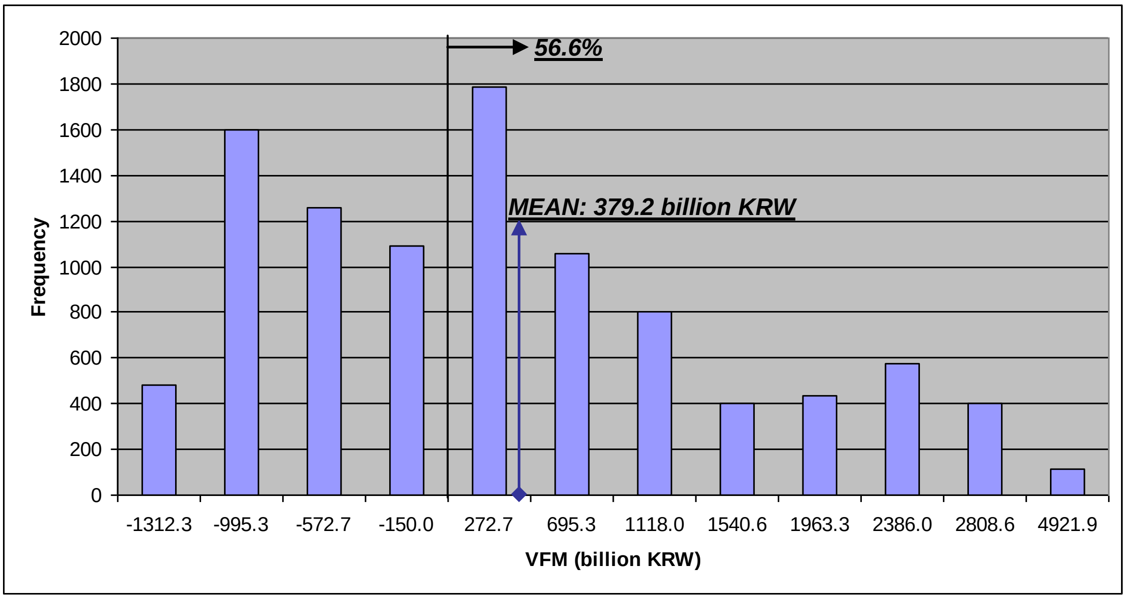


Figure 5.6 shows that the probability that the optimal PPP becomes the BTL model is 56.6%. Even if there had been no MRG condition in the Incheon Airport Expressway, the probability that the BTL model would be better might be higher. Thus, even in the case of considering the uncertainty of traffic forecast, the BTL model is advantageous for Incheon Airport Expressway.

However, the probability of inaccuracy of traffic forecast in road cannot explain a specific case. The average actual traffic for 8 years from 2001 in the Incheon Airport Expressway was around 47% of the forecasted. As seen in the section 5.5.1, the BTO without MRG model can be better for this project if the actual traffic is lower than the 67.2% of the forecasted. This result shows that the quantitative VFM which has been used as a decisive tool for the PPP seems not enough to cope with the uncertainty of input factors. Therefore, it needs to deal with the qualitative VFM assessment more importantly than suggested in the current VFM assessment guidance of South Korea, though the BTL option is still quantitatively better for the Incheon Airport Expressway if the MRG condition applies to the BTO option.

5.6 Findings

Through the quantitative and qualitative VFM assessment and the sensitivity analysis about the BTO and BTL option for the Incheon Airport Expressway case, six characteristics were found.

Firstly, the BTL option for the Incheon Airport Expressway can provide better quantitative VFM than the BTO option. In this case, the BTL option gives better VFM compared with the BTO by ₩693.4 billion. It is because the demand risk is on the public sector in the BTL model of Korea, so the rate of profit in the BTL option is lower than that of the BTO option where the private sector has the traffic demand risk. The government pays a lease fee to the private sector but can charge toll to end users, so the government can make a profit in the BTL option. It is a different result with common guess that the financial burden of BTL model is likely to be bigger than the BTO model because the public sector compensates for whole investment and profit of the private sector in the BTL model while the public sector burdens partly in the BTO model even in the case with the MRG condition. In the BTL model for toll road, the government pays a lease fee to the private sector but can charge a toll to the end user, so the government can have an opportunity to make a profit.

Secondly, the BTL option can be better than the BTO option to improve the quality of service. Generally, the BTO was thought to have a benefit to improve the service quality, because the private sector is usually affected by the end users more in the BTO model than in the BTL model. However, the Incheon Airport Expressway was in monopoly for the first 7 years and revenue was guaranteed by 90% of the forecasted, so the private sector seems less sensitive to the end user. In the BTL option, the government can impose a condition for improving service to the public sector through the payment mechanism.

Thirdly, the BTL option seems to be attractive to the public sector than the BTO option in the operational flexibility to cope with the change of future circumstances. According the interviews of the PPP experts in South Korea, the private sector, which is the operator of the Incheon Airport Expressway, is more sensitive to the sector which pays to them. In the BTO option with MRG, there were few incentives for the private sector to react to the change of circumstances. However, the public sector can have more rights to discuss the unexpected operational issues through the performance assessment in the BTL option.

Fourthly, the BTL option can be better for the public sector to incentivise a good risk management of the private sector in operation. The private sector is compensated for only by the end users in the BTO option, so it looks harder to incentivise risk management which is not related with the direct revenue. On the other hand, the public sector can incentivise operational risks which are directly related with the revenue through the performance assessment in the BTL option.

Fifthly, the level of MRG in this case does not look appropriate. The BTO option without MRG can provide better VFM than the BTL option when the actual traffic is lower than 67.2% of the forecasted. However, this project guaranteed 90% of the expected revenue for 20 years, and it is around 87.3% of the revenue (NPV) for 30 years. As a result, the BTL option was analysed as it was always better than the BTO option with MRG of 90%. Thus, the level of MRG should have been lower than 67.2% of the expected revenue to use the strength of the BTO model where the private sector has traffic demand risk.

Lastly, despite of the uncertainty of traffic demand risk, the probability that the BTL option is better in this project is higher. In the BTO case, the private sector has whole traffic demand risk, so the public sector has a benefit when the traffic demand risk is high. Especially, recent criticisms on the PPP are mainly about the exaggerated traffic demand and excessively guaranteed revenue, so the BTO option without MRG seems to be regarded as the best option to the public sector. However, the mean value of inaccuracy of traffic forecast in expressway in South Korea is only -5.32%. It shows that traffic forecast in road in South Korea is relatively accurate when it is compared with rail cases. Thus, the probability that the BTL option is better than the BTO option is higher even in the case without MRG condition.

Consequently, the BTO model for the Incheon Airport Expressway does not look the optimal choice. The level of the MRG was too high, so it made it difficult to use the competitiveness of the private sector in the BTO model.

CHAPTER 6

Case study in the Oksan-Ochang Expressway

6.1 Introduction

The Oksan-Ochang Expressway is an unsolicited BTO project suggested by the private sector. The original suggestion was rejected by the MLTM because of the lack of VFM which was compared with the PSC, but the modified suggestion was accepted after all. This chapter examines whether the BTL could be the better PPP option than the BTO model through the quantitative and qualitative VFM assessment and the sensitivity analysis. Also, it explores why the PPP was rejected at first and how it was accepted in the final.

This project is still in negotiation between the private and public sector. According to the interviews of the PPP experts of South Korea in November, 2010, the most important obstacle is the financing plan, because the government does not consider the MRG condition in this project. This project was supposed to be built by the government direct investment, but the private sector proposed the BTO, so the government does not seem to guarantee minimum revenue to the private sector. Especially, the MRG regulation to an unsolicited project was abolished in 2006. Seven years have passed since this project was proposed for the BTO by the private sector, so an interviewee criticised that it could have been better for the public sector to do the project.

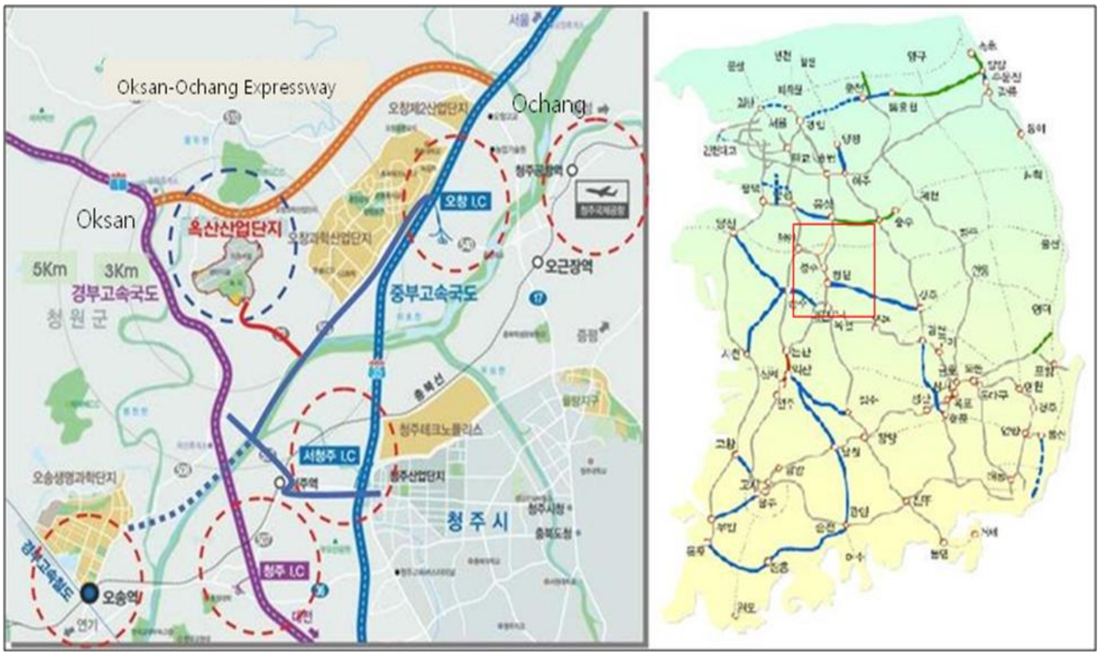
This chapter mainly focuses on the comparison of the BTO model with BTL model but also explores the PSC. Other cases in this thesis were already decided to choose the PPP instead of the PSC, so it does not need to compare with the PSC. However, the first proposal of the private sector was refused, so the better PPP model based on this proposal needs to be compared with the PSC to examine whether the PPP is better than the PSC.

6.2 Summary of the project

6.2.1 Details of the project

The Oksan-Ochang Expressway is a part of National Expressway network to connect Cheonan, Asan, and Cheongju area. It aims to invigorate the Cheongju International Airport and to improve the accessibility to near national industrial complexes such as Osong, Ochang, etc. It has a total length of 13.5km and four lanes. The initial plan was to launch the construction in 2006, but it was delayed. Though it is still in negotiation, but this case study is for comparing the different PPP models in a planning stage. Thus, details of project follow the VFM assessment report on the proposal from the private sector. According to the VFM report of KDI (2007b), the construction is done from January 2008 to end of 2012 and the operation starts from 2013. Total building cost for a facility is estimated as ₩225.9 billion in a design level[16].

Figure 6.1 The Oksan-Ochang Expressway line map



Source: MLTM

[16] Actual investment can be discounted by bidding, so the cost for the VFM assessment is different with the cost in a design stage. More details are explained in section 6.2.2 History of the project as a PPP

6.2.2 History of the project as a PPP

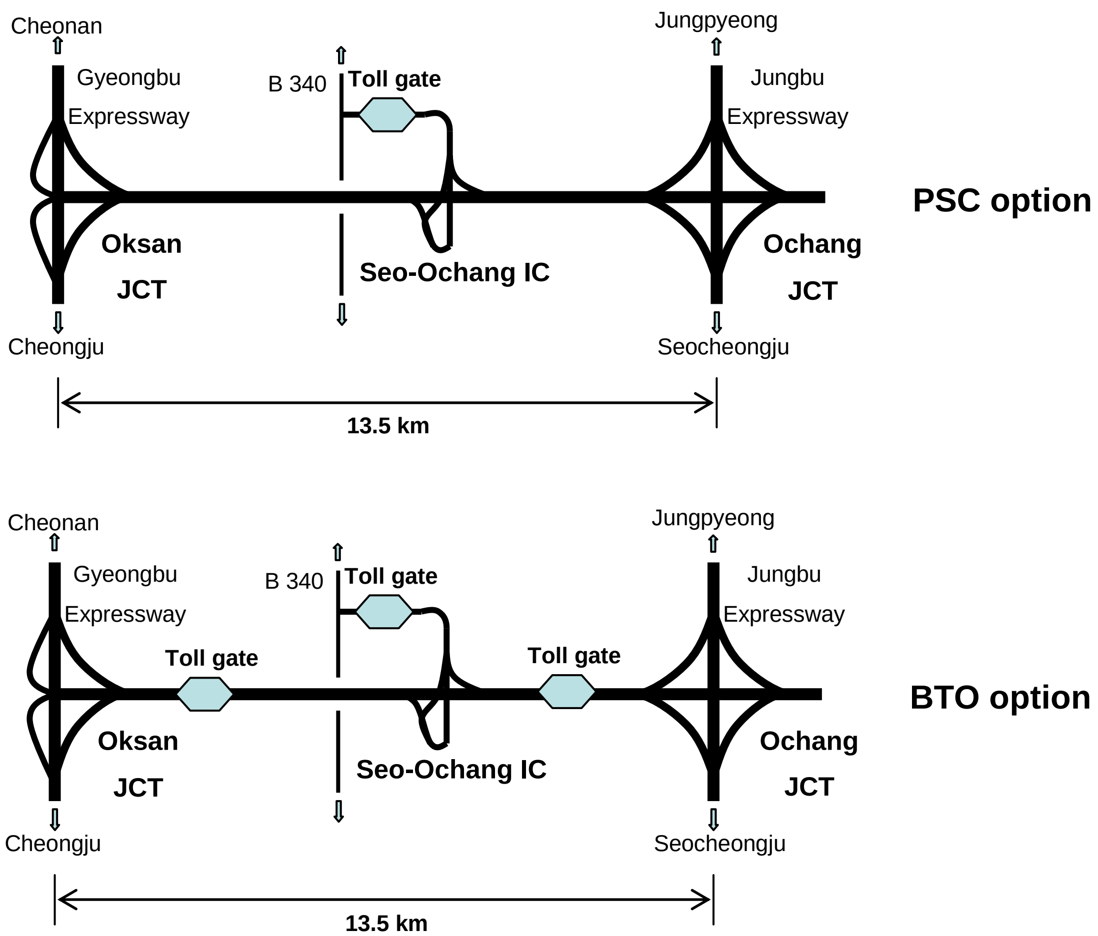
This expressway was originally planned as a government direct investment project to connect Cheonan with Ochang. It has four lanes and the length is 25.0 km. According to the pre-feasibility test of this project (KDI, 2003), it was thought to be inappropriate to use the PPP because it needed an excessive construction subsidy reaching 77% of total construction cost. Based on the result of the pre-feasibility test of KDI, the MLTM did a feasibility test and was making a master plan to construct from 2008 to 2013 by the government direct investment.

However, the private sector proposed the BTO with an alternative route which was shorter than the plan of the government. They changed the origin from Cheonan to Oksan, so the distance became 13.5 km which was shorter than the government original plan by 11.5 km. The MRG regulation for the unsolicited project has been abolished since 2006, so the MRG condition was not considered. Instead, the private sector requested a government subsidy up to 24.4%[17] of cost for the facility part. Real rate of profit suggested was 9.23% and nominal rate was 14.7%. Operation period was from 2013 to 2042 for 30 years (KDI, 2007b).

KDI on behalf of the government concluded that the VFM of the BTO was ₩-12.6 billion. The LCC of the PSC option was ₩60.0 billion and the LCC of the BTO option was ₩72.6 billion. It meant that the PSC was better than the BTO proposed by the private sector. Thus, the proposed BTO plan was assessed as inappropriate (ibid). The main reason seemed that the operation cost and the rate of profit for the private sector were too high. The operation cost in the BTO option was ₩89.1 billion, but it was only ₩44.7 billion in the PSC option. This road connected to two current expressways which were operated by the public sector, so the private sector had to plan two more toll gates on main road for charging, though it did not need them in case that the public sector constructed and operated. It cost almost twice as the PSC option in operation (See Figure 6.2).

[17] The private sector requested 30% at first, but later it was reduced to 24.4%.

Figure 6.2 Toll gates in the PSC and the BTO option



The real profit rate which the private sector requested was 9.23%. It was thought quite high at that time, because competition in the PPP was getting high and the financial market was invigorated with project finances. To guarantee this profit rate, the government subsidy was highly needed when it was compared with similar projects at that time.

Table 6.1 Profit rate of expressway BTO projects proposed in the mid of 2000s

Rate of profit	Oksan-Ochang	Siheung-Pyeongtaek	Anyang-Seongnam	Incheon-Gimpo
Real	9.23%	6.11%	6.41%	5.70%

Source: KDI

KDI proposed the BTO would be possible if the rate of profit were decreased to around 6.07%. The private sector accepted the offer of the government and has been in negotiation with the MLTM for making a contract.

6.2.3 The appraisal of the project as a PPP

This project is still in negotiation between the government and the private sector, so there are few studies about this case. However, several problems were found through the literature review and the PPP expert interviews which were done in November, 2010 in South Korea.

First, this project has been heavily delayed. One of the purposes of choosing PPP instead of government direct investment is to acquire infrastructure early (Tvarno, 2010). The government plan was to start construction in 2008, but after deciding to use the BTO, even the negotiation has not been agreed yet. An interviewee who works for the private sector said that the biggest problem was difficult to find a financial investor for a project without the MRG under the current circumstances that the uncertainty of global economy was getting high. Another interviewee from the public sector also commented on this project that he was quite sceptical about the prospect of this PPP contract. Thus, it does not look easy to expect to get an agreement and make a contract soon.

Second, the proposed level of toll was too high. It is related with the high profit rate, but KDI (2007b) recommended cut the government subsidy by decreasing the profit rate. Although it was pointed out that proposed toll was more than twice as the PSC (PPP option: ₩1,003 / PSC option: ₩494), but there was no recommendation or discussion on an appropriate toll level.

Third, additional toll gates in a short distance in case of the BTO model can make people uncomfortable and make additional delays for payment, though it was inevitable in the BTO case to charge end users. However, it can evoke a protest from road users and make the absurdness of the toll price clearly shown as seen in other BTO roads (Kim, 2010c, Carpintero, 2010).

Consequently, the negotiation between the private and public sectors for an agreement is still proceeding, but it seems that considerations for end users are missing in this project. There seems no excuse and no alternative plan for delay. Discussed toll price looks too high and many toll gates may be inconvenient. An interviewee from the public sector agreed that the government could be seen as irresponsible for this project.

6.3 Quantitative VFM assessment

6.3.1 Basic assumption

The year for calculating life cycle cost is 2004 which was the base year in the first proposal of the private sector. Korean VFM guidance for the BTO model (KDI, 2007a) recommends using 6% (real) based on the Weighted Average Capital Cost (WACC) method. This project was assessed in 2007, and it followed basic procedure of the BTO VFM guidance, so this chapter uses 6.0% as a real financial discount rate. The inflation is assumed as 5.0% same with the VFM assessment report for the proposal.

A rate of profit of the BTO case is proposed as 9.23% in real and 14.7% in nominal by the private sector, so the same value is used in this chapter. In case of the BTL, the MLTM recommends adding a mark-up rate for the long term investment in the five-year Korea national bond, which can be a base interest. The MLTM suggested 0.77% as an appropriate mark-up rate in a recent railway BTL project (MOCT, 2007c). In addition, there are two more BTL cases of rail in Korea, and mark-up rates are suggested as 0.76% and 0.70%, so the highest 0.77 will be used in the BTL model of the Oksan-Ochang Expressway project as a common mark-up rate under Korean financial and construction circumstances (MOCT, 2007c). In 2007 when the VFM was assessed, the mean value of interest of five-year Korea national bond was 5.28%, so the appropriate rate of profit in this case analysis is used as 6.05% in nominal (real rate: 1%) .

6.3.2 Construction subsidy

There is no construction subsidy from the public sector in the BTL model. Though land acquisition cost is provided by the government, the difference between the BTL and the BTO case is only ₩0.3 billion. It is a very small size compared with other costs, so land acquisition cost is not considered in this case study like other cases.

In the case of the BTO, the construction subsidy is finally decided through the negotiation. Requested construction subsidy by the private sector in this case for the BTO option is ₩45.0 billion (real price, nominal price is ₩61.7 billion) which is 24.4% of total building cost for facility part. However, KDI (2007b) assessed that government subsidy would be ₩117.4 billion (real price)[18] to accept the real rate of profit as 9.23%. Though the private sector requested only ₩45.0 billion, but KDI regarded their request as based on the overestimated traffic demand, because they also wanted the MRG when the project was suggested in 2004. It pointed out that more subsidies would be needed if real traffic is lower than what the private sector forecasted. Forecasted traffic demand by the private sector was overestimated up to 91.3% more than that of KDI as shown in the Table 6.2.

Table 6.2 Traffic forecast at the proposed toll level

(Unit: car/day)

Year	2013	2016	2021	2026	2031
Proposal (A)	32,343	39,440	49,732	53,872	58,012
KDI (B)	16,996	20,612	33,665	36,302	38,780
(A-B)/B %	90.3%	91.3%	47.7%	48.4%	49.6%

Source: KDI

This chapter basically follows the result of VFM assessment of KDI, so ₩117.4 billion is used for construction subsidy in the BTO model. Construction subsidy from the government is financed through the 5-year national bond of Korea and it is assumed as 4.9% in the KDI report. Thus, government expenditure is ₩116.9 billion. The reason why the government expenditure is less than the construction subsidy is due to the highly assumed inflation. KDI used the inflation 5% as proposed by the private sector, but it looks inappropriate as can be seen in this case. When inflation is 5%, it is not possible to finance through only 4.9% of national bond. However, this study focuses on comparing the BTL with the BTO model with the same condition which was used in the VFM assessment by the public sector. This project was assessed as better to be done by the PSC than the BTO, so it needs to examine the BTL case with the same condition. Therefore, this chapter uses the same values with those of the KDI assessment.

[18] Land acquisition cost (29 billion KRW in the BTO model) is excluded to this subsidy.

6.3.3 Lease fee

Lease fee is calculated by the following formula as explained in chapter 5;

$$Aunnal\ lease\ fee = \frac{Building\ \cos t - the\ present\ value\ of\ the\ additional\ incomes}{PVIFA(n,k)}$$

Here, PVIFA is the present value index for annual lease fee and the N, which is the operation period of this project, is 30 years. The k means the rate of profit, so the k value in this case is 6.05%. Consequently, the PVIFA (30, 6.05%) is 13.6915.

$$PVIFA(30,6.05\%) = \sum_{t=1}^{30} \frac{1}{(1+0.0605)^t} = 13.6915$$

Lease fee is calculated based on the building cost of the private sector in the BTL model. In this case, the design is different in the BTO and the BTL model, because two toll gates in main road do not need in the BTL model. Thus, construction and land acquisition cost are different in both PPP models.

Table 6.3 shows the building costs of the BTO and the BTL case. The building cost of the BTL case was assumed same with the BTO model except construction cost and land acquisition cost. Land acquisition cost is paid by the government, so this is omitted in the lease fee calculation.

Table 6.3 Building cost in the BTO, and the BTL case

(Unit: billion KRW, nominal price)

			BTO	BTL
Building Cost	**Total**		**213.8**	**206.8**
	Facility Part	1) Construction & Design - surveying - design - construction	160.1 0.5 3.2 156.4	153.1 0.5 3.2 149.4
		2) Land acquisition	-	-
		3) Utility	9.9	9.9
		4) Operating reserve	5.2	5.2
		5) Other cost	9.2	9.2
	Financial Part	6) Tax and financial cost	29.4	29.4

* Data of the BTO case were cited from the VFM assessment report of KDI (2007).

There is no additional income in this case, so the annual lease fee from 2013 to 2042 for 30 years is ₩15.1 billion per year and total lease fee is ₩453 billion in nominal (₩157.1 billion in real price).

6.3.4 Operating cost

Operating cost is different in the BTO and the BTL model, because the two toll gates on the main road in the BTO model need more cost to operate. KDI (2007b) suggested two alternatives to the private sector. The first one is to decrease the profit rate and the second is the option not to set up two toll gates on main road in addition to the first alternative. In case of the second option, toll fee can be paid by the public sector operator of connecting expressways, though it should be negotiated for counting traffic and payment method. Thus, the operation cost of the BTL model is assumed the same with this second option of KDI.

According to the VFM assessment of KDI (ibid), operating cost for 30 years in the BTO model is ₩138.1 billion (real price), and that of the second alternative without two toll gates is ₩111.3 billion. This chapter uses the operating cost of the second alternative as the operating cost of the BTL model.

6.3.5 Revenue

Revenue is decided by the toll level and traffic demand and they are much related with each other. In other cases of this thesis, revenues in the BTL model are assumed the same as in the BTO model, because the toll level is a very political issue, so this factor would be better to be dealt with in a more qualitative way. However, this case is a part of an expressway network operated by the public sector, so it can be difficult to increase the toll level in the BTL model differently from the PSC. Thus, this case uses the same level of toll with the public sector expressway operator.

According to the VFM assessment report for the BTO proposal (KDI, 2007b), average toll price for 13.5 km of whole section from Oksan to Ochang was ₩494 for a car in the PSC. It was almost half of the BTO proposal which was ₩1,003. Based on the traffic forecast of KDI, traffic of the BTO was forecasted less than the PSC by up to 14.3%. Total revenue for 30 years was ₩303.3 billion in the PSC, so the revenue in the BTL model uses the same value as the PSC of the KDI assessment.

Table 6.4 Traffic forecast considering toll price in the BTO and PSC

(Unit: car/day)

Year	2013	2016	2021	2026	2031
BTO (A)	16,996	20,612	33,665	36,302	38,780
PSC (B)	19,835	24,005	36,370	38,728	41,299
(A-B)/B %	-14.3%	-14.1%	-7.4%	-6.3%	-6.1%

Source: KDI

6.3.6 Summary of the analysis factors

- Building cost (nominal) : BTO: ₩213.8 billion, BTL: ₩206.8 billion
- Operating cost (real) : BTO: ₩138.1 billion, BTL: ₩111.3 billion
- Operation period: 30 years (2013~2042)
- Construction subsidy (BTO model only): ₩117.4 billion (real)
  *Government expenditure: ₩116.9 (real)
- Annual lease fee: ₩15.1 billion (nominal)
  * Lease fee for 30 years: ₩453 billion (nominal) / ₩157.1 billion (real)
- Rate of profit
  Nominal: 6.05% in the BTL, 14.7%[19] in the BTO
  Real: 1.0% in the BTL, 9.23% in the BTO
- Real financial discount rate: 6.0%
- Inflation: 5.0%
- Revenue: ₩303.3 billion (real)

6.3.7 Result

The quantitative VFM of the BTL model compared with the BTO model in the Oksan-Ochang Expressway project is ₩56.6 billion. It means that the BTL model provides more value for money than the BTO model in this project. It looks a natural result like other cases, because the profit rate of the BTL model

[19] Rate of profit in the BTO model means the financial internal rate of return.

is much lower than the BTO model. As seen in the following table, revenue collected from passengers is ₩303.3 billion and it is greater than the sum of lease fee and operating cost. It means that the government has to pay construction subsidy in the BTO model, but the government can make a profit with revenue after providing lease fee and operating cost in the BTL model.

Table 6.5 Quantitative VFM assessment in the Oksan-Ochang Expressway

Unit: billion KRW (real price)

Year	BTO	BTL			VFM	
	Subsidy (Gov. Exp.)	Lease fee	Operating cost	Revenue	Real price	NPV
SUM	116.9	157.1	111.4	303.3	151.7	56.6
2008					0.0	0.0
2009	0.1				0.1	0.1
2010	0.5				0.5	0.3
2011	2.2				2.2	1.5
2012	4.1				4.1	2.6
2013	6.7	9.7	2.8	6.0	0.2	0.1
2014	11.2	9.3	3.0	6.5	5.4	3.0
2015	34.3	8.8	2.9	7.0	29.6	15.6
2016	35.7	8.4	3.1	7.4	31.6	15.7
2017	22.1	8.0	3.1	7.9	18.9	8.9
2018		7.6	3.1	8.4	-2.3	-1.0
2019		7.3	2.9	8.8	-1.4	-0.6
2020		6.9	3.6	9.3	-1.2	-0.5
2021		6.6	3.3	9.8	-0.1	0.0
2022		6.3	5.5	9.9	-1.9	-0.7
2023		6.0	3.4	10.1	0.7	0.2
2024		5.7	3.4	10.3	1.2	0.4
2025		5.4	3.2	10.5	1.9	0.6
2026		5.2	3.4	10.6	2.0	0.6
2027		4.9	5.1	10.8	0.8	0.2
2028		4.7	3.6	10.9	2.6	0.6
2029		4.5	3.4	11.1	3.2	0.8

2030		4.2	3.6	11.2	3.4	0.7
2031		4.0	3.5	11.4	3.9	0.8
2032		3.9	6.6	11.4	0.9	0.2
2033		3.7	3.3	11.4	4.4	0.8
2034		3.5	3.3	11.4	4.6	0.8
2035		3.3	3.1	11.4	5.0	0.8
2036		3.2	3.8	11.4	4.4	0.7
2037		3.0	4.4	11.4	4.0	0.6
2038		2.9	3.4	11.4	5.1	0.7
2039		2.7	3.6	11.4	5.1	0.7
2040		2.6	3.1	11.4	5.7	0.7
2041		2.5	3.7	11.4	5.2	0.6
2042		2.4	7.2	11.4	1.8	0.2

Comparing LCC (Life Cycle Cost) of the BTL model with the PSC, the BTL model also gives better VFM than the PSC. The NPV of LCC in the PSC is ₩37.9 billion. KDI suggested two other alternative BTO options with much lower profit rate, but the BTL is also better than both options as seen in the following table.

Table 6.6 VFM of various PPP options compared with the PSC

Unit: billion KRW (NPV)

	PSC	BTL	BTO	BTO$_1$	BTO$_2$
LCC	37.9	4.3	60.9	27.0	20.9
VFM(with PSC)	-	33.6	-23.0	10.9	17.0

* LCCs of PSC, BTO$_1$, and BTO$_2$ are cited from the VFM assessment report (KDI, 2007b). Land acquisition cost was excluded in all cases. BTO$_1$ is an alternative with 6.07 of real rate of profit. BTO$_2$ is an alternative BTO option without two main road toll gates in addition to BTO$_1$ option.

6.4 Qualitative VFM assessment

This section examines four issues; service quality, contract & management, risk management, and operational flexibility.

6.4.1 Service quality

Most interviewees agreed that there would be little difference between the BTL and the BTO model in the quality of service (Ⓐin section 3.3 in APPENDIX 4). They argued that most factors in service quality such as speed, physical condition, diver etiquette, etc. seemed to be decided not by the effort of the private sector but by the geographic route, a standard of the government, and transport culture. Especially, the Oksan-Ochang expressway is a part of national expressway network, so it needs to balance service quality with other networks. Though the private sector makes a profit through charging a toll in the BTO option, but the service quality except level of toll looks to affect little for the end users to choose the PPP road. An officer of BAI (Board of Audit and Inspection) also pointed out that the Oksan-Ochang Expressway was not expected to be congested at first as newly constructed road which was designed for decades later, so people would be more interested in toll price (Ⓑ in section 3.3 in APPENDIX 4). The toll price could be lower in the BTL model where the government could decide the toll level without negotiation with the private sector. Thus, considering the difference between the BTL and the BTO model in the service quality is little, the BTL model could be better to the end users in toll wise.

6.4.2 Contract and Management

This issue is about the ability and experience of the public and private sectors for supervising and managing the PPP project. The BTO case in this project does not have a MRG condition and traffic demand risk is fully on the private sector. Thus, most interviewees consented that choosing the BTL model would be helpful to finance and make a contract (© in section 3.3 in APPENDIX 4).

With regard to the management, it was also difficult to find any evidence that the BTO option is better than the BTL option. Though the BTO case needs more toll charging facilities, but this factor already considered quantitatively, so there would be little difference in management in both PPP models.

6.4.3 Risk management

In the BTO option, the private sector can be incentivised only through attracting more traffic (KDI, 2007b). An interviewee argued the traffic demand in road was much affected not by the effort of an operator but by the route of road which was decided by the government (Ⓓin section 3.3 in APPENDIX 4). Thus, he alleged that it could not be possible to incentivise good risk management except traffic demand risk in the BTO model. In the BTL option, it can be incentivised in good risk management through the performance assessment linked to the government payment (KDI and MOPB, 2005). Especially, this project is a short section of national expressway network, so the change of traffic demand is expected relatively low when it is compared with other long distance roads. It means that the charging a toll can be hard to incentivise good risk management and it can affect the BTO model negatively.

Consequently, the difference between the BTO and the BTL model does not look big, but the BTL model can have more advantage in risk management.

6.4.4 Operational flexibility

As seen in the case of the Incheon Airport Expressway, opinions of the private sector and the public sector were different. Interviewees from the private sector said the BTO model would be better to cope with the change of circumstances in an operation stage (Ⓔin section 3.3 in APPENDIX 4). Interviewees from the public sector argued that the private sector would not be interested in the circumstance change if it was not related with a profit. Thus, they said that the BTL model could be better in the operational flexibility (Ⓕin section 3.3 in APPENDIX 4). Like other PPP cases, an operational flexibility is a controversial factor between the private and the public sectors. However, the BTL model can be more attractive to the public sector.

6.5 Sensitivity analysis

Considering variable input factors in the VFM assessment, sensitivities of these factors need to be analysed. Especially, this project is being delayed, so the possibility that assumed factors can be changed or upgraded is rising. It means better PPP model can be changed by this uncertainty.

The MOCT (2007a) recommended analysing the sensitivity of operation period, level of toll, traffic demand, construction cost, operation cost and subsidy from the public sector. Toll and traffic demand are related with each other, and it can be considered at a same time with revenue factor. Though inflation is not a factor recommended by the MLTM, but it needs to be reviewed, because the proposed inflation is too high compared with the 5-year national bond of South Korea. Evaluation on the current VFM assessment of KDI is not an objective of this study, but the sensitivity of inflation needs to be analysed for comparing the BTL and the BTO models. Thus, this section examines the sensitivity of inflation in addition to the recommendation of the MLTM.

6.5.1 Revenue

This project is a toll road, so revenue is decided through toll charge on traffic. The MOCT (2007a) suggested the sensitivity analysis of toll level instead of analysing sensitivity of traffic demand, because they are integrated to the revenue and the same effect can be acquired even when one of both is analysed. However, toll price was assumed same with that of public sector operator in the BTL case, so uncertainty of toll is relatively low. Thus, revenue is mainly affected by the traffic demand.

Table 6.7 Sensitivity of VFM to traffic

Unit: billion KRW (NPV)

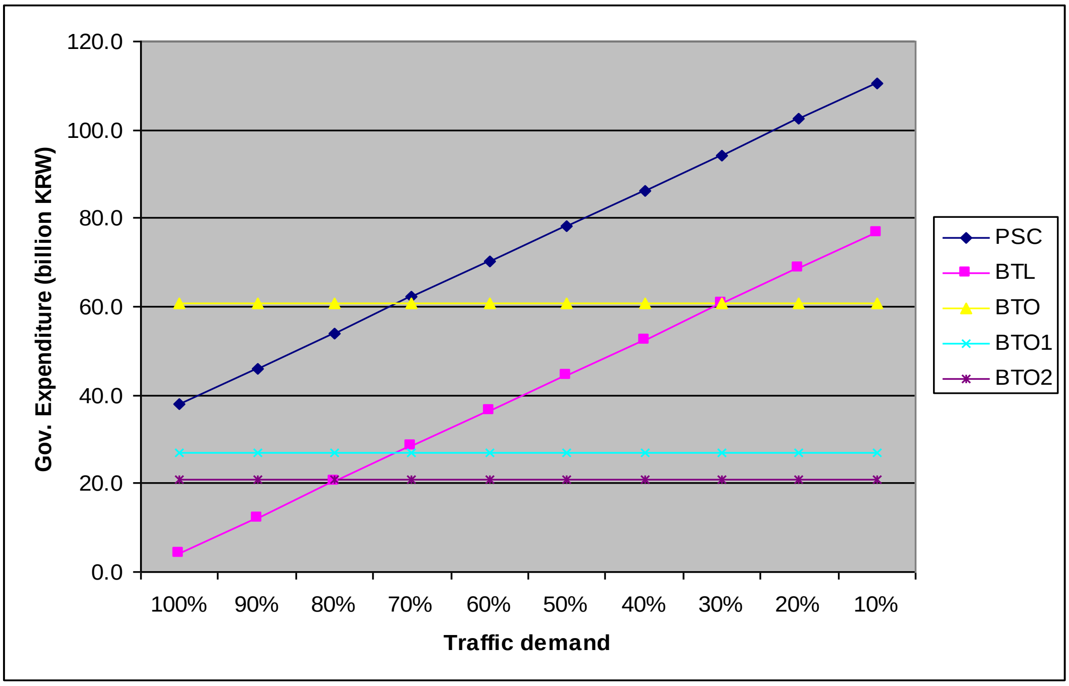
Traffic demand	BTO	BTL			VFM*lo*
	Subsidy (Gov. Exp.)	Lease	Operation	Revenue	
100%	60.9	54.5	30.4	80.6	56.6
90%	60.9	54.5	30.4	72.5	48.6
80%	60.9	54.5	30.4	64.4	40.5

70%	60.9	54.5	30.4	56.4	32.4
60%	60.9	54.5	30.4	48.3	24.4
50%	60.9	54.5	30.4	40.3	16.3
40%	60.9	54.5	30.4	32.2	8.3
30%	60.9	54.5	30.4	24.2	0.2
29.7%	60.9	54.5	30.4	23.9	0.0
20%	60.9	54.5	30.4	16.1	-7.8
10%	60.9	54.5	30.4	8.1	-15.9

Above table shows that if actual traffic demand is over 29.7% of the forecasted then the BTL model has higher quantitative VFM than the BTO. It also means that if traffic demand is below 29.7%, then the BTO is better. Demand risk is on the private sector in the BTO model, which can have higher profit rate because of high risk, so if the actual demand is lower than the anticipated then the BTO model can be beneficial to the government.

As explained in the quantitative assessment section, the original BTO proposal did not provide the better VFM than the PSC, so the alternative BTO option suggested by KDI is in negotiation. Thus, Figure 6.3 shows the result of sensitivity analysis of revenue to the LCC of each option.

Figure 6.3 Sensitivity analysis of the revenue (traffic demand)



This sensitivity analysis shows that the BTL is the best option for the Oksan-Ochang Expressway project if traffic forecast is accurate. Considering the uncertainty of traffic demand, alternative BTO_1 option which was suggested by KDI and is in negotiation can be better if actual traffic is below 72%.

The biggest problem of this project is difficult financing due to high demand risk on the private sector, and the contract prospect still looks gloomy. If it is delayed longer, the government may have to choose whether to abandon the current BTO model or to share demand risk by a method such as a MRG. In case of sharing demand risks, above result shows that the MRG should not exceeded to more than 72% of expected revenue.

6.5.2 Construction cost

This project is in negotiation, so the construction cost can be changed afterwards. Thus, it needs to analyse the sensitivity of construction cost. The MOCT recommends doing the sensitivity analysis of construction cost with the range from ±5% to ±15%. Construction cost also affects other costs such as design cost, financial cost, etc., so building cost including these costs is analysed in this case study.

The following table shows the NPVs of each VFM factors.

Table 6.8 Sensitivity of VFM to construction cost

Unit: billion KRW (NPV)

Construction cost	BTO	BTL			VFM*lo*
	Subsidy (Gov. Exp.)	Lease fee	Operating cost	Revenue	
-15%	44.2	46.3	30.4	80.6	48.1
-10%	49.8	49.0	30.4	80.6	51.0
-5%	55.3	51.7	30.4	80.6	53.8
0%	60.9	54.5	30.4	80.6	56.6
5%	66.4	57.2	30.4	80.6	59.4
10%	72.0	59.9	30.4	80.6	62.3
15%	77.5	62.6	30.4	80.6	65.1

6.5.3 Operating cost

The MOCT recommends analysing the operating cost from ±10% to ±20%. Following table shows the result and the operating cost seems not affective to the VFM in this case. Operating cost is compensated in the BTL model by the public sector, so higher operating cost burdens more cost to the public sector. However, the public sector does not cover the variation of operating cost in the BTO model. Operating cost is one of factors to decide a profit rate in the BTO model, so it is possible to increase the government subsidy to guarantee a profit rate of the private sector. However, the risk of operating cost is on the private sector in the BTO model, so it does not need to guarantee its profit by the change of operating cost. Thus, operating cost does not affect the government subsidy in the BTO model.

Table 6.9 Sensitivity to operating cost

Unit: billion KRW (NPV)

Actual Operating cost	BTO	BTL			VFM
	Subsidy (Gov. Exp.)	Lease fee	Operating cost	Revenue	
-20%	60.9	54.5	24.3	80.6	62.7
-10%	60.9	54.5	27.3	80.6	59.6
0%	60.9	54.5	30.4	80.6	56.6
10%	60.9	54.5	33.4	80.6	53.6
20%	60.9	54.5	36.4	80.6	50.5

6.5.4 Rate of profit

The rate of profit is a very important factor to induce the private sector to the PPP project, so the sensitivity of the profit rate needs to be considered before negotiation with the private sector. In this study, toll level is assumed as fixed, so the rate of profit is directly related with the subsidy in the BTO option and is related with the lease fee in the BTL model. Profit rate of each model is different, so the sensitivity is analysed separately.

Following result shows that the rate of profit affects more to the VFM in the BTL model than the BTO model. The investment of the private sector is higher in the BTL option than the BTO option where the public sector provides construction subsidy, so the rate of profit is more sensitive in the BTL option.

Table 6.10 Sensitivity to rate of profit (BTL)

Unit: billion KRW (NPV)

Profit rate (Nominal)	BTO	BTL			VFM
	Subsidy (Gov. Exp.)	Lease fee	Operating cost	Revenue	
6.05%	60.9	54.5	30.4	80.6	56.6
7.05%	60.9	60.2	30.4	80.6	50.9
8.05%	60.9	66.7	30.4	80.6	44.4
9.05%	60.9	72.9	30.4	80.6	38.2
10.05%	60.9	79.3	30.4	80.6	31.8

Table 6.11 Sensitivity to rate of profit (BTO)

Unit: billion KRW (NPV)

Profit rate (Real)	BTO	BTL			VFM
	Subsidy (Gov. Exp.)	Lease fee	Operating cost	Revenue	
6.23% (11.5%)	38.8	54.5	30.4	80.6	34.5
7.23% (12.6%)	47.6	54.5	30.4	80.6	43.3
8.23% (13.6%)	54.9	54.5	30.4	80.6	50.6
9.23% (14.7%)	60.9	54.5	30.4	80.6	56.6

6.5.5 Inflation

Inflation which was accepted in the VFM report of KDI was 5.0%, but it looks too high compared with other projects or economic circumstance at that time. According to the data of the Statistics Korea, average inflation for previous 3 years before 2007 is only 2.5%. Thus, the sensitivity of inflation needs to be examined to analyse the effect of the inflation to the VFM.

Table 6.12 Sensitivity to inflation

Unit: billion KRW (NPV)

Inflation	BTO	BTL			VFM
	Subsidy (Gov. Exp.)	Lease fee	Operating cost	Revenue	
5.0%	60.9	54.5	30.4	80.6	56.6
4.0%	63.5	64.0	30.4	80.6	49.8
3.0%	66.4	75.6	30.4	80.6	40.9
2.5%	67.8	82.4	30.4	80.6	35.6

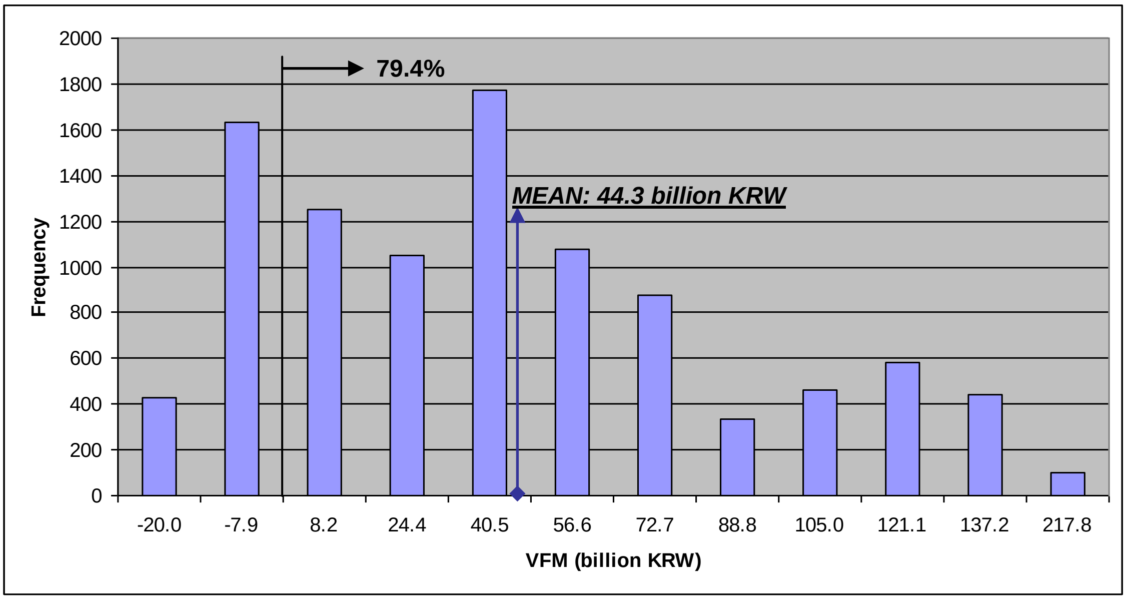
Table 6.12 shows that inflation does not affect government expenditure much, but affects the lease fee in the BTL case because it is spread for a longer time than the period of government expenditure in the BTO case. However, the BTL model still provides better VFM than the BTO model, though the VFM can be reduced in lower inflation.

6.5.6 Stochastic analysis

This section examines a stochastic analysis of traffic demand on the VFM based on road traffic forecast statistics. As seen in Chapter 5, this case is the expressway with toll, so the statistics of the inaccuracy of road traffic forecast in South Korea based on 86 expressways are used.

Figure 6.4 shows the result of Monte Carlo simulation for the probability of the VFM by the traffic demand risk. The iteration was undertaken 10,000 times and the mean value of VFM is ₩44.3 billion and standard deviation is ₩47.2 billion. The mean value is lower than the VFM presented in the point estimation by ₩12.3 billion and the probability that the BTL model is better than the BTO model is 79.4%.

Figure 6.4 VFM by the probability of traffic forecast in the BTO without MRG option



6.6 Findings

Through the quantitative and qualitative VFM assessment and sensitivity analysis about the BTO and BTL option for this Oksan-Ochang Expressway case, six characteristics were found.

Firstly, the BTL option for expressway can provide better quantitative VFM than the BTO option. In this case, the BTL option gives the quantitative VFM compared with the BTO by ₩56.6 billion. It is because the demand risk is on the government in the BTL model of Korea, so the government can make a PPP contract with the private sector with lower rate of profit than the BTO model where the private sector has to be in charge of traffic demand risk which is the source of revenue. The government pays a lease fee to the private sector but can collect tolls from end users, so the government can make a profit in the BTL model. Especially, it seems that the BTL option provides better VFM than not only the alternative BTO option in negotiation but also the PSC option hypothesised in the VFM report of KDI. Considering this project is delayed for more than three years, the quantitative VFM assessment shows that the BTL model can be the better choice to continue the PPP project.

Secondly, the BTL model can be better option than the BTO model to finance. In recent years, the biggest issue of BTO projects is a difficult financing from investors. After the global financial crisis, the uncertainty of the economy is still existent and the financial investors seem to avoid long term investment with high demand risk. In the BTL case, the public sector has traffic demand risk and the lease fee is paid by the government. Thus, the BTL model looks to have an advantage in financing.

Thirdly, in the view of the government, the BTL seems to be better than the BTO option in operational flexibility to cope with the change of future circumstances. This project is a part of national expressway network, so the operation is much related with other expressway which the public sector operates. It means that more cooperation and discussion are needed to deal with operational change for long period. In the BTL option, the government can more easily manage this through the regular payment mechanism. It gives the government more flexibility in operation than in the BTO option.

Fourthly, the BTL option can be beneficial for the public sector to incentivise a good risk management of the private sector. The private sector is compensated for only by the end users in the BTO model, so it looks difficult to incentivise risk management which is not related with the direct revenue. On the other hand, the public sector can incentivise operational risks which are directly related with the revenue through performance assessment in the BTL option.

Fifthly, several important input factors such as construction cost, operating cost, rate of profit, and inflation does not affect much to change the optimal PPP model. These factors are not variable as much as traffic demand, so the BTL model provides better VFM than the BTO model if only revenue which is based on traffic volume is as much as expected.

Lastly, the BTO option can be better if traffic demand is lower than expected, but the probability does not look high in this project. In the BTO case, the private sector has whole traffic demand risk, so the public sector has more benefits when the traffic demand risk is high. Especially, recent criticisms on the PPP are mainly about the exaggerated traffic demand and excessively guaranteed revenue, so the BTO model without MRG condition seems to be regarded as the best option to the public sector. However, considering statistics of traffic demand in expressway in South Korea, the probability that the BTO model provides more VFM is only 20.6%. Traffic forecast for road in South Korea is relatively accurate when it is compared with rail cases. In addition, this project is a part of national expressway network which is already in operation, so traffic forecast is expected to be more stable than other transport projects.

Consequently, the BTO model for the Oksan-Ochang Expressway does not look the best choice. Though the MRG condition is not included in this project, high traffic demand risk on the private sector is making it difficult to induce the financial investor. This resulted in the long delay of the project and the strength of the PPP to procure the transport facility early was void. The optimal option in this case seems to be the BTL model even when considering the alternative BTO option with only around 6.07% real profit rate, PSC option, and the traffic demand risk of expressway in South Korea.

CHAPTER 7

Case study in the Incheon Airport Railway

7.1 Introduction

In South Korea, rail transport has been recognised as a typical field where the private sector finds it difficult to build and operate, because it costs much but it is easy for the increase in the level of tariff to be limited, which is the major source of income. The early industrial and economic development of South Korea was driven by the central government, so the tariff of rail services was firmly regulated. It was a big obstacle of introducing the PPP to rail. This chapter examines how the PPP was introduced to the rail transport in South Korea for the first time and whether the chosen PPP model was an appropriate decision at that time through the quantitative VFM assessment, the qualitative VFM assessment and the sensitivity analysis.

There are many studies about the Incheon Airport Railway as a PPP project. Many of them are dealing with inaccurate traffic forecast, project financing, appropriate tariff in the PPP scheme, effective operation with other rail network operated by the public sector (Kang, 2010, Lee and Yoo, 2009, Kim, 2007b, Roh and Kim, 2010, Namkung et al., 2010). However, they are comparing the PPP with the direct investment of the public sector, so these studies do not consider the appropriateness of the PPP model.

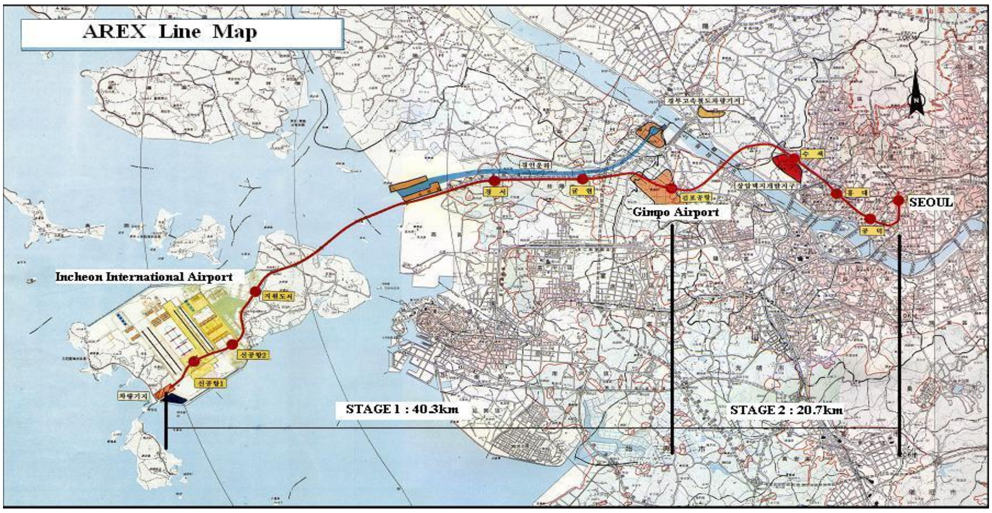
This chapter mainly focuses on the comparison of the PPP models between the BTO and the BTL model which are the most dominant PPP models in South Korea and examines the possibility of using the BTL model instead of the BTO model. This possibility is shown both quantitatively and qualitatively, based on the PPP regulation and financial circumstance at that time for the usefulness as a practical policy decision tool in a planning stage.

7.2 Summary of the project

7.2.1 Details of the project

The Incheon Airport Railway was built to connect the Incheon International Airport, which aims to be a hub airport of East Northern Asia, and Seoul metropolitan area. It is designed as an electrified double track railway project and its total length is 61.0 km. This project is divided into two stages; the first stage is 40.3km connecting the Incheon airport with the Gimpo Airport, which is the nearest domestic airport to Seoul. This stage has six stations. The construction was completed in 2007, and the rail service has been operated since then. The second stage is 20.7km connecting the Gimpo Airport with the downtown of Seoul (Seoul station), and four stations are operated in this line. Construction for the second stage started from 2004, and it opened from December 2010 (MLTM, 2010b). Total investment in real price is ₩3,949 billion, the government subsidy of that investment is ₩763 billion and the investment of the private sector is ₩3,186 billion (IIAC, 2001).

Figure 7.1 Incheon International Airport Railway[20] line map



Source: MLTM

[20] The name of the Incheon Airport Railway was the Airport Express (AREX), and now it has been changed to KORAIL AIRPORT RAILROAD since the most equities of the private sectors were sold to KORAIL in 2009.

7.2.2 History of the project as a PPP

This railway was originally planned as a government direct investment project like the Incheon airport expressway case. However, the Korean government could not afford to pay the whole expense for a new international airport, exclusive expressway and railway at the same time. According to the Incheon International Airport Corporation (IIAC, 2001), the whole cost for an airport, expressway, and railway was ₩9.4 trillion: airport ₩5.6 trillion, expressway ₩1.7 trillion, railway ₩3.1 trillion. It burdened the budget too much, so the government decided to induce the investment of the private sector to the expressway in 1994 and the railway project in 1996. It was the first case of a railway PPP in Korea.

The PPP contract for the Incheon airport railway was made in March 2001 and the construction was started in April 2001. The chosen PPP model is the BTO, and the operation period is 30 years after open. The government guaranteed the minimum revenue, 90% of the expected revenue for the whole operation period when the PPP contract was first made.

7.2.3 The appraisal of the project as a PPP

This project looks a failure as a PPP because KORAIL, which is a public sector operator, bought most equities of the private sector because of much lower demand than expected and excessive minimum revenue guarantee.

After operation, the real passenger of the first stage which is being operated is only 6.4% of the expected number. The reason of inappropriate passenger forecast is analysed due to low demand of Incheon airport (67% of expected), the delay of region development (30% of planned population in Yeongjong-Do), low traffic in Seoul Metropolitan area (78% of expected), error on transport mode selection, and 5-year delay of construction (Namkung et al., 2010, MLTM, 2010b). It was also pointed out that the airport express bus service was much more competitive than expected. However, considering the actual traffic of the Incheon Airport Expressway is lower than 50% of forecasted, the problem is due to generally inaccurate traffic forecast. Recently, the traffic demand was examined and forecasted again by KOTI (Korea Transport Institute), but the current status seems not to be improved even if the second stage linking the Gimpo airport and the Seoul Station would be operated as expected (KOTI, 2009a).

Table 7.1 Passengers of the Incheon Airport Railway

Unit: passengers/day

Year	2007	2011	2016	2021	2026	2031
Contracted demand (2001) (A)	207,421	492,982	703,309	819,197	819,197	819,197
Re-estimated demand (2009) (B)	13,312 (real)	109,719	159,881	223,475	248,371	268,689
B/A	6.4%	22.3%	22.7%	27.3%	30.3%	32.8%

Source: KOTI (2009)

The MLTM was supposed to compensate the difference with the 90% of expected revenue, and KOTI (2009a) said the total payment could reach ₩13.2 trillion for whole operation period. Especially, the private sector did not have to make an effort to increase passengers, because their incomes were guaranteed by the MLTM. Thus, the MLTM decided to let KORAIL (Korea Railroad Ltd.), which is a national railway company owned by the government and supervised by the MLTM, buy the 89% of equity from the Incheon Airport Railway Ltd. in 2009. The government lowered the level of minimum revenue guarantee to 58% of original contracted revenue. As a matter of fact, it looks like the PPP for the Incheon Airport Railway has failed and it was transferred to the public sector, although it still has the PPP form between the government and KORAIL.

The Korean government still argues that the PPP was an unavoidable choice, because the budgets for connecting transport to new airport was not enough. The airport railway was a necessary transport to provide various options to travellers and to guarantee safe connection to the airport in case of the emergency or congestion of the Incheon Airport Expressway (MLTM, 2010b). However, it is still doubtable whether the BTO model was optimal in rail under the circumstance that the level of tariff was politically restricted and whether the minimum revenue guarantee was excessive.

7.3 Quantitative VFM assessment

7.3.1 Basic assumption

This project has a minimum revenue guarantee. It was 90% at first, and now it became 58% after refinancing. This study examines the possibility of using the BTL model instead of the BTO model in a planning stage, so the minimum revenue guarantee used in this chapter is 90%, which was firstly decided in a planning stage.

The date for calculating life cycle cost is June 2002 when the actual design was done. Most data collected from KOTI are real price in June 2002, so a nominal price is not used in this chapter.

The quantitative VFM is assessed through the analysis of the discounted cash flow of the project, and it needs a financial discount rate[21] to calculate this. Korean VFM guidance (2006b) recommends using the WACC (Weighted Average Capital Cost) method to decide the financial discount rate. This guidance has suggested 6.0% for the nominal financial discount rate since 2006, and that rate was based on the economic circumstances around the middle of 2000s. The inflation in this guideline was assumed as 3.0%, so the real financial discount rate is 2.91%. However, this can be affected by the economic circumstances like market interest. According to the General guidelines for pre-feasibility study of Korea (KDI, 1999), the real financial discount rate for an expressway project in 1999 was 4.83%. Considering the contract of this rail case was made in early 2001, it seems more rational to use the real financial discount rate as 4.83%, which was used in 1999. Thus, 4.83% is used as the real financial discount rate in this rail case. If the inflation is assumed as 3.1% which is the average of previous 3 years from 2002, then the nominal financial discount rate is 8.08%.

[21] Social discount rate is used to test the economic feasibility in which the social value is quantified as the benefit of a project. The quantitative VFM assessment for the PPP is based on the cash flow of the project, so the financial discount rate needs to assess the financial feasibility of the PPP project.

Rate of profit, which is the most critical point in making a contract for the PPP, is decided by the negotiation between the government and the private company. In the BTO model, the rate of profit of the private sector is the FIRR (Financial Internal Rate of Return) which is the internal rate of return making the NPV of the total revenue equal to the NPV of the total cost for the whole operation period. The Incheon Airport Railway was built by the BTO model, and the real FIRR of the BTO model, which was decided through the negotiation between the government and the private company, was 10.43%. The rate of profit in the BTL model should be also decided by the negotiation, and the MLTM recommend it should be the five-year Korea national bond, which can be a standard interest, plus an appropriate mark-up rate for the long term investment. The MLTM suggested 0.77% as an appropriate mark-up nominal rate in a recent railway BTL project (MOCT, 2007c). In addition, there are two more BTL cases of rail in Korea, and mark-up rates are suggested as 0.76% and 0.70%, so the highest 0.77 will be used in the BTL model of Incheon Airport Railway project as a common mark-up rate under Korean financial and construction circumstances (MOCT, 2007c). In March 2001, the year in which the PPP contract was made, the mean value of interest of five-year Korea national bond was 6.40%, so the appropriate nominal rate of profit in this case analysis is used as 7.17%. The real rate of profit is 3.95% when the inflation is 3.1%.

7.3.2 Construction subsidy

The BTL model does not need a subsidy from the public sector in the construction stage, but, in the BTO model, the public sector can provide construction subsidy to induce the private sector. The MOSF regulates that the maximum subsidy rate which the public sector can provide in the BTO model is 50% in case of light rail and is 40% in other facilities (Kim, 2010a). In case of the Incheon Airport Railway, the government provided a subsidy of 30% of construction cost.

According to the report of KOTI (2009a), the signed construction subsidy with the private sector is ₩763.1 billion in real prices from 2002 to 2008. Like road cases, KDI (2009a) suggests to assume that the construction subsidy of the government is financed from the bond market. If the construction subsidy is not financed by the tax, it needs to analyse the government expenditure for financing. The most dominant financing for government budget is the 5-year national bond, so it is also used in this chapter. Annual average interest of the 5-year national bond in 2002 was 6.3%, and the real interest is 3.1% when the inflation is 3.1%.

7.3.3 Lease fee

Lease fee is calculated by the following formula;

$$Aunnal lease\ fee = \frac{Total invesment - the\ present value of\ the additional\ incomes}{PVIFA(n,k)}$$

Here, PVIFA is the present value index for annual lease fee and the N, which is the operation period of this project, is 30 years. The k means the rate of profit, so the k value in this case is 7.17%. Consequently, the PVIFA(30, 7.17%) of each stage is equal to 12.2.

$$PVIFA(30,7.17\%) = \sum_{t=1}^{30} \frac{1}{(1+0.0717)^t} = 12.200$$

There are two different phases in this projcet, the first is from the Incheon Airport station to the Gimpo Airport station and the second is from the Gimpo Airport station to Seoul station. The building cost, which is the investment of the private sector in the BTL model, for the first stage is ₩1,935.8 billion, for the second stage is ₩2,013.2 billion. The additional incomes are assumed as nothing, because they are very small part of revenue. Thus, the annual lease fee of the first stage until 2036 for 30 years is ₩158.7 billion (nominal) per year, and the annual lease fee for the second until 2039 for 30 years is ₩165 billion (nominal) per year. Considering the inflation is 3.1% in this case, total lease fee in real prices for the first stage is ₩2,717.8 billion and total lease fee in real prices for the second stage is ₩2,578.4 billion. Thus, whole lease fee for the project is ₩5,296.1 billion in real prices for 33 years.

7.3.4 Operating cost

Operating cost was assumed as the same in the BTO and the BTL model. Though the operating cost can be affected by the private sector making more effort to increase customers in the BTO model, in which the demand risk is on the private sector, but this is difficult to be quantified. Thus, the issues about the operation of rail in PPP models are dealt with in the qualitative VFM assessment.

The operation period is 30 years, the first phase operated from 2007 and the second phase operated from 2010, so the total analysing period is 33 years. According to KOTI (2009a), total cost is ₩3,630.8 billion in real price for 33 years.

7.3.5 Revenue

The revenue which is the income from the end users through collected tariff is assumed same in both PPP model. In fact, the private sector can make more efforts to increase the incomes from passengers, but this factor is difficult to be quantified, so it is dealt with in the qualitative assessment. According to KOTI (2009a), the forecasted revenue of the BTO model is ₩18, 576.8 billion in real price for 33 years.

7.3.6 Summary of the analysis factors

- Building cost: ₩3,949 billion
  Facility part: the 1st stage ₩1,538 billion / the 2nd ₩1,599.5 billion
  Financial part: ₩811.5 billion (1st ₩397.8 billion / 2nd ₩413.7 billion)[22]
- Operating cost: ₩3,630.8 billion
- Operation period: 33 years
  The 1st stage: 2007~2039
  The 2nd stage: 2010~2039

[22] The collected data of financial cost was not divided into each stage, so the cost of each stage was assumed as based on the portion of the facility part cost.

- Construction subsidy: ₩763.1 billion
  government expenditure: ₩881.4 billion
- Lease fee for the BTL model
  < Nominal price: ₩9,711 billion >
  The 1st stage: ₩4,761 billion (annual ₩158.7 billion, 2007 ~ 2036)
  The 2nd stage: ₩4,950 billion (annual ₩165.0 billion, 2010 ~ 2039)
  < Real price: ₩5,296.1 billion >
  The 1st stage: ₩2,717.8 billion from 2007 to 2036
  The 2nd stage: ₩2,578.4 billion from 2010 to 2039
- Real rate of profit: 3.95% in the BTL, 10.43%[23] in the BTO
  Nominal rate of profit: 7.17% in the BTL, 13.85% in the BTO
- Real financial discount rate: 4.83%
- Inflation: 3.1%
- Revenue: ₩18, 576.8 billion

7.3.7 Result

The quantitative VFM of the BTL model compared with the BTO model in the Incheon Airport Railway project is ₩3,635.3 billion. It means that the BTL model provides more value for money than the BTO model in this project. It looks a natural result like a road case, because the profit rate of the BTL model is much lower than the BTO model. It can be easily seen in the revenue which is decided by the level to compensate for the investment and profit of the private sector. As seen in the following table, revenue collected from passengers is ₩18,576.8 billion and it is over the sum of lease fee and operating cost. It means that the government has to pay construction subsidy in the BTO model, but the government can make a profit with revenue after providing lease fee and operating cost in the BTL model.

[23] Rate of profit in the BTO model means the FIRR (Financial Internal Rate of Return).

Table 7.2 Quantitative VFM assessment in the Incheon Airport Railway

Unit: billion KRW

Year	BTO		BTL			VFM	
	Gov. subsidy	Gov. Expenditure	Lease fee	Operating cost	Revenue	Real	NPV
SUM	763.1	881.4	5296.1	3,630.8	18,576.8	10,531.3	3,635.3
2001	-	-				-	-
2002	16.1	-				-	-
2003	87.7	0.5				0.5	0.5
2004	139.5	3.2				3.2	2.9
2005	135.3	7.5				7.5	6.5
2006	183.2	11.7				11.7	9.7
2007	128.7	33.5	136.2	54.7	116.1	- 41.3	- 32.6
2008	72.6	108.6	132.1	56.3	165.0	85.2	64.2
2009		159.9	128.2	61.9	183.0	152.9	109.9
2010		151.4	253.6	80.8	378.8	195.9	134.3
2011		195.1	245.9	78.6	392.7	263.3	172.2
2012		134.9	238.5	112.8	407.3	190.9	119.1
2013		74.9	231.4	102.3	422.6	163.8	97.5
2014			224.4	105.5	438.8	108.9	61.8
2015			217.7	101.2	528.6	209.7	113.6
2016			211.1	87.9	551.7	252.7	130.6
2017			204.8	124.4	576.2	247.0	121.7
2018			198.6	96.2	602.2	307.4	144.5
2019			192.6	98.0	629.8	339.2	152.1
2020			186.8	139.2	659.2	333.2	142.5
2021			181.2	91.7	659.2	386.3	157.6
2022			175.8	152.6	659.2	330.8	128.8
2023			170.5	90.7	659.2	398.0	147.8
2024			165.4	90.9	659.2	402.9	142.7
2025			160.4	121.9	659.2	376.9	127.4
2026			155.6	97.7	659.2	405.9	130.9
2027			150.9	155.8	659.2	352.5	108.4
2028			146.4	91.4	659.2	421.4	123.6
2029			142.0	127.3	659.2	389.9	109.1
2030			137.7	196.7	659.2	324.8	86.7
2031			133.5	120.1	659.2	405.6	103.3
2032			129.5	162.9	659.2	366.8	89.1
2033			125.6	121.2	659.2	412.4	95.5
2034			121.9	124.3	659.2	413.0	91.3
2035			118.2	141.4	659.2	399.6	84.3
2036			114.6	90.3	659.2	454.3	91.4
2037			56.7	175.5	659.2	427.0	81.9
2038			55.0	90.6	659.2	513.6	94.0
2039			53.3	88.0	659.2	517.9	90.4

7.4 Qualitative VFM assessment

This chapter examines the following four issues of the qualitative VFM assessment suggested in the methodology chapter. This is assessed based on the opinions the PPP experts gave through the face to face interview which was done from the 6th November to the 21st November 2010.

7.4.1 Service quality

Passenger rail needs much more services such as an accessibility to station, comfortableness of cabin, frequency of train, etc. besides safety, travel time and cost which are common service factors seen in a road (Higton, 2005, Lee, 2006). It means that the quality of service in rail is more complicated and important to attract end users than road. Especially, the Incheon Airport Railway competes with the bus service using the Incheon Airport Expressway (Namkung et al., 2010), so the quality of service seems decisive factor for the successful PPP.

This project was conducted by the BTO with MRG model, and the level of MRG was 90% at first, so most interviewees agreed that the private sector was not expected to make an effort to improve the service quality (Ⓐin section 3.2 in APPENDIX 4). However, one expert argued that the BTO model, even if it had the MRG, could have several benefits in the service quality than in the BTL model in rail (Ⓑin section 3.2 in APPENDIX 4). The respondent said that an operation investor could creatively involve in the project from design and construction stage while, in the BTL model, it did not need to make an effort to induce the creative and competitive ideas to the service quality. The only thing they have to do might be to have an ability to fulfil the demand of the government.

Consequently, it is not deniable that the BTO model can be better in the service quality wise than the BTL model. However, the government shared demand risk through the MRG condition in this project, so it made an advantage of the BTO model useless according to the level of MRG.

7.4.2 Contract and Management

This issue is about the ability and experience of the public and private sectors for supervising and managing the PPP project. The rail system is more complicated not only in construction but also in operation than road (Lee, 2006). Some rails are connected to other network and the fare system of railway is more complicated than road, so it is difficult to say that managing the BTO model is simpler than the BTL as seen in a road case. In the view of the public sector, the BTL model can have more advantages in managing the project to cope with the needs of public sector. However, one expert opposed this opinion, because there was no experience of performance assessment in operation not only in road but also in rail, so it could take much time for the public sector to make the criteria and standard of performance (©in section 3.2 in APPENDIX 4). Also this might be worse in rail which is more complicated in operation than road.

With regard to making a contract, most interviewees said that if the BTL model had been used instead of the BTO, the time spent on negotiation could have been reduced (Ⓓin section 3.2 in APPENDIX 4). One of the most controversial problems in transport PPP is sharing demand risk and the public sector has traffic demand risk in the BTL model. Both sectors do not have to discuss traffic forecast in the BTL model (KDI, 2009b). Considering that recent delays of the PPP projects were due to financing, the BTL model, where the demand risk was on the public sector, could be advantageous to reduce time in negotiation and to make a contract.

7.4.3 Risk management

This issue is about the incentivising good risk management through the payment mechanism and contract terms. All interviewees said that there was no incentive to good risk management of the private sector in the Incheon Airport Railway project which was done by the BTO model with the MRG (Ⓔin section 3.2 in APPENDIX 4). An interviewee said that if the BTL model had been used in this project, the private sector might have more burdens in operation (Ⓕin section 3.2 in APPENDIX 4). She pointed out that good risk management was regularly checked in the BTL model through the performance assessment, but the public sector did not want to interfere with the risk management of the private sector beyond their responsibility in the BTO model.

7.4.4 Operational flexibility

The operational flexibility means how to let the private sector cope with the change of circumstances under the long term contract. An interviewee said that it was decided by the conditions of each project contract rather than by the PPP model (Ⓒin section 3.2 in APPENDIX 4). Thus, this section is discussed on the basis that the terms and conditions of a project are similar.

Similarly with road cases, interviewees from the private sectors alleged that they became more sensitive to the change of circumstances or technology in the BTO model and a respondent from the public sector argued that the private sector was only interested in making a profit, so technology or innovative skill might be only adapted when it could make an additional profit in the BTO model. He said that the BTL model seemed to be more beneficial in the operational flexibility (Ⓗin section 3.2 in APPENDIX 4).

Consequently, the VFM is assessed by the public sector and it basically reflects the interest of the public sector. Thus, the BTL seems better than the BTO in the operational flexibility in the view of the public sector. The government has few rights in the operation stage in the BTO model, but, in the BTL model, needs to monitor the operation stage to give the lease fee by the performance assessment. The government can discuss operational problems with the private sector whenever they pay, and they have more opportunities to change the operation condition according to the change of circumstances. However, for this kind of governmental role, it needs more administrative efforts like time and cost for PPP operation. According to the House of Commons of the UK, many PFI schools and hospitals were considered as they did not have enough staff to do a good job, though the management cost for operational PFI deals was over £6 million a year (House of Commons, 2008).

7.5 Sensitivity analysis

Many factors of the quantitative VFM assessment such as construction cost, operation cost, and rate of profit are possible to change. The VFM assessed in previous section is based on the point estimation, so a review of sensitivity of important factors is needed. The MOCT (2007a) recommended analysing the sensitivity of the operation period, level of tariff, demand, construction cost, operation cost and subsidy from the public sector. Level of tariff and demand are related with each other, and it can be considered at the same time with revenue factor. However, the sensitivity was not analysed in real case, because there was no guideline in 2001 when the contract was made. The report of KOTI which is the source of data in this chapter does not consider sensitivity analysis either, because many factors are already known and fixed.

This chapter compares the BTL with the BTO model in the Incheon Airport Railway, but construction cost, operation cost and profit rate is already fixed and the out-turn values were not much different with the original plan.

Table 7.3 Out-turn value of construction and operation cost

Unit: billion KRW

	Contracted value (A)	Out-turn value (B)	(B-A)/A (%)
Construction cost	3,138	3,272	4.3%
Operation cost	3,631	3,623	-0.2%

Source: KOTI (2009)

The most differently forecasted factor with actual value was the number of passenger which was directly related with the revenue of the project. The level of tariff is difficult to change, so the sensitivity of VFM to the number of passengers can be analysed through the analysis of revenue. Thus, this chapter examines the sensitivity of revenue.

7.5.1 Revenue

During the operation of the Incheon airport railway for previous two years, the real passengers were below 7% of the expected. After linking the second stage from the Gimpo airport to the Seoul station, the passengers were estimated to be only around 30% of the originally expected (KOTI, 2009a). However, the government guaranteed 90% of the contracted revenue, which is the most condemned point. Thus, two cases with and without MRG condition are analysed, and the range is from 10% to 100% of the expected revenue.

Table 7.4 Sensitivity of the VFM to passenger without MRG

Unit: billion KRW (NPV)

Passenger	BTO	BTL			VFM*lo*
	Subsidy (Gov. Exp.)	Lease	Operation	Revenue	
100%	603.1	2369.8	1375.9	6777.9	3,635.3
90%	603.1	2369.8	1375.9	6100.1	2,957.5
80%	603.1	2369.8	1375.9	5422.3	2,279.7
70%	603.1	2369.8	1375.9	4744.5	1,601.9
60%	603.1	2369.8	1375.9	4066.7	924.2
50%	603.1	2369.8	1375.9	3388.9	246.4
46.4%	603.1	2369.8	1375.9	3142.6	0.0
40%	603.1	2369.8	1375.9	2711.1	- 431.4
30%	603.1	2369.8	1375.9	2033.4	- 1,109.2
20%	603.1	2369.8	1375.9	1355.6	- 1,787.0
10%	603.1	2369.8	1375.9	677.8	- 2,464.8

Above table shows that if the number of passengers is over 46.4% of the contracted number then the BTL model has higher quantitative VFM than the BTO. It also means that if the number of passengers is below 46.4%, then the BTO is better. Demand risk is on the private sector in the BTO model, which can have higher profit rate because of high risk, so if the demand risk of the project is high then the BTO model can be beneficial to the government.

However, the BTO model may not be suitable if the private sector makes a loss by low demand. Thus, this project, which was done by the BTO, has the MRG condition, and the difference with 90% of contracted revenue is compensated to the private sector by the government. Considering the minimum revenue guarantee, the quantitative VFM can be affected. Table 7.4 shows the sensitivity of the revenue to the VFM when there is the MRG condition.

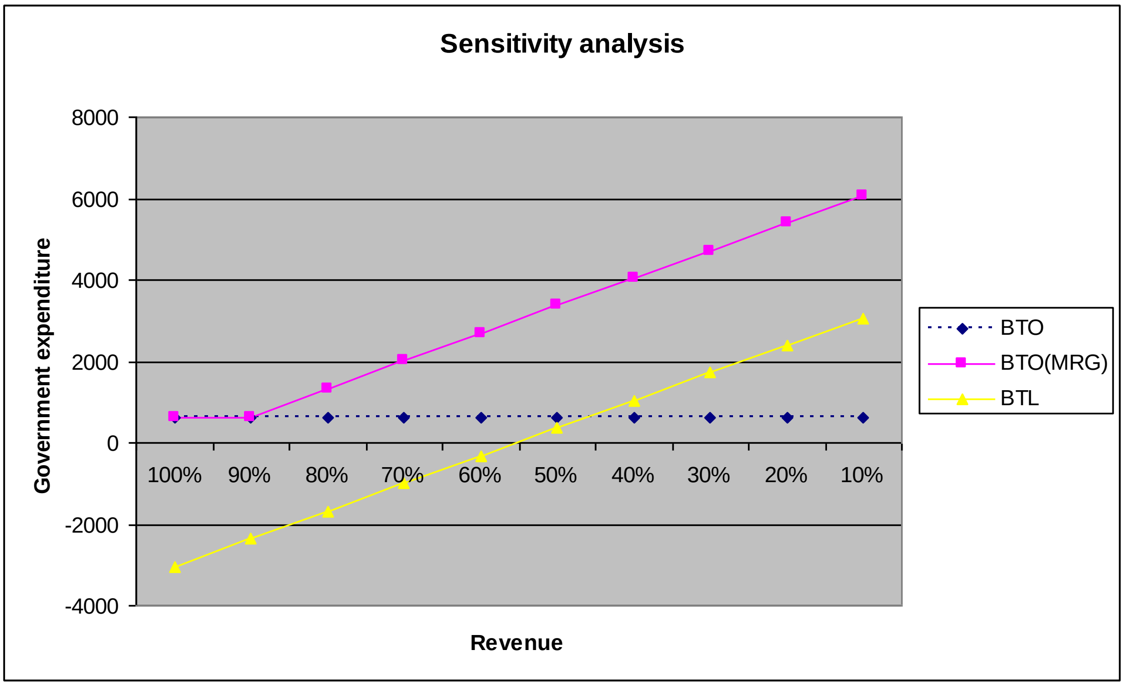
Table 7.5 Sensitivity of the VFM to passenger with MRG

Unit: billion KRW (NPV)

Passenger	BTO		BTL			VFM*lo*
	Subsidy for construction	Subsidy for operation	Lease	Operation	Revenue	
100%	603.1	-	2,369.8	1,375.9	6,777.9	3,635.3
90%	603.1	-	2,369.8	1,375.9	6,100.1	2,957.5
80%	603.1	677.8	2,369.8	1,375.9	5,422.3	2,957.5
70%	603.1	1,355.6	2,369.8	1,375.9	4,744.5	2,957.5
60%	603.1	2,033.4	2,369.8	1,375.9	4,066.7	2,957.5
50%	603.1	2,711.2	2,369.8	1,375.9	3,388.9	2,957.5
40%	603.1	3,389.0	2,369.8	1,375.9	2,711.1	2,957.5
30%	603.1	4,066.7	2,369.8	1,375.9	2,033.4	2,957.5
20%	603.1	4,744.5	2,369.8	1,375.9	1,355.6	2,957.5
10%	603.1	5,422.3	2,369.8	1,375.9	677.8	2,957.5

Because of the minimum revenue guarantee in the BTO model, the quantitative VFM of the BTL is always higher than the BTO in this case. The following graph shows the result of sensitivity analysis and the effect of the minimum revenue guarantee in short.

Figure 7.2 Sensitivity analysis of the VFM to passenger



The Incheon Airport Railway was the first railway BTO project, and it followed the case of the Incheon Airport Expressway, which was the first case of the current BTO model. The level of MRG provided by the government for this project was 90%, the same as the Incheon Airport Expressway. There was no rational reason or data to decide the MRG as the 90% of expected revenue. According to an interviewee from the MLTM, there was only one bidder in this project, so the government was difficult to use the competitions between the private sectors. He argued that it looked natural to follow the Incheon Airport Expressway case which was the only BTO case at that time.

However, this sensitivity analysis shows that the level of minimum revenue guarantee of the Incheon Airport Railway BTO project was too high. The reason why the profit rate of the BTO was high was that the demand risk was on the private sector, but the government had the 90% of demand risk in this case. The Korean government suggested 9% as the real reference rate for the BTO project based on the economic circumstances, and advised to modify the rate by considering the characteristic of the project, risk transfer, financing condition, etc. (Lee et al., 2001). A railway was thought to be more risky than a road at that time because the size of project was bigger than a road, and there was a burden of operation which is directly related with end users. Thus, the real profit rate of the Incheon Airport Railway was decided at 10.43% which was higher than the profit rate of the Incheon Airport Expressway[24], but the private sector had little risk in operation or demand because of the minimum revenue guarantee from the government. The private sector did not have to try to improve serviceability or operation to draw customers.

7.5.2 Stochastic analysis

The most serious problem of quantitative VFM analysis is that uncertainty of input data is too big as seen in the Incheon Airport Railway case, so the fidelity of the result based on the point estimation analysis seems to be doubted. For this reason, the sensitivity to the VFM is analysed, but a demand factor in this rail project does not look enough to be covered with the sensitivity analysis. The MOCT explained that the sensitivity of level of tariff and demand had the

[24] The real profit rate of the Incheon Airport Expressway was 9.70%

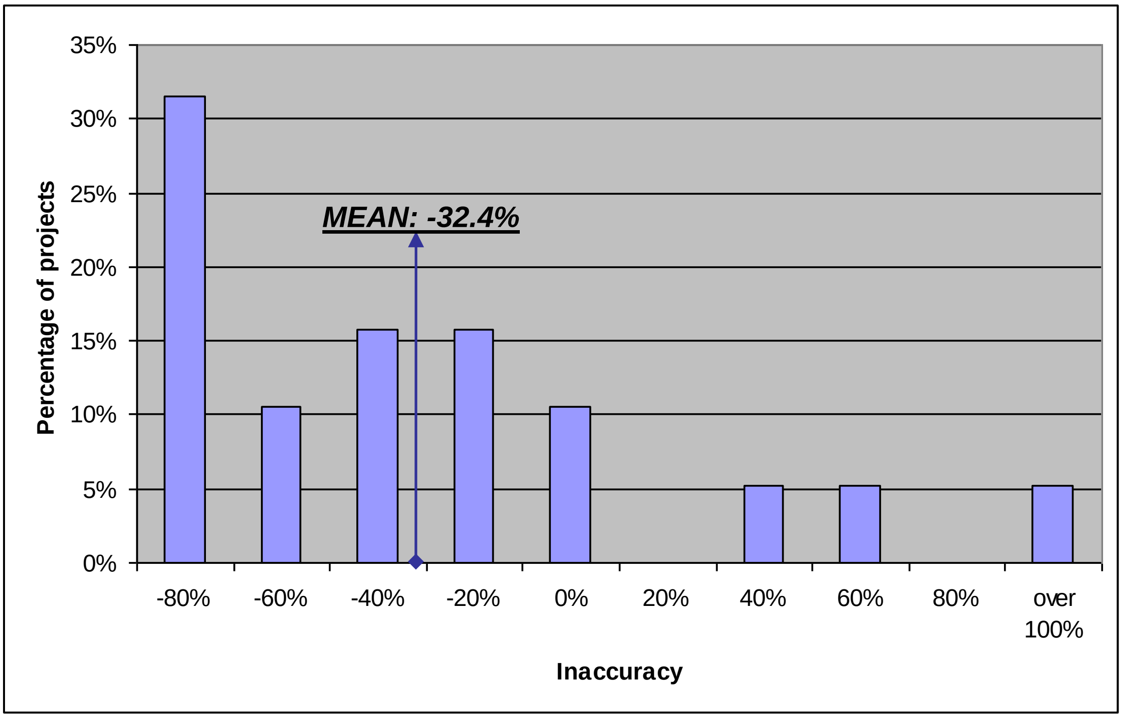
same effect to the VFM as a revenue factor. It recommended analysing the sensitivity of level of tariff instead of demand within a range from -10% to +10%. In case that the level of tariff is constant, it is same with that the demand was analysed within the same range. However, the inaccuracy of the demand of Incheon Airport Railway was over -90%, so the guideline of the MOCT could not cover this range in a planning stage.

Thus, this chapter examines a stochastic analysis on the VFM comparing the BTL with the BTO model based on the comparison data of demand forecast and actual passenger in South Korea. Figure 7.3 shows the probability of inaccuracy of rail in South Korea based on 19 projects which has been operated since 2000 (see APPENDIX 4). Inaccuracy was calculated by the following equation.

$$I = \left(\frac{Ta - Tf}{Tf}\right) \times 100(\%)$$

Here, I is the inaccuracy of traffic forecast
Ta is an actual traffic
Tf is a forecasted traffic

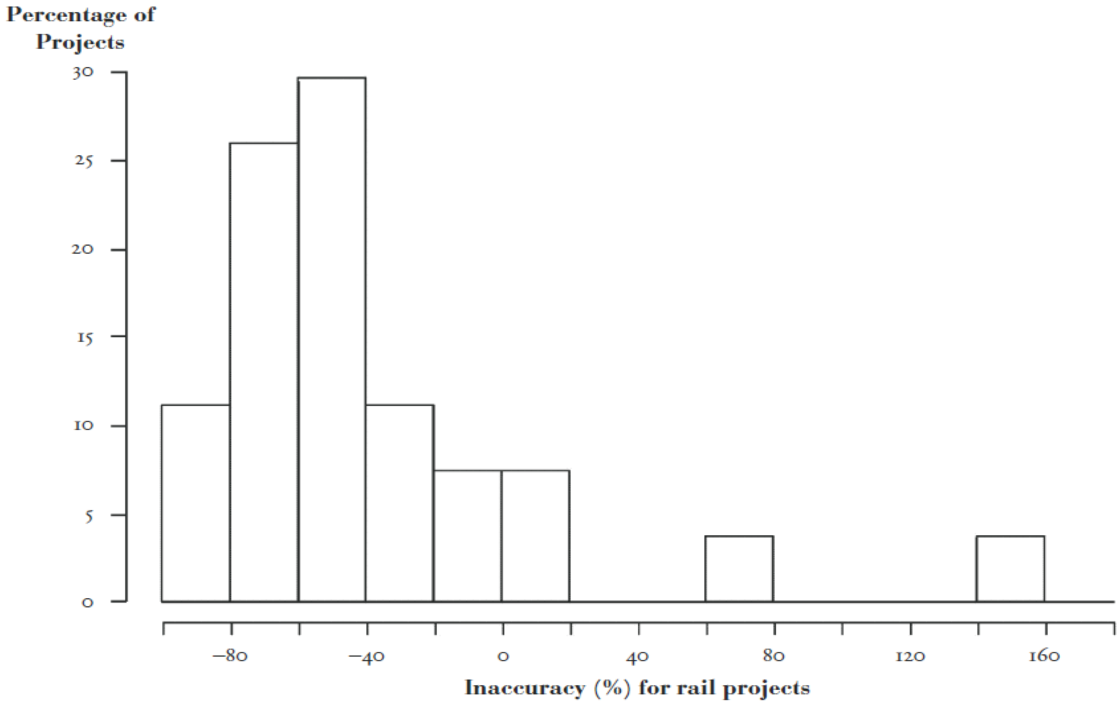
Figure 7.3 Inaccuracy of traffic forecast in rail of South Korea



Source: MLTM (2010)

This probability may not be enough to use as a PPP decision tool right now, but this can be a good example of using stochastic analysis. In near future, this analysis based on accumulated data or experiences of other countries can be practically helpful to choose the optimal PPP model. Especially, comparing with the research of Flyvbjerg *et al* (2005), the inaccuracy of rail projects in Korea shows many similarities and the result looks effective to stochastic analysis.

Figure 7.4 Inaccuracies of traffic forecasts in 27 rail projects, 1969-1998

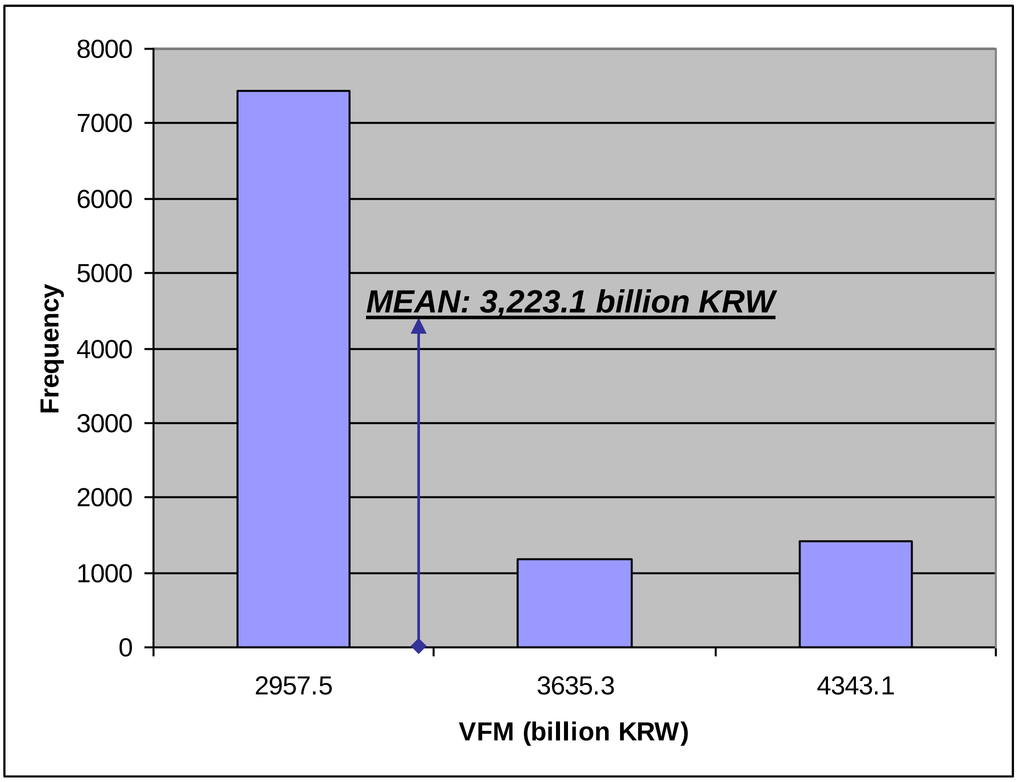


Cited from Flyvbjerg *et al* (2005)

For the stochastic analysis, the Monte Carlo simulation is undertaken 10,000 times based on the discrete probability of the inaccuracy of traffic forecasts in rail in South Korea with the Excel of Microsoft. Quantitative VFM is the definitely different by the MRG condition, so the simulation is undertaken in the case with MRG and without MRG condition.

In the case of the BTL option being compared with BTO with MRG option, the mean value of VFM is ₩3,223.1 billion. Because of MRG condition, the minimum possible VFM is ₩2,957.5 billion and the maximum is ₩4,343.1 billion. The private sector has to repay an additional profit to the government when the traffic is over 110% instead of guaranteed revenue below 90% of expected. Figure 7.5 shows the probability of the VFM of the BTO with MRG model and it says that the probability that the VFM is ₩2,957.5 billion which is the guaranteed level from the government is around 74%.

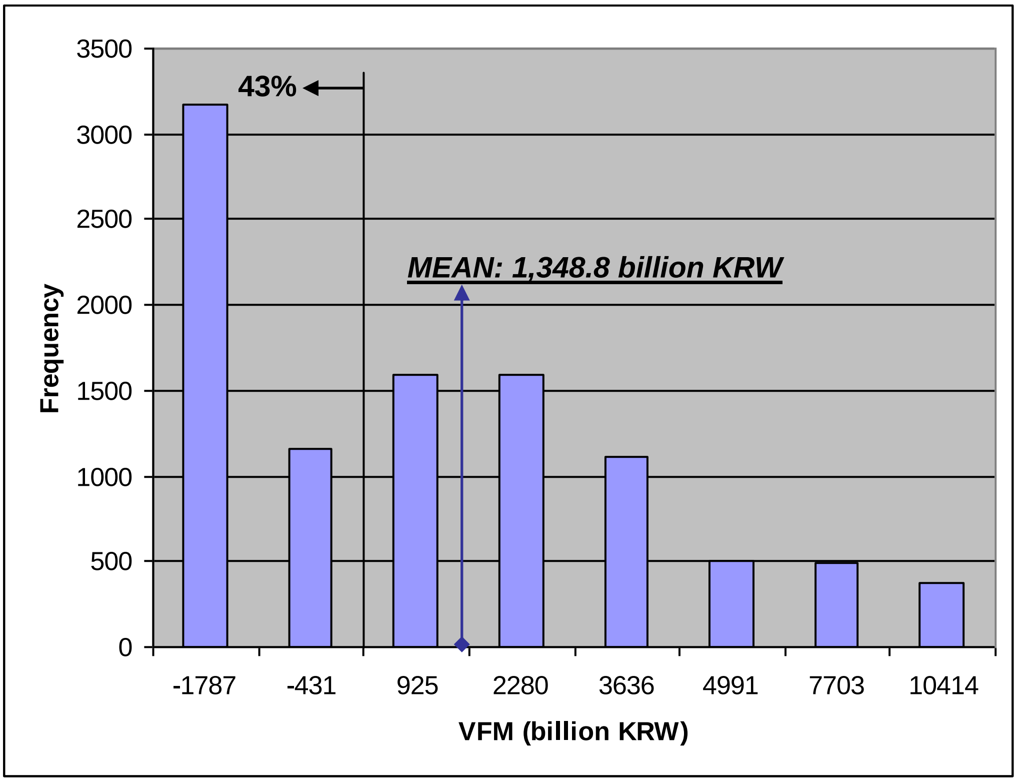
Figure 7.5 VFM by the probability of traffic forecast in the BTO with MRG option



This graph explains that if there is a MRG condition reaching 90% of the expected revenue then the BTL model is always better than the BTO model. Especially, the probability that revenue is compensated by the government through the MRG is 74%. MRG regulation is for sharing demand risk of the private sector with the public sector, but this stochastic analysis shows that the burden to the government seems too high.

In the case being compared with BTO without MRG option, the mean value of VFM is ₩1,348.8 billion as shown in Figure 7.6. Considering average probability of traffic forecast in rail in South Korea, this project can have more VFM in the BTL model than the BTO model. However, the inaccuracy changing the better PPP model from the BTL to the BTO is -53.6%, which is 46.4% of the forecasted traffic (see Table7.3), and the probability that the optimal PPP becomes the BTO model is 43% (see Figure 7.6). Especially, the actual traffic of this case is only 7% of the expected and the inaccuracy reached -93%, so it seems difficult to have a confidence that the BTL model is the optimal PPP in this project if there were no MRG condition, although it provides better VFM by more than three trillion KRW in the quantitative VFM assessment.

Figure 7.6 VFM by the probability of traffic forecast in the BTO without MRG option



The traffic forecast of a project cannot be corrected only by the probability of inaccuracy in rail traffic in South Korea, because the general inaccuracy cannot explain each case. The above result shows that the quantitative VFM being used as a decisive tool for the PPP can be inappropriate. The quantitative VFM shows that the BTL model is better, but the BTO model may be better regarding high traffic demand risk in rail. Though the probability that the BTL model is better is still high, but the extent is not big and the actual traffic shows the BTO model could be better only if there were no MRG condition. Therefore, it needs to deal with the qualitative VFM assessment, which can review this kind of characteristic, more importantly than suggested in the current VFM assessment guideline.

7.6 Findings

Through the quantitative and qualitative VFM assessment and sensitivity analysis about the BTO and BTL model for this Incheon Airport Railway case, five characteristics were found.

Firstly, the BTL model for railway can provide better quantitative VFM than the BTO model. In this case, the BTL model gives the quantitative VFM compared with the BTO of ₩3,635.3 billion. It is because the government can make a PPP contract with the private sector with lower rate of profit in the BTL model than in the BTO model where the demand risk is on the private sector. Demand in rail means passengers and the fare of passenger is the direct source of revenue. Like road cases, the government pays a lease fee to the private sector but can collect fares from end users, so the government can make a profit in the BTL model. Especially, this project has a MRG condition to guarantee 90% of expected revenue to the private sector, so the BTL model is always better than the BTO model regardless of traffic demand risk through the sensitivity analysis not only by the deterministic method but by the stochastic method.

Secondly, the BTO model can be better option than the BTL model to improve the quality of service of rail. Rail competes with the express bus service for the Incheon International Airport, so the BTO model which collects fees from the end user who can choose the alternative is more sensitive to improve the quality of service. However, the excessive MRG reaching 90% of expected revenue can make this kind of strength of the BTO model useless.

Thirdly, the BTL model seems to be better than the BTO model in operational flexibility for the government to cope with the change of future circumstances. In the BTL model, the government plays a role of connecting the private sector with the end users. Considering the qualitative VFM is also assessed in the view of the public sector, the government can have more flexible rights in the BTL model during the operation period through the payment mechanism, but it cost more administrative expense and time.

Fourthly, the BTO model without the MRG can provide better VFM than the BTL model when the real passengers are lower than forecasted, because the demand risk is on the private sector in the BTO model. Even if actual passengers are lower than expected, the government does not have to pay anything to the private sector in the BTO model without MRG. However, in the BTL model, the revenue from the end user is decreased in case actual passengers do not reach an aim level, so the net financial burden of the government is increased. Thus, the BTO model can be beneficial to the government if the actual passengers are lower by certain level than expected and there is no MRG condition in a contract. Considering probability of traffic forecast in rail of South Korea, the probability that BTO model is better is around 41% when there is no MRG condition. It means that if the project has high traffic demand risk, then the BTO model in which the private sector is responsible to the traffic demand risk can be better to the public sector.

Lastly, the level of MRG in this rail case is too high. One of the most important characteristics of the BTO model is the private sector has a demand risk. The MRG regulation is for sharing demand risk of the private sector with the public sector in the BTO model to prevent excessive traffic demand risk burdens to the private sector. However, the results of the Monte Carlo simulation on traffic demand risk show the probability that revenue is compensated by the government through the MRG reached 74%. Though the MRG is the policy tool for sharing demand risk, but majority of risks are on the public sector regardless of high rate of profit provided to the public sector. The government guaranteed 90% of forecasted revenue in this case, but if the BTL model had been chosen, the government could pay only 35.0% of expected revenue in the form of lease fee. Even considering the actual passengers, which are only around 7% of forecasted, the BTL model provides better VFM than the BTO with MRG model by ₩2,957.5 billion.

Consequently, the BTO model for the Incheon Airport Railway looks inappropriate. This project seems a bad case of the BTO model in transport infrastructures because of excessive MRG. Basically, the government prefers the BTO model without MRG condition, but if the MRG is necessary because of a high traffic demand risk, the maximum MRG should not exceed to the level that makes VFM of the BTL compared with the BTO model zero. If MRG exceeds this level, than the BTL model can be better to the public sector in the quantitative wise.

CHAPTER 8

Case study in the Daegok-Sosa Railway

8.1 Introduction

As seen not only in the Incheon Airport Expressway and the Incheon Airport Railway but also other BTO projects, excessive revenue subsidy by the MRG condition evoked many criticisms on the BTO model itself (Choi, 2007, Gil, 2008). In case of rail which needs more construction and operation cost with limited income from end users as a public transport than road, it was thought to be disadvantageous for the private sector to make a profit with only charging a tariff (Higton, 2005). Especially, the demand of rail in South Korea is generally known as overestimated (Oh, 2005). This means that a railway BTO project, where a profit of the private sector depends on the traffic demand, is less attractive to the private sector if there is no MRG condition. Thus, the BTL model was considered to a railway construction project as the alternative of the BTO model.

The Daegok-Sosa railway was designed as a government direct investment project in 2005, but considering the increasing public demand for rail service in the western Seoul Metropolitan area, the MLTM decided to use the PPP to this project in 2007. At first, it was planned as the BTL project without operation, but the MLTM changed to include the operation and the project is in negotiation with the private sector.

This chapter explores how the BTL model including the operation was introduced to the rail transport in South Korea for the first time and examines whether the BTL model is an appropriate decision to the Daegok-Sosa Railway project compared with the BTO model through the quantitative VFM assessment, the qualitative VFM assessment and the sensitivity analysis.

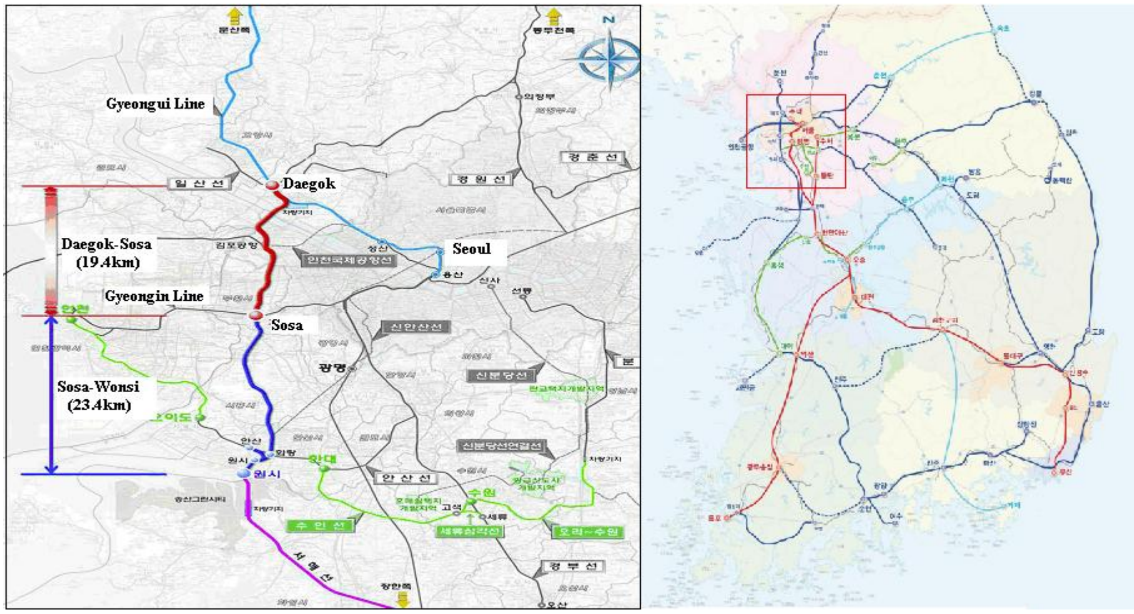
8.2 Summary of the project

8.2.1 Details of the project

The Daegok-Sosa Railway is a part of national rail network to link the West coast line and Gyeongui line[25] which connects Seoul with Shinuijoo of North Korea. The Daegok-Sosa line is planned to provide a rail service to the western of Seoul Metropolitan area. Also, this is aiming to fulfil a western arterial rail network to prepare to connect with North Korea area (Choi, 2009).

Total length of this project is 19.4km, and it has one train base and five stations where three stations are underground. The construction period is 5 years and the designed building cost is ₩1,625 billion which is the price in 2008 (PIMAC, 2009). In the PPP option, the actual building cost can be reduced by bidding, so PIMAC assumed the building cost as ₩1,526.2 billion by considering bidding rate in other PPP cases. Thus, the assumed building cost in the PIMAC report is used in this chapter. The project was planned to launch the construction in 2011 and to be operated from 2016.

Figure 8.1 The Daegok-Sosa railway line map



Source: MLTM

[25] The Geyongui line has been blocked since 1945 by the separation between South and North Korea.

8.2.2 History of the project as a PPP

The first railway BTL cases were the Gyeongjeon line and the Jeolla line. However, the BTL was only for the part of construction and the train operation was still on the public sector, KORAIL, which is the only public train operator of national rail network in South Korea. These BTL railway cases were part of a national rail network, so it was thought to be difficult to transfer an operation right to the private sector. However, the BTL model without operation made people doubt the necessity of the PPP for rail as there was little possibility for the private sector to be creative or effective in construction stage under the circumstance that the private sector follows the master plan and regulations on railway (NABO, 2007). The BTL model without operation was thought as another bidding way for the railway construction (Cheong, 2006).

From 2006 to 2007, a feasibility test for the Daegok-Sosa Railway project was done and the master plan was made. The basic design was executed by the Korea Rail Network Authority from 2008 to 2009. Through the VFM assessment of the PIMAC of the KDI (2009), the project was decided to be done by the BTL model. The BTL was analysed to give better VFM than the PSC by ₩101.8 billion (NPV in 2009) when the rate of profit was 5.31% and the operation period was 20 years after construction. In the BTL model assessed by the PIMAC, it was assumed that the private sector constructs the facility and maintains the facility without the operation of train and station.

However, considering sceptical opinions on the BTL model without train operation for rail as mentioned above, the MLTM decided to include train operation to the PPP. According to an interviewee from the MLTM in 2010, the positive appraisal on the performance of the Seoul Metro line 9, where the private sector operates train and station independently with the public operator in other urban rails, became one of the important reasons to change the policy. The MLTM aimed to introduce the competitiveness of the private sector to the national rail service and to upgrade the service quality and the efficiency of the rail industry. Especially, including train operation could be a big advantage to the BTL project, because the demand and opinions of the train operator became to be included to construction from the design stage by that the private sector controls construction and operation together.

8.3 Quantitative VFM assessment

8.3.1 Basic assumption for case study

The project seems to be postponed because of delayed negotiation, but this study is for comparing the BTL with the BTO option in the stage of project planning. Thus, it is analysed in the assumption that the design is completed in 2010 and the construction starts from 2011 to 2015. The operation begins in 2016 and it is operated by the private sector for 20 years which is common in the BTL projects in Korea.

The date for calculating life cycle cost is June 2009 when the VFM assessment for the BTL was done by the PIMAC. The price is assumed to rise by 3.88% per year during construction period, which is the GDP deflator for construction investment, and by 3.14% per year during operation period.

Data such as forecasted passengers in the quantitative VFM assessment are collected from the report of the KOTI (Choi, 2009).

8.3.2 Lease fee

The lease fee is calculated by the following formula;

$$Aunnal lease\ fee = \frac{Total investment - the present value of the additional incomes}{PVIFA(n,k)}$$

The total investment of the private sector presented by the report of PIMAC is ₩1,526.2 billion for construction and ₩24.3 billion for buying trains. The assumed nominal rate of profit in this report was 5.31%, which was calculated by the average interest rate (4.59%) of a five-year national bond of Korea for a year before assessment and the additional interest rate (0.72%) for a long term investment. The additional incomes from the incidental facility were not considered in this project. The operation period is 20 years, so the PVIFA (20, 5.31%) = 12.141 and the annual lease fee is ₩127.7 billion.

8.3.3 Operating cost

Operating cost can be divided into the cost for facility operation such as rail or station maintenance and the cost for train operation. The BTL report of the PIMAC (2009) does not consider the cost for train operation, because this project was planed as the PPP only for the facility except the train operation. It needs to assume the operating cost when the PPP covers whole services including operating train as currently discussed between the government and the private sector. It is assumed that the operating cost is the same in the BTL and the BTO model. Though there seems to be the possibility that the operating cost of the BTO model, in which the private sector can make an additional profit through saving cost in operation, is lower than the BTL model, it is difficult to deal with this factor quantitatively, because the private sector does not open the data to the public even if they saved the cost in operation. Operating cost of the BTL model for facility operation can be found at the Daegok-Sosa VFM assessment report (PIMAC, 2009). It was expected to be ₩403.9 billion in total for 20 years when an inflation rate is assumed as 3.14% which is an average value for previous three years from 2005 in Korea.

The cost for train operation needs to be assumed in this study. The feasibility test for the project, which was done for the government direct investment by the KOTI (Choi, 2009), shows the train operation cost is anticipated to be ₩36.4 billion in real prices and it is ₩61.3 billion in nominal prices when the inflation is 3.14%. Though this cost was derived based on the assumption that the public sector operates the train, but this value can be used in comparing the PPP model with each other because this cost is not big when it compared with the facility operation cost and the same values are used in both PPP models. Also, the sensitivity of the VFM to the operation cost will be analysed, so the effect of the operation cost can be tested. Consequently, the operation cost for the BTL and the BTO options are same and the nominal cost is ₩465.2 billion.

8.3.4 Revenue

Like other cases, the revenue is assumed as the same in both PPP models. Choi (2009) anticipated that the revenue of the Daegok-Sosa rail project is ₩992.5

billion (nominal price) by 2036 when it is operated by the public sector like other national rails. This value is used in this case study.

8.3.5 Subsidy

This project is planned as the BTL model, so subsidy for the BTO option should be assumed. The appropriate subsidy for the project depends on how much the public sector approves a profit rate for the private sector. The rate of profit is determined by the negotiation between the public and the private sector. For this negotiation and the VFM assessment, the MOSF recommends considering an average loan rate, risk sharing by the government, the size and kind of project, a risk premium and the level of profit rate of other PPP projects. Based on this guideline, the MLTM (2007a) suggests to use an average of profit rates in previous BTO projects, as seen in Table 8.1, with some consideration of the current bank interest, as an appropriate rate of profit in the BTO model.

Table 8.1 Rate of profit of BTO road project in South Korea

Project	Rate of profit (nominal)	Project	Rate of profit (nominal)
Incheon Airport Ex.	15.19%	Gwangju ringroad (2nd)	14.30%
Daegu-Busan	14.85%	Cheolmasan tunnel	13.99%
Seoul belt way	15.00%	Manwoelsan tunnel	14.30%
Daegu ring road(4th)	16.00%	Misiryeong tunnel	15.00%
Cheonan-Nonsan	14.70%	Average	14.81%

* Annual inflation is assumed as 5%. Source: MLTM

Table 8.2 Rate of profit of BTO rail project in South Korea

Project	Rate of profit (nominal)	Project	Rate of profit (nominal)
Choep light rail	16.00%	Incheon Airport rail	15.95%[26]
Seoul-Hanam	16.00%	Seoul Metro no. 9	14.35%
Busan-Kimhae	15.75%	Average	15.61%

* Annual inflation is assumed as 5%. Source: MLTM

[26] In chapter 7, the nominal rate of profit of the Incheon Airport Railway was 13.85%, because the inflation was assumed as 3.1%.

However, considering recent financial market it looks too high to use the average rate of profit. Above shown cases were mostly launched around 2000 when the bank interest was quite high since the East Asia financial crisis in 1997. In the case of 5 year national bond of Korea, it was 8.66% in 2000 but it was 5.28% in 2009 which is the basis year of this case study (KOFIA, 2011). On the other hand, after the abolition of the MRG regulation in 2009 and global financial crisis, many PPP road projects have failed to finance regardless of low bank interest. The possibility of inducing the private investment to a rail project is even harder than road in the BTO model. Thus, the nominal profit rate of BTO case uses the same rate of profit of the most recent rail BTO case. It is the Seoul Metro no. 9 and the nominal profit rate is 14.35% when the inflation is 5%. In this case, the inflation is 3.14%, so the nominal profit rate is assumed as 12.32%. Especially, in 2005, the PIMAC of the KDI (2005) analysed that the profit rate of the project phase 2 for the Seoul Metro 9 was appropriate to use the same profit rate with the phase 1. Considering many BTO projects signed after 2007 have a difficulty in financing because of the high risk in demand and uncertainty of long term investment, this rate does not look too high to use, although the basis year of this project is 2009.

The rate of profit of the BTO option is determined by the FIRR (Financial Internal Rate of Return) which is based on the discounted cash flow of the project (KEC, 2007). The FIRR is the discount rate making the NPV of revenue equal to the NPV of cost as shown in the following formula.

$$\sum_{i=0}^{n} \frac{R_i}{(1+r)^i} = \sum_{i=0}^{n} \frac{C_i}{(1+r)^i}$$

* Here, R is the revenue (cash income), C is the cost (cash outcome), and r is the FIRR

Details of revenue, building cost and operating cost are collected from the VFM report of KOTI (Choi, 2009). The Korean government provides the construction subsidy with a proportional rate on the construction cost. The subsidy for construction in the BTO option can be calculated by analysing the cash flow with assumed profit rate above mentioned. In this case, the government subsidy rate making the discounted cash flow with the profit rate zero is 92.19% and Table 8.4 shows the result to analyse the appropriate construction subsidy based on the above equation.

Table 8.3 Construction subsidy from the government

Unit: billion KRW (nominal price)

Year	Annual cost during construction				
	Construction	Subsidy	Train	Cash flow (out)	DCF*
SUM	**1,526.2**	**1,407.0**	**24.3**	**119.2**	**88.4**
2009					
2010	45.9	42.3		3.6	3.2
2011	136.9	126.2		10.7	8.5
2012	276.4	254.8		21.6	15.2
2013	390.6	360.0	8.1	30.5	24.3
2014	499.4	460.4	8.1	39.0	26.3
2015	177.0	163.2	8.1	13.8	10.9

Year	Annual revenue and cost during operation			
	Revenue	Operation	Cash flow (in)	DCF
SUM	**992.5**	**465.2**	**527.3**	**88.4**
2016	38.2	17.1	21.1	9.4
2017	39.2	17.6	21.6	8.5
2018	40.2	18.2	22.1	7.8
2019	41.3	18.7	22.5	7.1
2020	42.4	19.3	23.0	6.4
2021	43.5	19.9	23.5	5.8
2022	44.6	20.5	24.0	5.3
2023	45.8	21.2	24.6	4.8
2024	47.0	21.9	25.1	4.4
2025	48.2	22.5	25.6	4.0
2026	49.4	23.3	26.2	3.6
2027	50.8	24.0	26.9	3.3
2028	52.3	24.7	27.5	3.0
2029	53.8	25.5	28.2	2.8
2030	55.3	26.3	29.0	2.5
2031	56.8	27.1	29.7	2.3
2032	58.5	28.0	30.5	2.1
2033	60.1	28.9	31.2	1.9
2034	61.8	29.8	32.0	1.8
2035	63.6	30.7	32.9	1.6

* DCF: Discounted Cash Flow, the FIRR (here, discount rate) is 12.32% (nominal)

8.3.6 Summary of the analysis factors

Input factors used in this case study are as follows (Value written in this section is a nominal price);

- Building cost: ₩1,526.2 billion

- Operating cost: ₩465.2 billion
  Facility maintenance and operation: ₩403.9 billion
  Train operation: ₩61.3 billion

- Operation period: 20 years

- Construction subsidy: ₩1,407.0 billion
  Government expenditure based on 5-year Korea national bond: ₩1,739.1 billion

- Annual lease fee: ₩127.7 billion per year for 20 years

- Nominal rate of profit: 5.31% in the BTL, 12.32%[27] in the BTO

- Financial discount rate: real 5.5%, nominal 8.81%

- Inflation which is used in an operation stage: 3.14%
  GDP deflator for construction which is used in a construction stage: 3.88%

- Revenue: ₩992.5 billion

8.3.7 Result

The quantitative VFM of the BTL model compared with the BTO model in the Daegok-Sosa railway project is ₩266.3 billion. It means that the BTL model, which is currently chosen PPP model, provides more value for money than the BTO model. Real financial discount rate used here is 5.5% which was recommended by the KDI in 2008 and nominal rate is 8.81% when the inflation is 3.14%

[27] Rate of profit in the BTO model means the FIRR (Financial Internal Rate of Return).

Table 8.4 Quantitative VFM assessment in the Daegok-Sosa Railway

Unit: billion KRW (nominal prices)

Year	BTO		BTL			VFM	
	Gov. subsidy	Gov. Expenditure	Lease fee	Operating cost	Revenue	Nominal	NPV
SUM	1,407.0	1,739.1	2,554.2	465.2	992.5	-287.8	266.3
2009						0.0	0.0
2010	42.3	0.0				0.0	0.0
2011	126.2	2.0				2.0	1.7
2012	254.8	8.0				8.0	6.2
2013	360.0	20.0				20.0	14.3
2014	460.4	37.0				37.0	24.2
2015	163.2	101.0				101.0	60.9
2016		190.6	127.7	17.1	38.2	84.1	46.5
2017		313.3	127.7	17.6	39.2	207.2	105.4
2018		406.5	127.7	18.2	40.2	300.8	140.7
2019		489.8	127.7	18.7	41.3	384.6	165.3
2020		170.9	127.7	19.3	42.4	66.2	26.2
2021			127.7	19.9	43.5	-104.2	-37.8
2022			127.7	20.5	44.6	-103.7	-34.6
2023			127.7	21.2	45.8	-103.1	-31.6
2024			127.7	21.9	47.0	-102.6	-28.9
2025			127.7	22.5	48.2	-102.1	-26.4
2026			127.7	23.3	49.4	-101.5	-24.2
2027			127.7	24.0	50.8	-100.9	-22.1
2028			127.7	24.7	52.3	-100.2	-20.1
2029			127.7	25.5	53.8	-99.5	-18.4
2030			127.7	26.3	55.3	-98.7	-16.8
2031			127.7	27.1	56.8	-98.0	-15.3
2032			127.7	28.0	58.5	-97.2	-13.9
2033			127.7	28.9	60.1	-96.5	-12.7
2034			127.7	29.8	61.8	-95.7	-11.6
2035			127.7	30.7	63.6	-94.9	-10.6

8.4 Qualitative VFM assessment

This chapter examines the following four issues of the qualitative VFM assessment suggested in the methodology chapter.

8.4.1 Service quality

Many researchers explain that the big advantage of the PPP is improving the quality in the public service (HM Treasury, 2008, Szejnfeld, 2009, Herpen, 2002). This seems possible through the creativity and competition of the private sector. KDI (2009a) says that the service quality of the PPP option is expected to be higher than the PSC when the competition between the private sectors to bid is as high as possible. In general, the private sector seems to be more sensitive to the end users in the BTO model (see section 3.4.4). An interviewee from the private rail operation company argued that the Seoul Metro no. 9 constructed by the BTO model could be a good example of improving the service quality through the PPP (Ⓑin section 3.5 in APPENDIX 4). Passengers of rail are relatively sensitive to service quality such as frequency, on time and comfortableness to choose the transport mode, so the private sector is expected to try to meet the demand of passengers (Park et al., 2007).

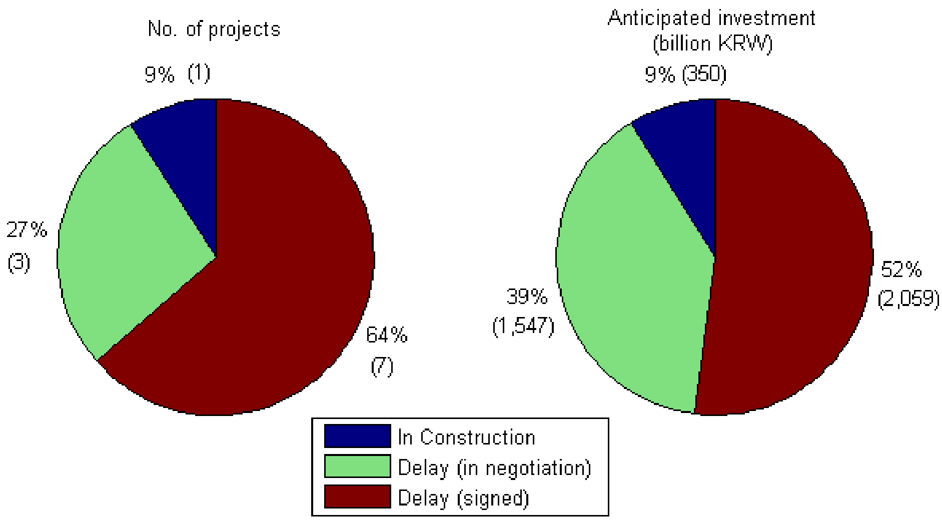
On the other hand, an interviewee from KORAIL said that the creativity of the private sector beyond the performance demand from the public sector was not clear to improve the service quality timely (Ⓐin section 3.4 in APPENDIX 4). He argued that the service quality might be affected by who operated it rather than by which PPP model was used. Especially, the Daegok-Sosa line is a part of national rail network and it can be operated with other public operating rail. Thus, he said that the BTL model can be advantageous in the service quality such as connecting or transferring to other trains and lowering the tariff through sharing common facilities or equipments with the public operator.

Consequently, though there is a possibility that the private sector make more efforts to improve the service quality in the BTO model, it seems difficult to say that the BTO model is beneficial to improve the service quality in this case.

8.4.2 Contract and Management

In recent years, the biggest problem in making a successful contract for the PPP is financing. The global financial crisis negatively impacted on the PPP market not only in South Korea but also in many other countries (European PPP Expertise Centre, 2009). In regard to financing, the BTL model in which the public sector guarantees the revenue looks easier than the BTO model in which the private sector has a risk if there is no risk sharing such as MRG. Especially, the unsolicited BTO projects became more difficult to finance after the abolition of the MRG regulation in 2006 as can be seen in the status of BTO projects decided to proceed in Figure 8.2

Figure 8.2 Status of BTO projects decided to proceed in Korea after 2006



Most interviewees agreed that the BTL model would be easy to finance, so it could make a contract easy (Ⓑin section 3.4 in APPENDIX 4). It means that the BTL model can be better than the BTO model in making a contract.
Management factor is assessed into two sides; one is the ability of the private sector to manage the project and the other is the supervision of the public sector. Actually, this is the first rail BTL project including the train operation, so there is no experience about a performance assessment in operation. In this view, the BTO model which has more experiences including a failed case can be advantageous. However, an interviewee from the MLTM said that the private sector has already experiences in train operation, so it did not seem to have difficulty in operation even in the BTL model (Ⓒin section 3.4 in APPENDIX 4).

Thus, the difference between the BTL and the BTO model in the management of the private sector is not big enough to say a specific model is better.

In the view of the public sector, many interviewees pointed out that there might be little difference in construction stage in both PPP models, but agreed that the BTL model looks easier to be supervised in operation stage than the BTO model by the public sector (Ⓓin section 3.4 in APPENDIX 4).

8.4.3 Risk management

An interviewee in charge of this BTL project said that the private sector did not make an effort to improve the service quality or to suggest a creative idea for better VFM (Ⓔin section 3.4 in APPENDIX 4). They just followed the guideline of the government and seemed passive in the BTL model. In the case of the BTO model, most interviewees consented that this project is a part of national rail network, so it might be limited to incentivise good risk management even in the BTO model (Ⓕin section 3.4 in APPENDIX 4). Consequently, it seems difficult to find the better PPP model in risk management.

8.4.4 Operational flexibility

In previous cases, the private sector and the public sector had opposite opinions on the better PPP model in an operational flexibility (see section 5.4.4, 6.4.4 and 7.4.4). The private sector preferred the BTO model for this issue, but the public sector argued that the BTL model is better to cope with the change of circumstances or technologies in operation stage. However, unlike other PPP cases, interviewees from the private sector agreed that the operational flexibility in the BTO model would be very restricted, because this project was a part of national rail network (Ⓖin section 3.4 in APPENDIX 4). Respondents of the public sector argued that the need for an operational change such as train time and equipment by the public sector was expected to be high (Ⓗin section 3.4 in APPENDIX 4). Thus, for this project, the BTL model looks better in an operational flexibility

8.5 Sensitivity analysis

This case is in negotiation and it has not been started yet, so main factors of VFM assessment such as construction cost, operation cost, rate of profit are possible to change. The VFM assessed in previous sections is based on the point estimation, so a review of the sensitivity of important factors is needed.

The MOCT (2007a) recommended analysing the sensitivity of operation period, level of tariff, demand, construction cost, operation cost and subsidy from the public sector. Level of tariff and demand are related with each other, and it can be considered at the same time with the revenue factor. In this BTL project, the KDI analysed the sensitivity of profit rate, construction cost and operation cost, because the BTL does not need to analyse the revenue which is decided by the construction and operation cost. There is no subsidy in the BTL model, so it does not need to be considered.

However, this case study is for comparing the BTL with the BTO model, so more factors need to be analysed. Thus, the sensitivity of revenue, construction cost, operation cost and profit rate[28] to the VFM is analysed.

8.5.1 Revenue

The MOCT (2007a) suggests that the range of sensitivity analysis in the level of tariff is ±10% of expected value. The guidance of the MOCT also says that demand, which is expected passenger in this case, does not need to analyse in the case of analysing the tariff because the change of tariff can affect the same with the change of passengers (ibid). In other words, in the VFM assessment of PPP model, tariff and demand can be analysed with revenue, so the sensitivity analysis of the revenue to the VFM can cover the tariff and demand factor at the same time. However, the range of sensitivity analysis is likely to be changed, because the number of passengers was quite different with forecasted. In recent, there are few rail cases that the real passengers are more

[28] In case of BTO model, profit rate is directly related with the subsidy, and there is no subsidy in the BTL model, so the sensitivity of subsidy does not need to be analysed separately.

than expected, and in the Incheon Airport Railway case, the real passengers were only 7% of anticipated. Thus, this case study analyses from 10% to 100% for the range of sensitivity analysis of revenue.

Table 8.5 Sensitivity to revenue

Unit: billion KRW

Actual passenger	BTO	BTL			VFM
	Subsidy (Gov. Exp.)	Lease fee	Operating cost	Revenue	
100%	840.4	712.1	119.2	257.2	266.3
90%	840.4	712.1	119.2	231.5	240.6
80%	840.4	712.1	119.2	205.8	214.9
70%	840.4	712.1	119.2	180.0	189.1
60%	840.4	712.1	119.2	154.3	163.4
50%	840.4	712.1	119.2	128.6	137.7
40%	840.4	712.1	119.2	102.9	112.0
30%	840.4	712.1	119.2	77.2	86.3
20%	840.4	712.1	119.2	51.4	60.5
10%	840.4	712.1	119.2	25.7	34.8

The result shows that the VFM of the BTL is always positive and it means that the BTL model gives better VFM than the BTO model regardless of how many passengers will be in real. The reason looks that the subsidy from the public sector, which is more than 90% of total construction cost, is too high. It is to guarantee the profit to the private sector in the BTO model, but 92.19% of building cost seems to be unacceptable to the government. This high subsidy is due to the high construction cost and low revenue, and it is much related with the construction and operation circumstance of this rail. This project passes Seoul metropolitan area, so the construction cost is much higher than any other region for over pass or underground facilities. Operation wise, the tariff is not easy to be raised as main role of this rail is commuting in the western Seoul metropolitan area.

Consequently, this analysis shows that this project seems much better to do with the BTL model regardless of traffic forecast. This result quantitatively shows that the current rail BTL policy is right and why the BTO model is difficult to choose under the current rail circumstance that the profitability is low because of high construction cost and low revenue.

8.5.2 Construction cost

This project is in negotiation, so the construction cost can be changed afterwards. Thus, it needs to analyse the sensitivity of construction cost. The MOCT recommends doing the sensitivity analysis of construction cost with the range from ±5% to ±15%. Construction cost also affects other costs such as design cost, financial cost, etc., so building cost including these costs is analysed in this case study. The following table shows the NPVs of each VFM factors.

Table 8.6 Sensitivity to construction cost

Unit: billion KRW

Construction cost	BTO	BTL			VFM
	Subsidy (Gov. Exp.)	Lease fee	Operating cost	Revenue	
-15%	703.6	605.2	119.2	257.2	236.4
-10%	749.2	640.8	119.2	257.2	246.4
-5%	794.8	676.4	119.2	257.2	256.4
0%	840.4	712.1	119.2	257.2	266.3
5%	886.0	747.7	119.2	257.2	276.3
10%	931.5	783.3	119.2	257.2	286.3
15%	977.1	818.9	119.2	257.2	296.3

Lower construction cost benefits the BTO model and higher construction cost benefits the BTL model. It is because that the government subsidy in the BTO model, where the profit rate is higher, is more sensitive to the construction cost than the lease fee in the BTL model. More construction cost can burden more expenditure of the government in the BTO model and less construction cost can also save more expenditure of the government in the BTO model.

8.5.3 Operating cost

The MOCT recommends analysing the operating cost from ±10% to ±20%. Following table shows the result and the operating cost seems not affective to the VFM in this case. Operating cost is compensated in the BTL model by the public sector, so higher operating cost burdens more cost to the public sector. However, the public sector does not cover the variation of operating cost in the

BTO model. Operating cost is one of factors to decide a profit rate in the BTO model, but the risk of operating cost is on the private sector in the actual operation stage.

Table 8.7 Sensitivity to operating cost

Unit: billion KRW

Actual Operating cost	BTO	BTL			VFM
	Subsidy (Gov. Exp.)	Lease fee	Operating cost	Revenue	
-20%	840.4	712.1	95.3	257.2	290.2
-10%	840.4	712.1	107.3	257.2	278.2
0%	840.4	712.1	119.2	257.2	266.3
10%	840.4	712.1	131.1	257.2	254.4
20%	840.4	712.1	143.0	257.2	242.5

8.5.4 Rate of profit

Rate of profit is very important factor to induce the private sector to the PPP project, so the sensitivity of the profit rate needs to be considered before negotiation with the private sector. In the BTO model, the rate of profit is directly related with subsidy, and it is related with the lease fee in the BTL model. Profit rate of each model is different, so the sensitivity is analysed separately.

Following result shows that the rate of profit is a decisive factor affecting much to the VFM in the BTL model. Lease fee is calculated by the rate of profit, so the VFM seems very sensitive to the rate of profit.

Table 8.8 Sensitivity to the rate of profit (BTL)

Unit: billion KRW

Profit rate (BTL)	BTO	BTL			VFM
	Subsidy (Gov. Exp.)	Lease fee	Operating cost	Revenue	
5.3%	840.4	712.1	119.2	257.2	266.3
6.3%	840.4	772.8	119.2	257.2	205.6
7.3%	840.4	835.8	119.2	257.2	142.6
8.3%	840.4	900.9	119.2	257.2	77.5
9.3%	840.4	968.0	119.2	257.2	10.4

Table 8.9 Sensitivity to the rate of profit (BTO)

Unit: billion KRW

Profit rate (BTO)	BTO	BTL			VFM
	Subsidy (Gov. Exp.)	Lease fee	Operating cost	Revenue	
9.3%	813.6	712.1	119.2	257.2	239.5
10.3%	823.7	712.1	119.2	257.2	249.6
11.3%	832.6	712.1	119.2	257.2	258.5
12.3%	840.4	712.1	119.2	257.2	266.3

A rate of profit of the BTO case is much less sensitive to the VFM than the BTL case. A rate of profit is calculated based on the investment of the private sector and the construction subsidy is over 90% in this case. The investment from the private sector in the BTO model is only ₩119.2 billion while it is ₩1,550.5 billion for the BTL model. Therefore even if the profit rate of the BTO case is much higher than that of the BTL case, the influence on the VFM is not big by the profit rate of the BTO case.

Consequently, this result shows that the BTL model in this case is better than the BTO model regardless of profit rate because an amount of subsidy in the BTO model is too much.

8.5.5 Stochastic analysis

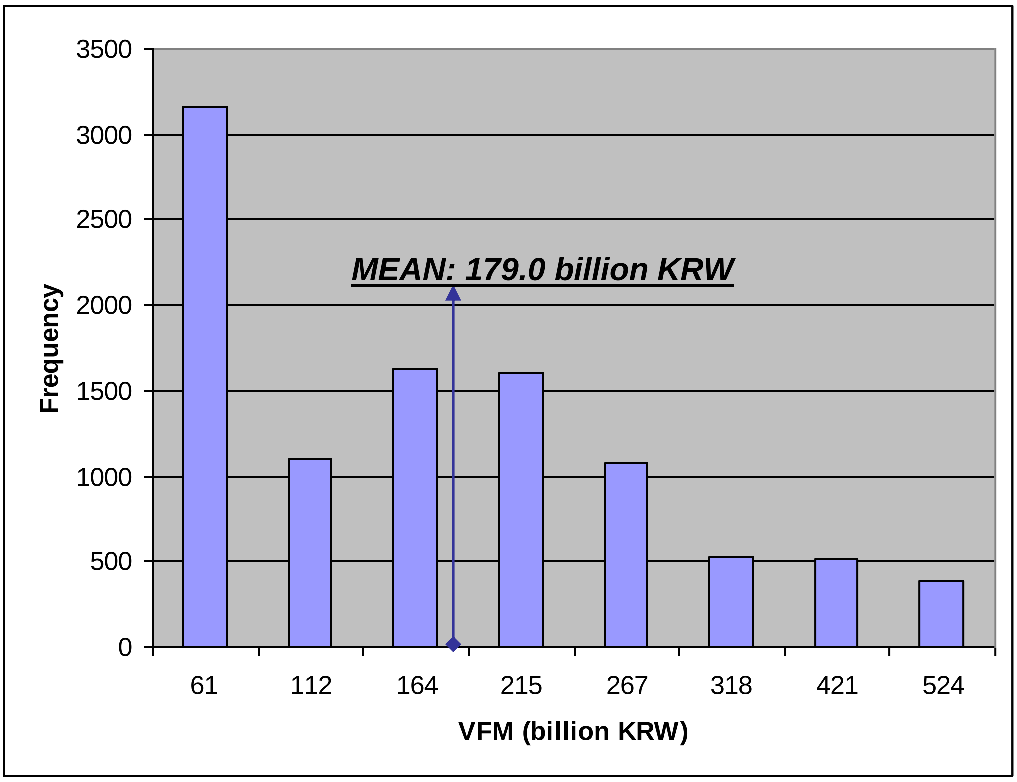
The most serious problem of VFM analysis is that uncertainty of input data is too big, so the fidelity of the result based on the point estimation is likely easy to be doubted. In the case of the construction cost, operation cost and rate of profit which are main factors to analyse the VFM, the private and public sectors have enough experiences and uncertainty is relatively low. However, uncertainty of traffic forecast is a big issue in South Korea.

Differently with road cases, there are not enough data in rail so this analysis cannot be used for PPP decision tool right now, but this try can be a good example of using stochastic analysis. In near future, this analysis based on accumulated data or other countries' experience data can be helpful to choose the optimal PPP model. Probability of rail traffic forecast was presented in Chapter 7 based on the actual traffic data of 19 rail projects. This chapter uses the same data for the stochastic analysis of traffic forecast.

In fact, this case does not need to analyse the stochastic analysis only to find an optimal PPP, because it is found through the sensitivity analysis of revenue that the BTL model is always better than the BTO model regardless of traffic demand risk. However, the reliability of VFM can be shown through the stochastic result.

Following graph shows the result of Monte Carlo simulation for the probability of the VFM by the traffic demand risk. The iteration was undertaken 10,000 times and the mean value of VFM is ₩179.0 billion and standard deviation is ₩121.5 billion. The mean value is lower than the VFM presented in the point estimation by ₩87.3 billion. It means that the BTL model does not perform as well as expected though it looks better than the BTO model.

Figure 8.3 VFM by the probability of traffic forecast in the BTO without MRG option



8.6 Findings

Through the quantitative and qualitative VFM assessment and sensitivity analysis for the Daegok-Sosa Railway case, four results were found.

Firstly, the BTL option for the Daegok-Sosa railway provides better quantitative VFM than the BTO option. In this case, the BTL option gives higher VFM compared with the BTO by ₩266.3 billion. The reason seems due to the government subsidy reaching 92% of total building cost in the BTO option. The subsidy was decided in the level compensating for the profit rate of the private sector under the circumstances of high construction cost and low revenue.

Secondly, it is disputable which PPP model is better in the service quality. The private sector can be more sensitive to the service quality in the BTO option, because the investment and profit is recouped through charging passengers. However, in this case as a part of national rail, several service attributes such as train frequencies, level of tariff is related with other networks, so the BTL option which is easy to be controlled by the public sector may have advantages.

Thirdly, the BTL option seems to be better to the public sector than the BTO option in the operational flexibility to cope with the change of circumstances. In the BTL option, the public sector pays lease fee based on the performance assessment, so the public sector can have more flexible rights in operation.

Fourthly, the sensitivity analysis including stochastic method shows that the BTL option always gives better VFM to the public sector in this case. Forecasted passengers (which were tested through the revenue analysis), construction cost, operation cost and even rate of profit could not change the positive VFM result negatively. It means that the main idea for the BTO was not available in the national rail network of which construction cost was high and the level of tariff and passengers were expected to low was right.

Consequently, the BTL option for the Daegok-Sosa Railway looks appropriate. This case study shows quantitatively why the BTL model could be better to national rail network than the BTO model which has been the most prevalent PPP model for transport infrastructures.

CHAPTER 9

Case study in the Seoul Metro 9

9.1 Introduction

The Seoul Metro 9 is a solicited BTO project operated for 30 years from 2009 with MRG condition and it is the first PPP case for a subway in South Korea. Subway is a typical form of public transport in Seoul and rail including subway carried around 34.5% of total passenger transport in Seoul in 2008 (KOTI, 2009b). As the dominant part of public transport, the level of tariff is regulated by the local government. It means that revenue is strictly restricted by the government and the private sector can find it difficult to have an appropriate profit only through charging a toll to end users in the BTO model. Thus, this project was divided into two parts to reduce the excessive burden of the private sector. The first part is the lower structure for the tunnel and track bed which was done by the local government and the second part is the upper structure for the station, track and equipment. The PPP was done only for the construction of upper structure and operation.

This project has been known as a successful BTO case in the rail field, because actual passengers were up to around 83% of the forecasted in 2010 and several operation systems which look innovative appealed to people who were sceptical about the PPP. However, the appraisal of the project is still controversial because the public sector provided the MRG up to 90% of the expected revenue and the public sector was burdened by the construction of the lower structure which was around 70% of total construction cost.

This chapter examines whether the BTL could be the better PPP option than the BTO model through the quantitative VFM assessment, the qualitative VFM assessment and the sensitivity analysis. In addition, it is examined whether the level of MRG was appropriate.

9.2 Summary of the project

9.2.1 Details of the project

The Seoul Metro 9 is a subway to connect Gimpo Airport with Gangnam area which is the centre of business in southern Seoul. Seoul is one of the most populated cities in the World, so the subway is the most important public transport in Seoul metropolitan area under the restriction of land use.

Table 9.1 Population density of major cities in OECD countries

City	Seoul	London	Tokyo	Berlin	Paris	New York
Population density (person/km^2)	16,700	5,100	4,750	3,750	3,550	2,050

Source: (Kim and Kim, 2009)

The construction of subway network of Seoul has been led by the Seoul Metropolitan Government (SMG) and there are three construction phases. The first phase was from subway line number 1 to 4 and they were constructed from 1971 to 1985. It has a total length of 131.6km and cost ₩2,958 billion and the subway line 3 and 4 was intended to induce the private investment but it failed because of no bidders. The second phase was from line number 5 to 8 and they were constructed from 1989 to 1998. It has a total length of 173.2km and cost ₩8,830 billion. The Seoul Metro 9 is the first project of the third phase (Lee et al., 1996).

The Seoul Metro 9 consists of two stages: the first stage is from the Gimpo Airport station to the Shinnonhyun station and the second stage is from the Shinnonhyun to Bohun hospital. The first stage has a total length of 25.5km and has 25 stations and one depot. The second stage which is in construction has a total length of 13.6km and has 13 stations (Seoul Metro Line 9 Co.Ltd, 2010). This chapter studies the first stage which was constructed from 2005 to 2009, and is already in operation. The first stage project was divided into the lower structure part such as construction of bedding and tunnel and the upper structure part such as setting up train system, construction of stations and operation. The PPP was used only for the upper structure and the building cost was ₩1,056 billion in ₩3,464 billion of total project cost in nominal prices (Kim, 2010b).

Figure 9.1 The Seoul Metro route map

Source: (Kim, 2010b)

9.2.2 History of the project as the PPP

According to Lee et al (1996), the reason for introducing the PPP to the subway was to lessen the financial burden of the SMG. Some 90% of the debt of the SMG in 1996 was due to the construction of subway phase 1 and 2. The PPP was attractive to cope with the lack of budget problem of the public sector, but the PPP for whole projects in phase 3 was analysed to be inappropriate because of low rate of return in the view of the private sector and high pressure on increasing tariff level in the view of the public sector. It was recommended that a few sections or lines in phase 3 projects had feasibility with the PPP.

In 1997, the SMG made a plan to construct 25.5km of a section of subway line no.9 from Gimpo to Gangnam through the PPP with central and local government subsidies. The master plan was ratified by the MOCT in 2000, and the SMG started negotiation with the preferred bidder, ULTRA CONSTRUCTION Ltd., to launch the construction from 2001. However, the negotiation was ruptured and the construction was delayed because of the discrepancy between construction cost and financing plan between the SMG and the preferred bidder. The SMG reopened bidding and got an agreement in 2005 with the second preferred bidder, the ROTEM, a train company of Korea.

The level of tariff for the subway was difficult to be freely decided by the private sector and it made the private sector be unsure about the profitability. Thus, the public sector had to do many parts of the project by its own direct investment to induce the private investment successfully. According to Seoul Development Institute (SDI, 2001), fully privately funded PPP was not recommended because the size of project was too big to ensure competition. Considering the possibility of PPP failure, it could be also too risky to the public sector who wanted on-time construction. Instead, SDI suggested three options of partly privately funded PPP by what functions would be transferred to the private sector. The first option was to transfer the operation function including the purchase and maintenance of trains to the private sector. The second option was to add building the electrified train power system to the first option. The third option was to add construction of station, incidental business to the second option. Basically, the reason of inducing the private sector was to lessen the financial burden of local government and to introduce the competitiveness of the private sector to subway operation. Thus, the third option which had the biggest private investment and was expected to have enough competitions among private sectors was chosen. The third option was designed for the private sector to invest ₩493.8 billion for the upper structure. Table 9.2 shows details of project cost and construction subsidy.

Table 9.2 Project cost and construction subsidy for the Seoul Metro 9 PPP

Unit: billion KRW (prices in 2000)

Project cost	2,416.2		
Project division	Lower structure	Upper structure (722.7)	
Project participant	Public sector	Private sector	
Investment	1,693.5	Public subsidy 228.9	Private investment 493.8

Source: SDI (2001)

The contract was made in May 2005 based on the above third option. The construction was started by the BTO model from May 2005 and it opened in July 2009. There was no BTL model at that time in South Korea, so other PPP models were not regarded. The operation period was 30 years and 90% of the revenue was guaranteed for the first five years, along with 80 % for the next five years and 70% for the five years after that.

9.2.3 The appraisal of the project as a PPP

Unlike other BTO with MRG projects, this project was appraised as the first successful BTO project by the private sector and procurement authority. Actual passengers reached more than 80% of the anticipated and different services with public subway operator were shown. Most other BTO projects with the MRG in South Korea were criticised because of excessive guaranteed revenue and exaggeration in traffic forecast. The PPP case of the Seoul Metro 9 is affecting other public subway companies. According to Kim (2010b), operational employees of the VEOLIA RAPT, which is the private operator of the Seoul Metro 9, are only 44% of the public operating subway and operation cost is around 45% of the public operator. Innovative systems such as one-man stations and on board monitor systems could minimise employees in operation.

Table 9.3 Comparison of operational employees and cost in the Seoul Metro 9

	Seoul Metro 9	Public Companies							
		Mean	Seoul (1~4)	Seoul (4~8)	In cheon	Dae jeon	Daegu	Busan	Gwang Ju
Employees /km	21	48	73	44	35	28	38	36	27
Operation cost/km	2.4 bn KRW	5.4	8.0	4.9	4.4	3.8	4.7	4.3	3.2

Source: Kim (2010)

In addition, various facility and services such as express train system, convenience store for ticketing, free wireless internet, LCD monitor for advertisement in station and train, etc. looked the positive results of the PPP.

Figure 9.2 Upgraded facility and service of the Seoul Metro 9

However, several controversies about tariff and revenue subsidy are existent despite a positive appraisal from the private and public sector. The contracted standard tariff level was ₩1,264 in 2009 (2003 price), but the SMG requested to reduce to ₩900 which is the common tariff level of public operators. Instead the SMG provided revenue subsidy to compensate for the loss of the private sector. As a result, the number of actual passenger was around 80% of the forecasted but the actual revenue was only 50.3% of that expected, so the SMG had to pay ₩14.3 billion to the private sector as a revenue subsidy in 2009 (Lee, 2010a). Criticism on the public sector which made a contract with high tariff level was inevitable. Especially, the SMG invested around 80% of total project cost and the private sector was in charge of only 20% of total investment. Considering the most important reason of the PPP was to cope with the lack of budget, it looked that the public sector’s investment was too big. This problem looks to be recognised to the public sector, because the second stage of subway line no.9 is being constructed by the direct investment of the public sector though the SMG argues that the PPP for the Seoul Metro 9 is successful.

Problems also are shown in the view of the end users. The private sector is operating four-cabin trains regardless of high demand from the commuter passengers. The capacity of facility is designed for an eight-cabin train, but train can be operated flexibly. Thus, it is doubted that the private sector wants to maximise the profitability and does not regard comfortableness of customer seriously. Complaints about late response from the private sector to the end users are rising though newly upgraded services and facilities (Lee, 2010b).

Consequently, direct share holders of the project want the Seoul Metro 9 to be appraised as a successful BTO project because of high traffic demand and upgraded services. However, there are still controversies about its appraisal because of the appropriateness of guaranteed revenue and much more investment from the public sector than the private sector. Opponents are arguing that the guaranteed revenue and much investment from the public sector might make the purpose of the BTO project meaningless. Thus, it seems too early to tell its success in this study, but the issues mentioned above needs to be examined when the BTL model is analysed as an alternative PPP model instead of the BTO with MRG model.

9.3 Quantitative VFM assessment

9.3.1 Basic assumption

The date for calculating life cycle cost is 2000 which was the base year in SDI report for the feasibility and VFM assessment of the BTO case. The quantitative VFM is assessed through the analysis of the discounted cash flow of the project, and it needs a financial discount rate to calculate this. Korean VFM guidance for the BTO model (KDI, 2007a) recommends using 6% (real) based on the WACC (Weighted Average Capital Cost) method. This project was assessed in Jan 2001, and bank interest of that time was much higher than now. SDI used 8.9% as real financial discount rate in its report on the VFM of this project and it is similar with the financial discount rate of the Incheon Airport Expressway which used the same base year in the VFM assessment. Thus, the same value with SDI report is used for the real financial discount rate in this case study.

Rate of profit of the BTL, the MLTM recommends it should be the five-year Korea national bond, which can be a standard interest, plus an appropriate mark-up rate for the long term investment. The MLTM suggested 0.77% as an appropriate mark-up rate in a recent railway BTL project (MOCT, 2007c). In addition, there are two more BTL cases of rail in Korea, and mark-up rates are suggested as 0.76% and 0.70%, so the highest 0.77 will be used in the BTL model of Incheon Airport Railway project as a common mark-up rate under Korean financial and construction circumstances (MOCT, 2007c). In 2000, when the VFM was assessed, the mean value of interest of five-year Korea national bond was 8.66%, so the appropriate rate of profit in this case analysis is used as 9.43% in nominal. Inflation is assumed as 5.0% by SDI report, so the real rate of profit of the BTL is 4.22%.

9.3.2 Construction subsidy

This project was partly done by the PPP and the lower structure constructed by the public sector was definitely divided with the upper structure done by the private sector. Thus, the PPP project is only analysed within the upper structure and operation. Though the public sector was in charge of lower structure, the public sector also provided the construction subsidy to the private sector for the upper structure to induce the private investment. As can be seen in Table 9.3 in section 9.2.2, it was recommended for the SMG to burden 31.7% of upper structure building cost by SDI and it was accepted. The building cost for the upper structure is ₩722.7 billion and the construction subsidy is ₩228.9 billion. Consequently, the public sector invested 79.6% of total project cost by its own resource.

This chapter basically follows the accepted recommendation of SDI VFM assessment, so ₩228.9 billion is used for construction subsidy in the BTO model. The life cycle cost (LCC) of the BTO case is measured by the expenditure of the government for subsidy. The financial resources of government expenditure mostly come from tax or debt. In the quantitative VFM assessment for the BTO model, KDI (2007a) recommends that the resource is assumed to come from debt acquired by selling 5-year national bond which is the most common financing way of Korean government. Thus, this study assumes that construction subsidy from the government is financed through the 5-year national bond of Korea and the LCC is calculated based on the government expenditure for repaying debt.

In this case, the interest of 5-year national bond of Korea is assumed as 8.66% which is the average value in 2000. Thus, the government expenditure is ₩408.5 billion in nominal and ₩278.4 billion in real price

9.3.3 Lease fee

Lease fee is calculated by the following formula;

$$Aunnal lease\ fee = \frac{Building\ \cos t - the\ present\ value\ of\ the\ additional\ incomes}{PVIFA(n,k)}$$

Here, n is 30 years. The k means the rate of profit in the BTL model, so the k value in this case is 9.43%. Consequently, the PVIFA(30, 9.43%) is 9.8942.

$$PVIFA(30{,}9.43\%) = \sum_{t=1}^{30} \frac{1}{(1+0.0943)^t} = 9.8942$$

Lease fee is calculated based on the building cost of the private sector in the BTL model. There is no construction subsidy in the BTL model, so the private sector should cover whole building cost for the project. This project is divided into lower structure and upper structure, and the PPP is only for the upper structure. Thus, building cost is ₩722.7 billion in real price and ₩900.0 billion in nominal price. Lease fee is calculated based on a nominal price to assess the impact on the financial burden of the government in the future. However, this case was done by the BTO using real price so the lease fee is used in the VFM assessment in real prices which are calculated from the nominal prices.

There are incidental incomes in this case by linking commercial complexes with the stations, and it is expected to have revenue by ₩269.0 billion for 30 years in real price. Base year of the present value of the incidental incomes is 2007 when the construction completed, so the present value of the incidental income in 2007 is ₩84.8 billion. Thus, the annual lease fee from 2008 to 2037 for 30 years is ₩82.4 billion per year (nominal). Total lease fee is ₩2,472.0 billion in nominal prices and it is ₩900.2 billion in real prices.

9.3.4 Operating cost

Operating cost was assumed as the same in the BTO and the BTL case. According to the SDI report (2001), the operation period is 30 years from 2008 to 2037 and the operation cost is ₩1,342.5 billion in real prices for 30 years.

9.3.5 Revenue

The revenue which is collected by charging a tariff to the end users is assumed the same in both PPP models. In fact, the private sector can make more efforts to increase the incomes from passengers, but this factor is difficult to be quantified, so it is dealt with in the qualitative assessment. According to SDI report (ibid), the forecasted revenue of the BTO model is ₩4,374.7 billion in real price for 30 years.

9.3.6 Summary of the analysis factors

- Building cost: ₩722.7 billion (real), ₩900.0 billion (nominal)

- Operating cost: ₩1,342.5 billion (real)
- Operation period: 30 years (2008~2037)
- Construction subsidy (BTO model only): ₩228.9 billion (real)

  Government expenditure: ₩278.4 (real)
- Annual lease fee: ₩824 billion (nominal)
- Rate of profit

  Nominal: 9.43% in the BTL, 14.35% in the BTO

  Real: 4.22% in the BTL, 8.86% in the BTO
- Real financial discount rate: 8.9%
- Inflation: 5.0%
- Revenue: ₩4,374.7 billion (real)

9.3.7 Result

The quantitative VFM of the BTL model compared with the BTO model in the Seoul Metro 9 project is ₩252.2 billion. It means that the BTL model provides more value for money than the BTO model in this project. It looks a natural result like other cases, because the profit rate of the BTL model is much lower than the BTO model. As seen in the following table, revenue collected from passengers is ₩4,374.7 billion and it is over the sum of lease fee and operating cost. It means that the government can make a profit through revenue collected from the end users after providing lease fee and operating cost in the BTL model.

Table 9.4 Quantitative VFM assessment in the Seoul Metro 9

Unit: billion KRW (in real prices)

Year	BTO	BTL			VFM	
	Subsidy (Gov. Exp.)[29]	Lease fee	Operating cost	Revenue	Real price	NPV
SUM	278.4	900.2	1460.2	4374.7	2292.8	252.2
2000	0.4				0.4	0.4
2001	1.1				1.1	1.0
2002	3.6				3.6	3.0
2003	6.2				6.2	4.8

[29] Gov. Exp. means the Government expenditure for construction subsidy.

2004	13.4				13.4	9.5
2005	18.0				18.0	11.8
2006	38.4				38.4	23.0
2007	41.8				41.8	23.0
2008	42.4	55.8	36.1	23.6	-25.9	-13.1
2009	41.1	53.1	39.5	34.3	-17.2	-8.0
2010	40.9	50.6	40.2	45.0	-4.9	-2.1
2011	31.2	48.2	40.9	55.7	-2.2	-0.9
2012		45.9	41.6	66.4	-21.1	-7.6
2013		43.7	42.2	77.0	-8.9	-2.9
2014		41.6	42.9	87.7	3.2	1.0
2015		39.6	43.6	98.4	15.2	4.2
2016		37.7	44.3	105.0	23.0	5.9
2017		36.0	44.9	111.7	30.8	7.2
2018		34.2	45.6	118.3	38.5	8.3
2019		32.6	46.2	124.9	46.1	9.1
2020		31.1	46.9	131.6	53.6	9.7
2021		29.6	47.6	138.2	61.0	10.2
2022		28.2	48.2	144.8	68.4	10.5
2023		26.8	48.9	151.4	75.7	10.7
2024		25.5	49.5	158.1	83.0	10.7
2025		24.3	50.2	164.7	90.2	10.7
2026		23.2	51.0	171.9	97.8	10.7
2027		22.1	51.7	179.1	105.3	10.5
2028		21.0	52.5	186.3	112.8	10.4
2029		20.0	53.2	193.5	120.3	10.1
2030		19.1	54.0	200.7	127.7	9.9
2031		18.2	54.7	207.9	135.0	9.6
2032		17.3	55.5	215.1	142.4	9.3
2033		16.5	56.2	222.3	149.6	9.0
2034		15.7	57.0	229.5	156.9	8.6
2035		14.9	57.7	236.7	164.1	8.3
2036		14.2	58.5	243.9	171.2	8.0
2037		13.5	59.2	251.1	178.4	7.6

9.4 Qualitative VFM assessment

This section examines four issues based on the interviews of the PPP experts in South Korea; service quality, contract & management, risk management, and operational flexibility.

9.4.1 Service quality

Like other rail PPP cases, most interviewees agreed that the private sector seems to be more sensitive to the end users in the BTO model (Ⓐin section 3.5 in APPENDIX 4). However, several respondents pointed out that the advantage of the BTO model in service quality could be realised only when there was no MRG condition (Ⓑin section 3.5 in APPENDIX 4). They argued that if a BTO project had a MRG condition, the revenue would be guaranteed to the private sector and efforts to improve service quality could be decreased. As can be seen in the complaints of the passengers mentioned in the section 9.2.3, the private sector can be passive when their revenue is guaranteed regardless of demand.

Also, an interviewee said that the service quality of the Seoul Metro 9 could be upgraded because there were enough competitions among subway operators (Ⓒin section 3.5 in APPENDIX 4). The operator of the Seoul Metro 9 had to show the effectiveness of the private sector compared with two other public subway operators in Seoul for sustaining PPP in rail. As can be seen in the Incheon Airport Railway which did not have a competitor in rail, the service such as introducing an express train was upgraded by the public operator after they bought most equities of the private sectors. The interviewee pointed out that there were more competitors in the Seoul Metro 9 than other railways (Ⓓin section 3.5 in APPENDIX 4). In urban area, the subway has to compete not only with cars but also local buses and the BRT (Bus Rapid Transit) in Seoul. Thus, the BTO model is expected to have strength in improvement of the service quality and have more benefits in urban subway than national arterial rail because of enough competitions. However, like other BTO cases, the MRG can affect the advantage of the BTO model negatively.

Service quality should be discussed with a tariff for assessing the value for money. Regardless of improved service quality, there are some complaints on subsidy from the SMG and high tariff level in the BTO option (Lee, 2010b). The rate of profit of the BTL option is lower than the BTO, so tariff level could be lowered in the BTL option. This possibility is a big advantage of the BTL model.

Consequently, the BTO model can be better to improve the quality of subway service, but the MRG condition may diminish this strength by the extent of the guarantee. The tariff level is also an important factor to assess the VFM of the service quality, and the BTL model is more advantageous than the BTO because the tariff level can be reduced by the low profit rate of the BTL option.

9.4.2 Contract and Management

With regard to contract, many interviewees said that financing was a key issue to make a contract and the BTL model looked easier to induce the private investment because there was no demand risk on the private sector (Ⓔin section 3.5 in APPENDIX 4). However, the BTO option of the Seoul Metro 9 had the MRG condition, so financing did not look difficult at that time. At first, the Seoul Metro was supposed to be operated from 2007, but it was delayed because negotiation, which was started from 2002 with the first preferred bidder, was ruptured in 2003. The SMG announced that the main reason was the ambiguous financing plan of the preferred bidder (Mun, 2003). Another preferred bidder was chosen soon and the contract was made in 2005. It shows that there was enough competition between the private sectors. An interviewee of the investment bank said that a financial investor could prefer the BTO with the MRG model than the BTL model (Ⓕin section 3.5 in APPENDIX 4).

With regard to the project management, the experience about the BTL model is not accumulated as much as the BTO model. It can cost more in the BTL model, but it does not seem to last for a long time. Except for the experience factor, many interviewees agreed that the difference between the BTL and the BTO in project management would be little (Ⓒin section 3.5 in APPENDIX 4). Instead, some of them pointed out that the ability of the private and public sector was more important than a kind of PPP model (Ⓗin section 3.5 in APPENDIX 4). According to the study on the critical success factors for the PPP in the UK(Li et al., 2005b), a strong private consortium was also the first factor for the success of the PPP. Consequently, the project management looks to be decided by the ability of each sector rather than the PPP model.

9.4.3 Risk management

Like other cases in this thesis, interviewees said that the appropriate risk management is variable by terms and conditions (Ⓘin section 3.5 in APPENDIX 4). However, the BTL model seems to need more cooperation between the private and public sector. The BTO model has a simple incentive scheme for the good risk management. The private sector is compensated for by the end user, and its risk management is assessed by the traffic demand. On the other hand, the BTL model needs a relatively complicated scheme to measure its performance of risk management of the private sector. This complexity wants a good relationship between the private and the public sector. NAO (National Audit Office) of the UK also pointed out the complexity of the deal as a problem and one of reasons resulted from the innovative output-based contracts which are used in the BTL model (NAO, 2004). The recent failed London Underground PPP case of the UK shows that the main reason was due to its poor corporate governance and leadership (NAO, 2009).

Several respondents said that the simplicity of risk management in the BTO model is a very strong advantage (Ⓙin section 3.5 in APPENDIX 4). Especially, the experiences in the BTL model for transport are not accumulated enough in South Korea, so the governance or sustained relationship for the BTL model in transport between the private and public sector does not look existent.

Consequently, it cannot be said that a specific PPP model is better in risk management, because risk management is based on the agreed contract of each PPP model. However, the BTL model needs much more relationship between the private and public sector for risk management while it assessment of good risk management is very simple in the BTO model. Thus, the BTL model might be disadvantageous in the circumstance that does not have a strong governance or relationship between the private and public sector.

9.4.4 Operational flexibility

The private sector has to discuss with the public sector when the operational circumstances get changed in the BTL model while the private sector has relatively high discretion in the BTO model even with the MRG condition. Interviewees from the private sector alleged that they were more sensitive to the change of circumstances or technology in the BTO model (Ⓚin section 3.5 in APPENDIX 4). A respondent from the public sector said that the private sector was only interested in making a profit, so the technology or innovative skill might be only adapted when it could make an additional profit in the BTO model. Even though the private sector could save operating cost or increase revenue, its profit might be included to the private sector as an incentive in the BTO model, so there would be little to increase the VFM in the view of the public sector.

Respondents from the public sector argued that it was easy to request operational change in the BTL model through performance assessment. Even the in case of affecting the profit of the private sector, the public sector can have more options to be involved in the operation stage than in the BTO model (Ⓛin section 2.3.5 in APPENDIX 4).

Consequently, the BTL seems better than the BTO in operational flexibility in the view of the public sector, but it costs more money and time. The government has few rights in the operation stage in the BTO model, but the government needs to monitor the operation stage to give the lease fee correctly according to the conditions of payment in the BTL model. The government can discuss operational problem with the private sector whenever they pay, and they have more opportunities to change the operation condition according to the change of circumstances. However, for this kind of governmental role, it needs more administrative efforts like time and cost for experts.

9.5 Sensitivity analysis

This project was done by the BTO model and it is in operation from 2009, so many input factors such as construction cost, subsidy and operation cost in the VFM assessment are already fixed. On the other hand, the BTL case for this project was analysed based on several assumptions. It means the better PPP model can be changed by the uncertainty of these assumed factors. Especially, the most decisive difference between the BTO and the BTL model is who is in charge of demand risk, so the uncertainty of revenue which is decided by the traffic demand and tariff level needs to be examined. The difference in demand risk makes a gap of profit rate between the BTO and the BTL model. Thus, this section examines the sensitivity of revenue. After, the stochastic analysis based on the inaccuracy of traffic forecast in South Korea will be done.

9.5.1 Revenue

Revenue which is decided by the traffic demand and tariff level is the most disputable issue in the BTO projects, especially in case with a MRG condition. Though the MRG can be a rational policy tool in the BTO model to share demand risk, but opinions that the MRG is excessive in this project also are rising. In the BTO case for the Seoul Metro 9, it has the MRG condition which covers 90% of revenue for the first 5 years, 80% from the sixth year to the tenth year and 70% from the eleventh year to the fifteenth year. If the actual traffic is below 50% of expected, there is no MRG to avoid the intentional exaggeration in traffic forecast by the private sector. Thus, analysing the sensitivity of revenue is very important to examine the optimal PPP model in the view of VFM.

Revenue does not affect the LCC of the BTO without MRG case. Here, the LCC is calculated in the view of the public sector, so the only factor in the LCC calculation of the BTO case is the construction subsidy. An appropriate government construction subsidy is calculated based on the revenue and profit rate, but it is negotiated by the private and public sectors. If only the construction subsidy is agreed in the BTO model, the public sector does not provide additional construction subsidy by the actual revenue. In this case, the construction was completed and the final construction subsidy was not much changed with the data used in this chapter. Thus, the revenue only affects the LCC of the BTL case.

Table 9.5 Sensitivity to revenue in case without MRG

Unit : billion KRW (NPV)

Actual traffic	BTO	BTL			VFM*lo*
	Con. subsidy (Gov. Exp.)	Lease	Operation	Revenue	
100%	146.7	220.7	254.0	580.3	252.3
90%	146.7	220.7	254.0	522.3	194.3
80%	146.7	220.7	254.0	464.2	136.2
70%	146.7	220.7	254.0	406.2	78.2
60%	146.7	220.7	254.0	348.2	20.2
56.5%	146.7	220.7	254.0	328.0	0.0
50%	146.7	220.7	254.0	290.2	-37.9

Table 9.7 shows that if actual revenue is over 56.5% of the expected, the BTL model has higher VFM than the BTO. On the contrary, the BTO model is better when actual revenue is lower than 56.5% of the expected. The Demand risk is on the private sector in the BTO model, which can have higher profit rate because of high risk in traffic demand, so if the actual demand is lower than the anticipated then the BTO model can be beneficial to the government. However, lower actual revenue than expected negatively affects the profit rate of the private sector. This risk makes the BTO project less attractive to the private sector, and the PPP could be failed because of the difficulty in financing from the private sector. Thus, the BTO projects before 2006 had a MRG condition to share the traffic demand risk with the public sector.

The Seoul Metro 9 also has the MRG condition and the revenue affects the LCC of the BTO case. The subsidy is offered in the operation stage to compensate for the lack of guaranteed revenue. According to the MRG condition of this project, there is no MRG when actual traffic is below 50% of the contracted, so the BTL model provides better VFM than the BTO even in case with MRG when the actual traffic is more than 50% of the expected. Table 9.8 shows the change of VFM by an actual revenue level in case with the MRG condition.

Table 9.6 Sensitivity to revenue in case with MRG

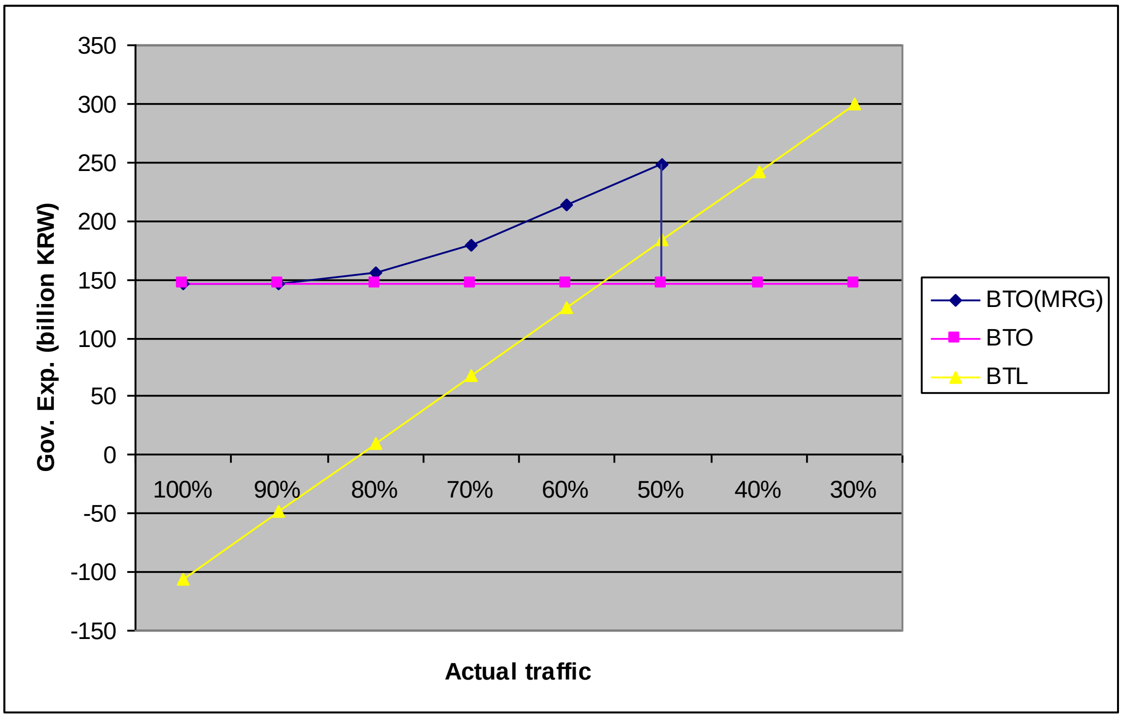
Unit : billion KRW (NPV)

Actual traffic	BTO		BTL			VFM
	Con. Subsidy (Gov. Exp.)	Operation subsidy	Lease	Operation	Revenue	
100%	146.7	0	220.7	254.0	580.3	252.3
90%	146.7	0	220.7	254.0	522.3	194.3
80%	146.7	9.3	220.7	254.0	464.2	145.5
70%	146.7	31.8	220.7	254.0	406.2	110.0
60%	146.7	66.2	220.7	254.0	348.2	86.4
50%	146.7	100.7	220.7	254.0	290.2	62.9
40%	146.7	0	220.7	254.0	232.1	-95.9
30%	146.7	0	220.7	254.0	174.1	-153.9

Interestingly, though actual traffic was around 80% in 2009, actual revenue was only 50.5% (Lee, 2010a). The SMG cut the tariff level by 25% of the contracted (₩1,200 → ₩900) instead of providing additional subsidy to compensate for the lack of expected revenue. It looked politically hard for The SMG to accept much higher tariff level than the public operated subway. However, it does not affect the VFM of the BTL compared with the BTO, because reduced tariff level also raises LCC of the BTO case through providing operational subsidy while it raises LCC of the BTL case through decreasing revenue. Considering that actual traffic is around 80% of the contracted, the BTL seems better PPP model than the BTO regardless of MRG condition.

Figure 9.3 shows the LCC of BTO, BTO with MRG and BTL case. The VFM is measured by the difference of the LCC which means the government expenditure on the PPP project in this study. The LCC of the BTO model is constant regardless of traffic demand risk, because the private sector has whole demand risk in the BTO model and there is no additional burden to the public sector. The LCC of the BTO and the BTL are same when actual traffic is 56.5% of the forecasted, so if the level of MRG in the BTO case had been below 56.5%, it could be thought as an appropriate level. Even though the public sector guarantees 56.6% of the expected revenue, the expenditure of the public sector is not over the LCC of the BTL case.

Figure 9.3 Life cycle cost of each PPP option by actual traffic



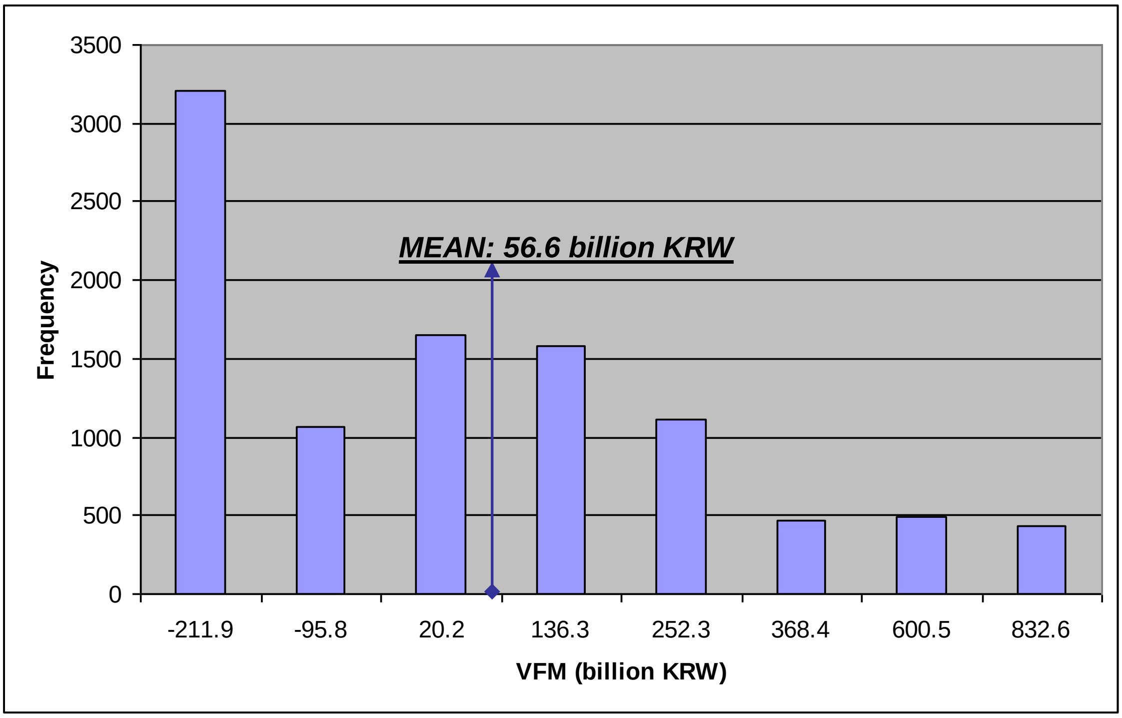
In this case, the MRG covers 90% of the expected revenue for the first five years and it gets decreased by 10% point in every five year for 15 years. The MRG condition is not applied if actual traffic is below 50% of the expected to prevent the private sector from intentional exaggeration of traffic forecast. The appropriateness of this condition is unclear in the sensitivity analysis, so it is dealt with in the section 9.5.2 stochastic analysis based on the probability of traffic forecast in rail in South Korea.

9.5.2 Stochastic analysis

This section examines a stochastic analysis on the VFM comparing the BTL with the BTO model based on the comparison data of forecast and actual number of passengers in rail in South Korea (See Chapter 7). Unlike other case studies in the thesis, contracted tariff in the Seoul Metro 9 BTO case was cut politically, so the accuracy of traffic forecast does not match the accuracy of the expected revenue. However, politically reduced tariff does not affect the VFM assessment for comparing the BTO and the BTL as mentioned in the section 9.5.1. Thus, it is assumed that the tariff in this section is the contracted value, so the uncertainty of revenue is assumed the same with the uncertainty of traffic forecast.

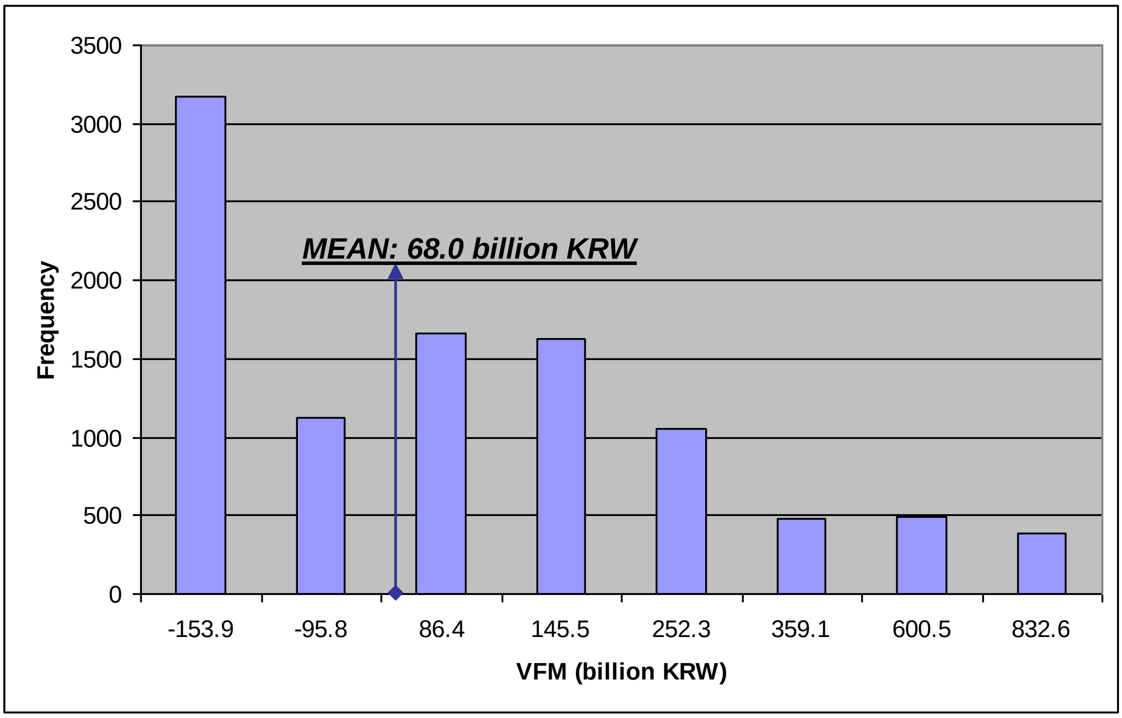
Like other cases, based on the inaccuracy of the passenger forecast in rail in South Korea, Monte Carlo simulation was undertaken to find out the probability of VFM of the BTL compared with the BTO. Figure 9.4 shows the mean value of VFM is ₩56.6 billion and the probability that the BTL model is better than the BTO model is 57.0%. This value is slightly over 50%, and it does not look that the BTL is clearly advantageous because of uncertainty of other factors such as a rate of profit in the BTL case. Especially, the mean value of inaccuracy of traffic forecast in 10 subways opened after 2000 including the Seoul Metro 9 in South Korea is -53.4%. It is much higher than -32.4%, an average of inaccuracy of 19 rail projects which are analysed in Chapter 7. Inaccuracy of -53.4% means that the actual traffic is 46.6% of the expected, so the BTO could provide better VFM in comparison with the BTO without MRG case. Though the number of subway projects is not enough to make a statistically effective result, but the possibility that the BTO model could be better is shown in this analysis.

Figure 9.4 Frequency of VFM by the probability of traffic forecast in the BTO without MRG model



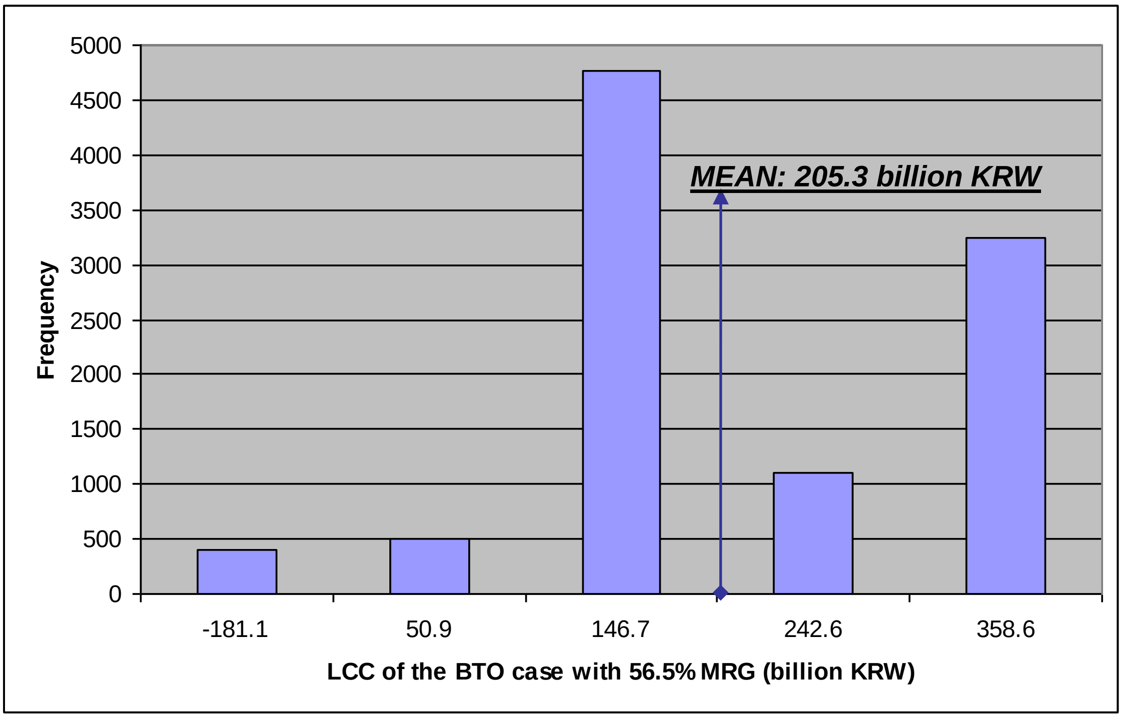
In the BTO case with MRG condition, the possibility that the BTL model is better than the BTO is slightly high, as in the case without MRG. The probability that the BTL gives higher VFM than the BTO model is 57.0%. It is same with the case without MRG condition, because the SMG does not cover revenue when the actual traffic is below 50% of the forecasted. Figure 9.5 shows that the MRG decreased the distribution of the VFM and increased the mean value of VFM.

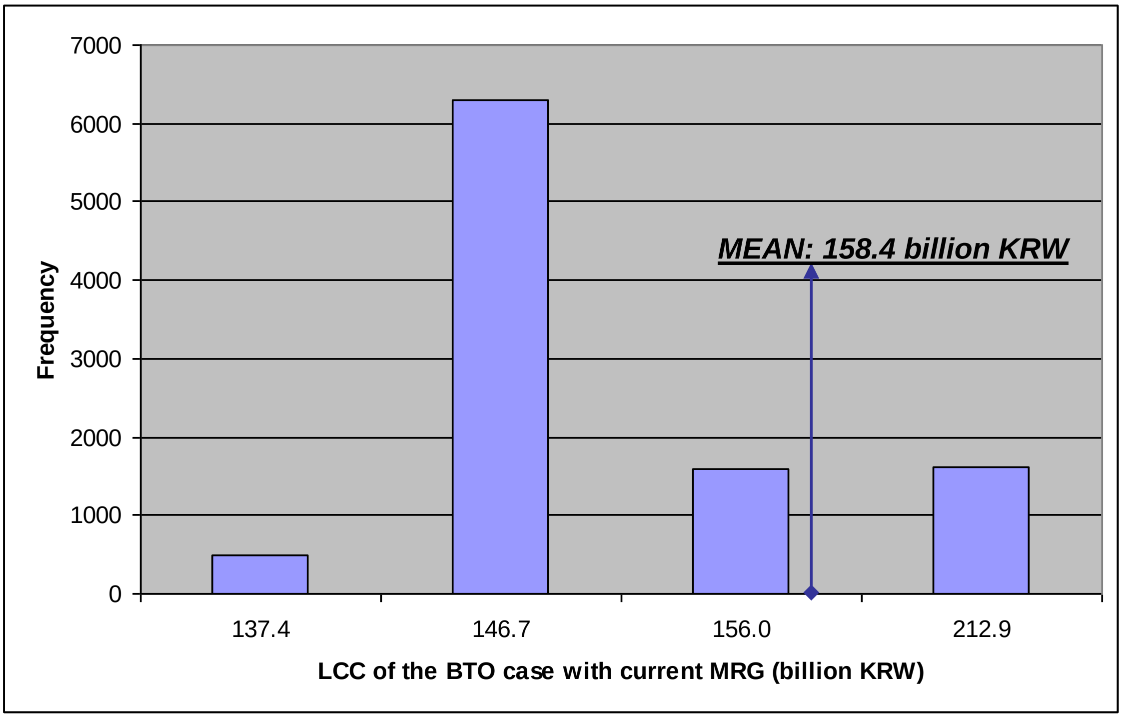
Figure 9.5 Frequency of VFM by the probability of traffic forecast in the BTO with MRG model



With regard to the appropriateness of the MRG, the LCCs of the BTO cases with different MRG conditions need to be compared. As explained in the section 9.5.1, an appropriate level of MRG can be thought as 56.5% of the expected revenue which is same as the cost paid by the public sector in the BTL case. In case of the BTO with the MRG of 56.5%, the expected value of the LCC is ₩205.3 billion when the inaccuracy of traffic forecast in rail in South Korea is considered. On the other hand, the expected LCC of the BTO with the MRG used in the Seoul Metro 9 case is ₩158.4 billion. Thus, the expected LCC of BTO with the current MRG condition is lower than the MRG of 56.6% by ₩46.9 billion. Contrary to common criticisms on the MRG, this result shows that the current MRG condition of the Seoul Metro 9 is not excessive.

Figure 9.6 Frequency of LCC of the BTO case with the current MRG condition and the MRG of 56.5% condition





9.6 Findings

Through the quantitative and qualitative VFM assessment and sensitivity analysis about the BTO and BTL model for the Seoul Metro 9 case, seven characteristics were found.

Firstly, the BTL case can provide better quantitative VFM than the BTO case. The BTL model gives the quantitative VFM compared with the BTO by ₩252.2 billion. It is because the demand risk is on the public sector in the BTL model of Korea, so the SMG can make a PPP contract with the private sector with lower rate of profit than the BTO model in which private sector has to be in charge of demand risk. Demand in subway means passengers and the fare of passenger is the direct source of revenue. As seen in the other cases, the public sector pays a lease fee to the private sector but can collect fares from end users, so the public sector can make a profit in the BTL case

Secondly, the BTO case can be a better option than the BTL case to improve the quality of service of subway. Subway competes with the bus service, so the BTO model which collects tariff from the end user may be more sensitive to improvements in the quality of service. However, the MRG in the BTO model can lessen the strength of the BTO model in the service quality by the extent.

Thirdly, the BTO case seems advantageous in risk management though it can be varied by a contract (e.g. MRG). Complexity of risk management in the BTL case is very high, so the BTL model can be appropriate under the circumstances that there are many experiences in the PPP or governance is strong enough to handle unexpected risk. In case of the BTO model, relationship between the private and the public sector is simple.

Fourthly, the BTL case has an advantage in financing under the current unstable financial circumstance. However, the BTO case can be more preferred by the financial investor if the MRG condition is applied.

Fifthly, the BTL case seems to be better than the BTO case in operational flexibility for the public sector to cope with the change of future circumstances. Considering the qualitative VFM is also assessed in the view of the public sector, the SMG can have more discretion in the BTL model during operation period through the payment mechanism. However, it can be realised when the relationship or governance between the private and the public sector is strong enough to handle this.

Sixthly, considering the uncertainty of traffic forecast in rail in South Korea, the probability that the BTL case is better than the BTO case is around 57% regardless of the MRG condition. If the actual passengers are below 56.5% of the forecasted, the BTO without MRG case can provide better VFM than the BTL case. In case of the BTO with MRG case, it can be better to the government than the BTL when the actual traffic is below 50% of the forecasted. Though the BTL case is still advantageous even when traffic forecast risk is considered, but the probability is slightly over 50% and there are many other uncertain factors affecting the VFM, so it seems difficult to say the BTL case is clearly better.

Lastly, the MRG in the Seoul Metro 9 case does not look a bad deal though there are many criticisms on the level of MRG up to 90% for the first five years. The contracted MRG is decreased by 10% point in every 5 year, and there is no revenue subsidy after 15 years. Also, the revenue is not covered for avoiding intentional traffic exaggeration when the actual traffic is below 50% of the forecasted. Considering the traffic forecast risk in rail in South Korea, the expected LCC of BTO case with the current MRG condition is analysed as lower than the appropriate level which covers LCC as much as the BTL case by ₩46.9 billion. Also, the current MRG condition does not affect the probability of the quantitatively better PPP model.

Consequently, the BTO for the Seoul Metro 9 looks a good alternative PPP model though the BTL model provides slightly better quantitative VFM. Regarding uncertainty of traffic forecast, BTO is better for the public sector to transfer traffic demand risk to the private sector and this makes the BTO model better in service quality and risk management. Recently, the biggest problem of the BTO seems a difficulty in financing, but this case could be more attractive than the BTL model through MRG. Differently with many criticisms, MRG condition which covers 70% to 90% of the expected revenue for first 15 years seems to be appropriate.

CHAPTER 10

The Analysis of Case Studies

10.1 Introduction

Five case studies were undertaken to explore the characteristics of the BTO and the BTL models, which were derived from literature reviews as the two best PPP options for Korea, and to examine the optimal PPP model providing better VFM quantitatively and qualitatively. Two cases were for road and three cases were for rail. Road was expressway with toll. One of the three rail cases was for an urban subway and others were for national arterial rails. Four cases used the BTO model and three of them used the MRG condition. Only one BTL case is for rail which is in negotiation between the private and the public sector. This reflects that the use of BTL for transport projects is in its infancy in Korea. The change of VFM by variable input factors was also examined through the sensitivity analysis including a stochastic approach to traffic demand risk. In addition to high traffic demand risk, the MRG condition invited serious issues. Thus, the appropriateness of the MRG which is a policy tool for demand risk sharing in South Korea was also tested.

This chapter attempts to derive key findings on three of the four research objectives from five case studies and literature reviews.

- Main features of PPP models in road and rail in South Korea
- Optimal PPP model providing better VFM for road and rail in South Korea
- Appropriate traffic demand risk sharing in road and rail in South Korea

Based on these findings, several suggestions on transport PPP policy are provided to enhance the PPP in transport in South Korea.

10.2 The main features of the PPP models in road and rail in South Korea

This thesis compares the BTL with the BTO model in road and rail in South Korea. The BTO is a “financially free standing” model which is one of the most prevalent PPP models for transport infrastructure not only in South Korea but also in the world[30] . The BTL model was introduced for the school, military accommodation, sewage facility, etc. with little or no income from the end user, but recently the BTL model has been tried for rail and it is argued that the BTL could be the alternative to the BTO model for road. The BTL model is the “service sold to the public sector” model like the DBFO model in the PFI of the UK. The service sold to the public sector model was rarely used for transport infrastructures in South Korea, but it was very common for transport in the UK (Partnerships UK, 2011).

The main characteristics of the BTO and the BTL models for land transport like road and rail in South Korea were found through the literature review and case studies. General characteristics of each PPP model were also set out by the interviews of 23 PPP experts in South Korea in November 2010. The PPP project could be successful when three stakeholders were satisfied: the public sector, the private sector and the end users. Mostly, the interest of the end user should be covered by the public sector, but the complaints of end users in many PPP cases showed that their interest was not considered enough or even sometimes ignored (Lee, 2005). The appraisals of the PPP projects was different from the view of each stakeholder, so the main features of the PPP model in road and rail were analysed from such three different viewpoints.

Each sector had different interests in the PPP. It was found that the main interest of the public sector was to minimise the government financial burden through saving budget on a project (see section 3.4.4 and 9.2.2). In the Seoul Metro 9 case and the Daegok-Sosa railway case, the creativity and competitiveness of the private sectors were also important interests (see section 8.2.2 and 9.2.2). Considering the public sector should be in final

[30] The BTO model of South Korea is very similar with the BOT model which is very common in other countries.

charge of public service, an appropriate supervision letting the private sector provide the service effectively and efficiently was also a key interest. In the view of the private sector, several literatures and interviews showed that main interests were in making a profit (ADB, 2008, European Commission, 2003). The rate of profit was the most important factor for the private sector. In the current circumstances of South Korea, interviews of the PPP experts showed that the most difficult problem to the private sector was financing, as could be seen in the five case studies (see section 5.4.2, 6.4.2, 7.4.2, 8.4.2 and 9.4.2). The project management of the private sector was also an issue in comparing the BTL with the BTO model, because the private sector has to lead the project in every stage from design, build and finance to operation. The interest of end users should be considered enough by the public sector, because the end user cannot join in negotiation directly. However, the view of the end user has not been regarded important, so this study separated this view from that of the public sector. Literature reviews and several interviews showed that the focus of the end user was on how the service was improved with lower cost and how the operator paid attention to them as customers (HM Treasury, 2000, ADB, 2008). Thus, the main interests were summarised as the improvement of service quality, the communication with the end users and the user fee.

The main interests of the three different views can be summarised in the Table 10.1 and the features of the BTL and the BTO models are discussed by these categories.

Table 10.1 Main interests of three stakeholders of the PPP in South Korea

Stakeholder	Main interests
Public sector	• Government financial burden
	• Creativity and competitiveness of the private sectors
	• Project supervision
Private sector	• Rate of profit
	• Financing
	• Project management
End user	• Improvement of service quality
	• Communications with the end users
	• User fee

10.2.1 The features of the PPP models in the view of the public sector

Government financial burden

A common thought on the BTO model was that it did not need the government investment as it was a “financially free standing” model, so the BTO model was thought to be better to lessen the financial burden of the public sector (Allen, 2001, Song, 2005, KEC, 2007). It was thought that the financial burden of the public sector was higher in the BTL model than that in the BTO model, because the public sector regularly pays contracted lease fee to cover whole building cost, operating cost and even the profit of the private sector. However, five case studies showed that the BTL for transport PPP with income from the end users could be beneficial to save the expenditure of the public sector, because toll road and rail could charge user fee and the revenue could cover whole cost of the public sector in the BTL model (see section 10.2.1 and 10.3.1).

According to the sensitivity analysis of the case studies, the financial burden of the government in the BTO model was less than that in the BTL model only when the accuracy of the anticipated revenue was high enough to cover the LCC of the BTL model (see section 5.5.1, 6.5.1, 7.5.1 and 9.5.1). In a transport PPP charging user fee, revenue for a given fee is decided by the resultant traffic, so a better PPP model for lessening the financial burden of the public sector is affected by the traffic demand risk. The financial burden in the BTL model increased when the actual traffic was lower than expected.

Consequently, the BTL model is better to reduce the financial burden of the government for transport PPP with incomes, but the BTO model can be desirable for the project with high traffic demand risk.

Creativity and competitiveness of the private sectors

The competition between the private sectors was relatively low in the BTO model for transport because the traffic demand risk was on the private sector (see Table 3.5). Interviews for the qualitative VFM assessments of case studies showed that the private sector was sensitive to the demand risk in the BTO model and the creativity and competition could be acquired by the effort of the private sector to maximise traffic demand (Ⓐin section 2.1.2 in APPENDIX 4). Thus, the BTO model seems better for the transport facility where the elasticity of demand with respect to service levels is high.

The competition between the private sectors was relatively high to bid in the BTL model because the private sector did not have to manage traffic demand risk (see Table 3.6). Basically, the level of service is decided by the performance agreement between the private and the public sector. According to several sources in the literature, the public sector can encourage the private sector to make more efforts for creativity and competitiveness when many private sector consortia compete with each other in the bidding process (Shin, 2006, Grout, 2008, KDI, 2009a, Kim et al., 2008a).

In summary, the creativity of the private sector can come out by the effort of the private sector to increase traffic demand in the BTO model and it can come out by the competition among bidders in the BTL model.

Project supervision

Some literature shows that, in a pre-construction stage, the early or on-time procurement of the transport infrastructure is an important motive for the public sector to use the PPP (Estache, 1999, NAO, 2009b, Chen, 2010). However, the problem was that much time and cost is needed in negotiation to get an agreement between the private and the public sectors and to sign a contract (Lee, 2008a). Especially, the Korean government has abolished the MRG condition in the BTO model since 2009 (since 2006 for unsolicited projects). Thus, many BTO projects failed in financing and many of them are pending. Many interviewees agreed that the BTL model was better to finance and to reduce the negotiation time (Ⓑin section 2.1.2 in APPENDIX 4).

In the post-construction stage, the government needs to control several factors such as toll level, frequency of train, charging system, etc. as a part of the transport network. In the BTL model, the government could discuss the performance of the private sector regularly through the payment mechanism based on the performance assessment. However, in the BTO model, the private sector has most rights in operation in return for having the traffic demand risk.

Transport infrastructures are much related with each other and the government may make and activate transport policy affecting the PPP projects. However, the BTO model could be difficult for the public sector to control.

The BTL model needs much more detailed performance assessment and experienced supervision to ensure that the private sector is not chiselling on service quality and quantity (NABO, 2009). In South Korea, there are many experiences in the operation of road and rail by the public operator. KHC (Korea Highway Corporation) and KORAIL (Korea Rail Corporation) are the public owned companies for the operation of road and rail. They have enough ability to supervise the project in road and rail.

Consequently, the BTL model has more advantages in project supervision not only in the pre-construction stage but also in the post-construction stage.

10.2.2 The features of the PPP model in the view of the private sector

Rate of profit

The rate of profit is decided by the negotiation between the private and the public sectors. In the BTO model, the traffic demand risk was on the private sector, so the higher rate of profit was provided to the private sector. Actually other risks such as construction risk and operation and maintenance risks except demand risks did not look much different between the BTO and the BTL models (see section 6.5.2, 6.5.3, 8.5.2 and 8.5.3). Traffic demand was much affected by the government policy or regional development which the private sector could not control. Park (2008) suggested the appropriate rate of profit should be 6.68~7.09% for the BTL model and 8.53%~9.3% for the BTO model in South Korea in his thesis using the CAPM (Capital Asset Pricing Model). Consequently, the BTO model is high risk - high return while the BTL model is a low risk - low return model.

Financing

According to the interviews, financing was a big issue to the private sector under recent unstable economic circumstances (©in section 2.2.1 in APPENDIX

4). Many cases of the PPP for road and rail in South Korea were mega projects of which costs were over $1 billion, so the private sector found it difficult to finance under the current difficult economic times. Especially, the BTO model where the demand risk is on the private sector is more seriously affected by the change of financial circumstances (see section 8.4.2). Relatively, the BTL model is better to finance because the traffic demand risk is on the public sector.

Project management

The five case studies show that the private sector is more independent in the project management in the BTO model. The private sector was more active to manage the project from the construction stage as can be seen in the case study for the Seoul Metro 9.

However, in the cases of road, the role of the private sector in the project management does not look as critical in rail. The process and standard of construction of road are quite regulated, so there is not much room for the private sector to encourage creativity or innovation. Rail is much more complicated and various in its system, equipment and operation than road. Thus, the strengths of the private sector in the BTO model that give more autonomy to the private sector can be easier to come out in rail.

10.2.3 The features of the PPP model in the view of the end user

Improvement of service quality

The private sector was expected to be more competitive and creative to improve the service quality (ADB, 2008, HM Treasury, 2000, KDI, 2006a, Yescombe, 2007). Especially, as seen in the Seoul Metro 9, the service quality was improved more in the BTO model, because the private sector directly charged end users.

However, in the case related to other transport networks, the quality of service can be improved in the BTL model where the public sector can control other public road or rail networks. As seen in the case of the Incheon Airport Railway, it was linked to Korea Train Express (KTX) network after the private sector sold their whole equities to the public operator, KORAIL.

Thus, the BTO model can be better to improve the quality of service in the case that road or rail can be operated independently from the rest of the network. In the case that road or rail is strongly connected with other roads or rail routes, the BTL model can be better because the public sector can lead to manage other networks.

Communication with the end users

It was expected the private sector would communicate better with end users than the public sector in the BTO model, because the private sector make a profit by collecting tolls from end users directly. However, operating transport PPP cases in South Korea had MRG conditions and actual demand was lower than expected in most cases (see Table 3.8). Thus, it was difficult for the private sector to get additional revenue over the guaranteed level by the effort of the private sector to increase demand. As seen in the case of the Incheon Airport Expressway and the Incheon Airport Railway, the moral hazard of the private sector due to the excessive MRG could weaken incentives to enhance the concentration on their customers.

In the BTL model, the customer of the private sector in the BTL model is the procurement authority paying a lease fee to them, so the private sector is likely to communicate with end users based on the contracted performance condition only. According to the interviews, it is difficult to say that the BTL model is always worse in communication with the end users because it is decided by the contract condition. However, usually the private sector is likely to be passive to communicate with end users in the BTL model (Ⓓin section 2.2.1 in APPENDIX 4).

User fee

Mostly, user fee is expected to be higher in the BTO model than the BTL model (see Table 3.9). The private sector has a demand risk in the BTO model, so the rate of profit is higher. Considering that the reason to use the BTO model, which is the “financially free standing” model, is to save the budget of the public sector, the burden to compensate for higher profit is transferred to the end users.

However, in the BTL model, the public sector pays a lease fee regardless of the toll level, so it seems difficult for the government to ignore the complaint of the end users. Most interviewees agreed that the BTL model looked better for the end users to be provided with the service with a lower cost, though it could be an additional burden to the government (Ⓑin section 2.2.1 in APPENDIX 4).

10.2 Optimal PPP model for road in South Korea

10.2.1 Quantitative features of PPP models in road cases

For finding the PPP model giving better VFM, the LCCs of the BTO and the BTL cases were calculated in the Incheon Airport Expressway and the Oksan-Ochang Expressway. The results were summarised in the Table 10.2. The LCC in this table means the government expenditure, so the expected LCC of BTO option in Incheon Airport Expressway was zero, because the private sector paid the whole cost for construction and operation. The LCC of BTL option was expected to be (-) 693.4 billion KRW. The negative value means the public sector can recover its investment in construction and make a profit through charging tolls as well. The LCC of the BTL option in the Oksan-Ochang Expressway is also smaller than that of the BTO option. It shows that the BTL model had higher quantitative VFM because the LCC was lower in the BTL option.

Table 10.2 VFM of case studies in road

Unit: billion KRW (NPV)

Project	LCC(BTO option)	LCC(BTL option)	VFM_{lo}
Incheon Airport Expressway	0	- 693.4	693.4
Oksan-Ochang Expressway	60.9	4.3	56.6

Source: Chapter 5 and 6

Though this result came from the two case studies, the same results are expected to come out in other road PPP cases with the following reasons:

- ***The rate of profit is higher in the BTO model than the BTL model.***

The rate of profit has a big gap between the BTL and the BTO models. Traffic demand risk is on the public sector in the BTL model and it is on the private sector in the BTO model. This difference was anticipated to be 5.82% in the Incheon Airport Expressway and 8.65% in the Oksan-Ochang Expressway (see section 5.3.6 and 6.3.6). The Korean government adds a mark-up interest to the interest of the 5-year national bond for the PPP. Mark-up interest of the BTO projects in South Korea was from 4.84 up to 9.41 (Shin, 2009). However, the government suggests a mark-up rate of the BTL model should be around 0.77% in rail case and it did not exceed 1.0% in other BTL cases such as school and military accommodation (see section 5.3.1).

- ***There can be additional building cost in the case of the BTO project needed to be separated from other transport network.***

As seen in the Oksan-Ochang Expressway case, additional toll collecting system and facility may be needed in the BTO model, because it needs to be operated separately from other road networks (see Figure 6.2). However, in the BTL model, the public sector pays a lease fee and the project can be operated in the same way as other linked roads.

- ***There can be additional operating cost in the case of the BTO project needed to be separated from other transport network.***

In the BTO case, a road needs to be independently operated from other road networks and it can increase the operation cost. It needs more facility and employees for operating increased toll gates. The Incheon Airport Expressway is an exclusive road to the Incheon Airport, so it does not need an additional facility to be operated independently. On the other hand, the Oksan-Ochang Expressway needs additional toll gates on the main road.

Table 10.3 Details of input factors in road case studies

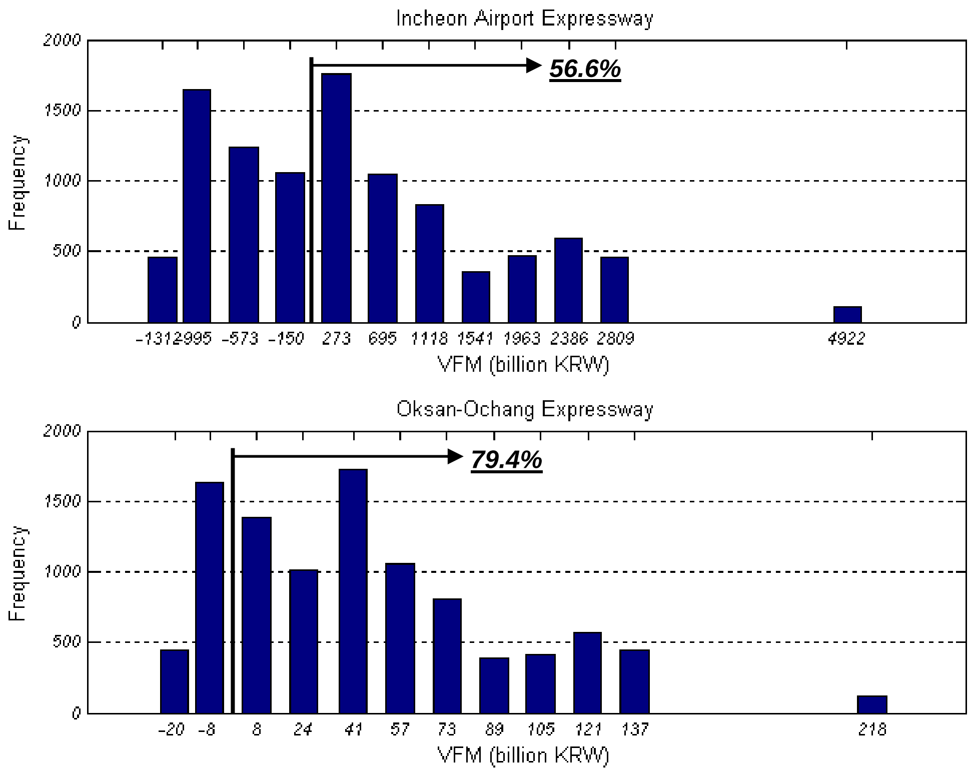
Unit: billion KRW (nominal)

Project	Factor	BTO option	BTL option
Incheon Airport Expressway	Rate of profit (Nominal)	15.19%	9.70%
	Building cost	1,460.2	1,460.2
	Operating cost	5,938.8	5,938.8
Oksan-Ochang Expressway	Rate of profit (Nominal)	14.70%	6.05%
	Building cost	213.8	206.8
	Operating cost	502.6	399.6

Source: Chapter 5 and 6

However, the quantitative VFM was done by the point estimation and many input factors were variable, so the sensitivity of VFM to several input factors was analysed. Many input factors such as construction cost, operation cost, and the rate of profit did not change the optimal PPP model giving the better VFM within the range suggested by the government. The main problem was the traffic volume which was the most criticised factor in South Korea. Considering the probability of the inaccuracy of traffic forecast in road in South Korea, the BTL model was still advantageous in the two expressway cases. Basically, the accuracy of traffic forecast depends on each project, but the stochastic analysis on the two cases showed that the probability was that the BTL model would be better than the BTO model would. In the Figure 10.1, the results of probability of VFM by traffic forecast risk in Incheon Airport Expressway and Oksan-Ochang Expressway are shown from the stochastic analysis in the Chapter 5 and 6. Probability that the BTL model was better in the Incheon Airport Expressway was 56.6% even if there was no MRG condition. In the case with the MRG condition, the BTL model was always better (see section 5.5.2). In the case of the Oksan-Ochang Expressway, the probability that the BTL model would be better was 79.4% (see section 6.5.6). The results of stochastic analysis show that the traffic forecast risk is not high enough to give higher profit rate to the private sector through the BTO model. Thus, considering the traffic demand was the most decisive risk in the transport PPP, the BTO model is not the best choice for road in South Korea.

Figure 10.1 Probability of VFM by the traffic forecasting risk in South Korea



Source: see Figure 5.6 and Figure 6.4

Consequently, the quantitatively optimal PPP model for road in South Korea is thought to be the BTL model. The BTL model gives higher quantitative VFM than the BTO model because of the lower rate of profit reflecting on the low demand risk. Considering the inaccuracy of road traffic forecast, the probability that the BTL model is better is high.

10.2.2 Qualitative features of PPP models in road

In Chapter 5 and 6, qualitative features of PPP models were examined by following four factors; service quality, contract and management, risk management, operational flexibility.

Service quality

Basically, the service quality was affected by the traffic demand in the BTO model and the performance assessment in the BTL model. The service quality in road is assessed by the traffic density affecting speed and congestion and geometric structure of road (Hostovsky et al., 2004, Washburn et al., 2004). These factors were mainly decided by the route or technical standard of road rather than the effort of the private sector (see section 5.4.1). Thus, it was difficult to find a big difference in service quality between the BTO and the BTL model for road. However, if the price for the same service quality is considered, the BTL model in which the price could be lowered seemed to be better. Also, in the case of the BTO model with the MRG condition, interviews showed that the motive to upgrade the service quality could be decreased (see section 5.4.3). Therefore, the BTL model is thought to have an advantage in the service quality of road.

Contract and management

With regard to the management of the project, any difference between both PPP models was not found in the two case studies. However, the BTL model was thought to be better in finance, because fixed revenue is paid by the public sector (see section 5.4.2 and 6.4.2). Considering the most serious problem in making a contract in recent years is the difficulty in financing because of high risk, the BTL model, where demand risk is on the public sector, has an advantage in making a contract.

Risk management

This factor is about incentivising on the good risk management of the private sector. The difference between the BTO and the BTL model was not big in risk management except traffic demand, because risk was managed by the content of contract rather than by the PPP model (see section 5.4.3 and 6.4.3). However, the BTL model could have more advantages for the public sector to incentivise its performance. The public sector could assess the appropriateness of the risk management of the private sector and could incentivise this regularly by performance assessment (see 5.4.3 and 6.4.3). On the other hand, the private sector is responsible for its demand in the BTO model, so the public sector had few roles in the risk management of the private sector.

Operational flexibility

With regard to the operational flexibility, it was explored how the public service could be provided flexibly under varying circumstances or technologies during operation period. In this issue, there were opposite viewpoints. Interviewees from the private sector alleged that the BTO model was better to cope with the change of circumstances, but interviewees from the public sector responded that the reaction of the private sector was available only when the private sector has a benefit (see section 5.4.4 and 6.4.4). Generally roles and responsibilities in an operation stage are decided by a contract on a case-by-case basis (ADB, 2012), but it looks natural that the private sector can be quicker than the public sector to change the operation when it is related with the profit of the private sector (Lee, 2005). In regard to road, the change of operational circumstances is not as fast as other PPP fields such as telecoms and it is affected by network linkages rather than by technology. Thus, the BTL model where the public sector controls and manages the project with other road network seems better than the BTO model.

10.3.3 Optimal PPP model for road in South Korea

In comparison with the BTO and the BTL model for road, the BTL model can be recommended with following reasons;

First, the BTL model gives higher quantitative VFM. The private sector has traffic demand risk in the BTO model, so they can have higher rate of profit. In the BTL model, the public sector has traffic demand risk and revenue is provided to the private sector by the performance assessment. In most BTO cases, it was emphasised that the public sector could pay nothing or a small amount of subsidy to the private sector. However, the public sector can make a profit with the same revenue in the BTL model providing lower rate profit to the private sector. In the BTL model, the profit of the public sector can be used to reduce the toll level or upgrade service.

Second, considering the inaccuracy of traffic forecasting in expressways in South Korea, it does not need to transfer the traffic demand risk to the private sector by using the BTO model. Mean value of inaccuracy of traffic forecasting in 86 expressways in South Korea was only -5.32%. It means that it may not need to transfer the traffic demand risk to the private sector with much higher rate of profit.

Third, traffic demand in road is difficult to be affected by the private sector, so the BTO model cannot be expected to have advantages in upgrading service quality, making a contract, managing risk and operating flexibly. Though the mean value of traffic forecasting was not bad, the variance was big, so it cannot be said that the traffic forecasting is accurate. However, traffic demand in road is much affected by the route and the government policy such as regional development. It shows the BTO model is very limited in controlling traffic demand by its own effort though the private sector is in charge of traffic demand. Thus, the BTO model does not have strength in upgrading service and managing risk by payment mechanism. The high demand risk of the private sector in the BTO model does not look manageable, so it makes it difficult to finance and it is a big obstacle in making a contract.

Consequently, the BTL model looks better for a road PPP project in South Korea.

10.4 Optimal PPP model for rail in South Korea

10.4.1 Quantitative features of PPP models in rail

For finding the PPP model giving higher VFM, the LCCs of the BTL cases were compared with those of the BTO cases in the Incheon Airport Railway, the Daegok-Sosa Railway and the Seoul Metro 9. The results were that the BTL model had higher quantitative VFM if the actual passengers were as many as anticipated. The VFM assessment is done in the planning stage and the traffic forecast is assumed as accurate. Thus, the quantitatively optimal PPP model for rail was the BTL model.

Table 10.4 VFM of case studies in rail

Unit: billion KRW (NPV)

Project	LCC(BTO option)	LCC(BTL option)	VFM_{lo}
Incheon Airport Railway	603.1	-3,032.2	3,635.3
Daegok-Sosa Railway	840.4	574.1	266.3
Seoul Metro 9	146.7	-105.6	252.3

Source: Chapter 7, 8 and 9

Though this result came from three case studies, but the same results are expected to come out in other rail PPP cases because the rate of profit is higher in the BTO model than the BTL model like road cases. The difference of rate of profit between the BTO and the BTL model was anticipated to be 6.68% in the Incheon Airport Railway, 7.01% in the Daegok-Sosa Railway and 4.92% in the Seoul Metro 9.

Table 10.5 Rate of profit in rail cases

Project	BTO (A)	BTL (B)	A-B
Incheon Airport Railway	13.85%	7.17%	6.68%
Daegok-Sosa Railway	12.32%	5.31%	7.01%
Seoul Metro 9	14.35%	9.43%	4.92%

Source: Chapter 7, 8 and 9

However, the more important factor in rail cases is the construction subsidy in the BTO option. Two railway cases (excluding the Incheon Airport Railway, which was expected to have enough incomes from the end user, but after all, it was revealed that traffic demand was overestimated) did not have enough revenues from anticipated passengers to be financially free standing (see section 8.3.4 and 9.3.5). The public sector had to provide construction subsidy and the private sector could save its investment in the project. The rate of profit is only related with the investment of the private sector. Even if the rate of profit of the BTO option might be lower than that of the BTL option, the LCC of the BTO, which was measured by the capital expenditure of the public sector, could be affected little as could be seen in the sensitivity analysis of VFM to the rate of profit of the Daegok-Sosa Railway case (see section 8.5.4). The construction subsidy in the BTO option of the Daegok-Sosa Railway reached 92% of total building cost, because of limited revenue as a part of national rail network.

Table 10.6 The private investment in rail cases

Unit: billion KRW

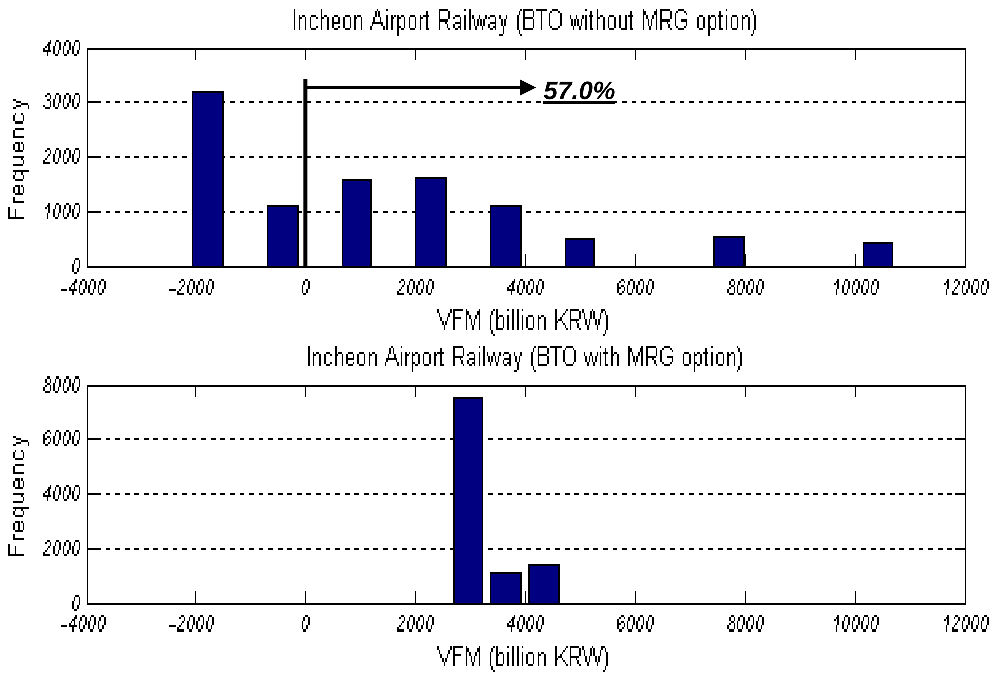
Project	Building cost (A)	Private investment in construction stage		
		BTL	BTO (B)	B/A (%)
Incheon Airport Railway	3,949	3,949	3,186	80.7%
Daegok-Sosa Railway	1,526	1,526	119	7.8%
Seoul Metro 9	722.7	722.7	493.8	68.3%

Source: Chapter 7, 8 and 9

However, quantitative VFM was done by the point estimation and many input factors were variable, so it was needed to check the sensitivity of VFM to several main input factors. Like road cases, forecasted traffic was the most criticised factor. Many BTO cases had less traffic than contracted, so the public sector had to pay revenue subsidy by the MRG condition.

Considering the inaccuracy of traffic forecast in rail in South Korea, the BTL model was still advantageous in the three rail cases. Mean value of inaccuracy of traffic forecast in 19 railway projects in South Korea was -32.4% (see Figure 7.3). Basically, the accuracy of traffic forecast depends on each project, but the stochastic analysis on the three cases showed that the probability that the BTL model would be better was higher than the BTO model would. As seen in the Figure 10.2, the probability that the BTL model was better in the Incheon Airport Railway was around 57% in the case without MRG condition. In the case with a MRG condition, the BTL model was always better. In fact, the actual passengers of the Incheon Airport Railway were around 7% of the expected, so the BTO model, in which the private sector had a traffic demand risk, could be better to the public sector. However, the MRG condition made the strength of the BTO model be faded away.

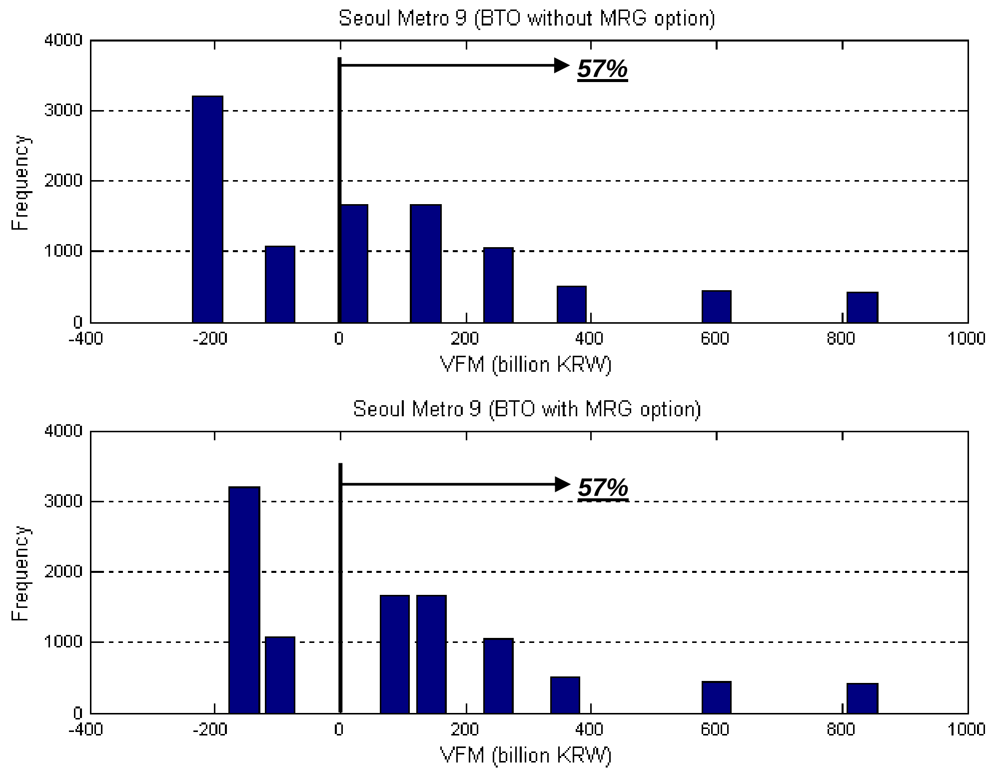
Figure 10.2 Probability of VFM by traffic forecast risk in the Incheon Airport Railway



(See details in section 7.5.2)

In the case of the Daegok-Sosa Railway, the BTL model was always better regardless of the inaccuracy of traffic forecast. It has a small amount of revenue compared with the construction cost, so the result shows that the BTL model chosen in this case was appropriate (see section 8.5.5). As seen in Figure 10.3, the probability that the BTL model was better in the Seoul Metro 9 which was also around 57% in case with no MRG condition. Interestingly, even in the case with a MRG condition, the probability that BTL model would be better was not changed. It means that the MRG condition did not affect to choose the optimal PPP model and it was not excessive unlike other cases.

Figure 10.3 Probability of VFM by the traffic forecast risk in the Seoul Metro 9



(See details in section 9.5.2)

Consequently, the quantitatively optimal PPP model for rail in South Korea is thought to be the BTL model. The BTL model gives higher quantitative VFM than the BTO model because of lower rate of profit. Especially, rail construction and operation need much cost and the revenue was politically limited in usual, so it could be difficult to be done by the “financially free standing” model. Since traffic forecast risk in rail was higher than in road, the BTO model in which the private sector had traffic demand risk, could be beneficial to the public sector in rail. However, the structure of rail project with high cost and low revenue decreases this kind of strength of the BTO model.

10.4.2 Qualitative features of PPP models in rail

Service quality

Like road cases, the important motive to upgrade the service quality is based on the traffic demand in the BTO model and on the performance assessment in the BTL model. Also, the MRG condition could be also an important obstacle to the private sector in improving the service quality. The service quality in rail is assessed by the frequency of train operation, on time operation, comfortableness of cabin, etc (Higton, 2005, Lee, 2006). These services were affected not only by route but by an operator in rail cases. In the case of the national arterial rail network, the service quality was mainly related to the operation of other connected rail (see section 8.4.1). Thus, the BTL model in which the public sector could control general services related to the rest of the rail network could be better. In addition, if the service quality is the same, the price for that service should be considered importantly. Considering the price for the service, the BTL model seemed to be better, because the price would be strictly limited by the public sector in the BTL model. Also, in the case of the BTO model with a MRG condition, it can diminish the motive for the private sector to upgrade the service quality (see section 7.4.1).

Unlike the two other rail cases, the Seoul Metro 9 was connected with different subway lines and had more competitors such as a BRT (Bus Rapid Transit), local buses, bikes and cars, so the private sector could be more active to upgrade the service quality in the BTO model than the BTL (see section 9.4.1). It means that for the urban subway it could be more beneficial to use the BTO model than for the national arterial railway.

Contract and management

The BTL model was thought to be better in finance, because fixed revenue is paid by the public sector. Considering the most serious problem in making a contract has been the financing since the global financial crisis, the BTL model has an advantage in signing a contract. With regard to the project management, it looks to be decided by the ability of each sector rather than the PPP model.

Risk management

Risk management was based on the agreed contract of each PPP case rather than the PPP model (ADB, 2012). However, the BTL model needed much closer relationship between the private and public sectors for risk management while the structure of risk management was very simple in the BTO model. The public sector had to assess the risk management of the private sector through the performance regularly in the BTL model. Thus, the BTL model might be disadvantageous in the circumstances without a strong governance or relationship between the private and the public sector. In South Korea, there are many experiences in construction and operation of rail, but it is still disputable whether strong governance and strong relationships could be forged between the private and the public sectors. However, regarding the interviews from the public sector, it was though the private sector still preferred the BTO model in risk management, because of its simplicity of risk sharing and management in the operation stage of rail (see section 9.4.3).

Operational flexibility

In regard to the operational flexibility, there was the same dispute as with road case. The private sector alleged that the BTO model was better to cope with the change of circumstances, but the public sector said that the private sector would react to the change of circumstances only when they had a profit through changing the operation (see section 7.4.4, 8.4.4 and 9.4.4). However, operational circumstances of rail are related to other rail networks and many of them are needed to be dealt with as a general rail policy or standardisation regulated by the public sector. Thus, the BTL model in which the public sector controls and manages the PPP project with the rest of the rail network seems better than the BTO model in railway.

10.4.3 Optimal PPP model for rail in South Korea

Based on the result of the case studies on the Incheon Airport Railway and the Daegok-Sosa Railway, the BTL model looks better for the national arterial rail though the BTO model has several strengths in service quality and risk management with the following reasons:

First, the BTL model gives better quantitative VFM. Like the road PPP, the private sector has traffic demand risk in the BTO model, so they can have much higher rate of profit. In the BTL model, the public sector has traffic demand risk and revenue is provided to the private sector by the performance assessment. In most BTO cases, it was emphasised that the public sector could pay nothing or small amount of subsidy to the private sector. However, the public sector can make a profit with the same revenue in the BTL model providing lower rate profit to the private sector. In the BTL model, the profit of the public sector can be used to reduce tariff level or to upgrade the quality of service;

Second, the financially free standing construction and operation is difficult for the rail PPP because of high construction cost and very limited and low revenue. Considering of high cost in rail construction and operation, the BTO model does not have enough revenue which is collected from passengers to return the investment of the private sector. Mean inaccuracy of traffic forecast in rail in South Korea was -32.4% and it is much higher than – 5.32% of road. It means that rail has higher traffic demand risk than road and the BTO model is benefit to the public sector because the demand risk is on the private sector. However, rail seems difficult to be constructed and operated through the BTO model without large amount of subsidy from the public sector. This is well seen in the Daegok-Sosa Railway case which will be done by the BTL model including operation for the first time in South Korea. Sensitivity analysis shows that the BTL model was better for the Daegok-Sosa Railway regardless of traffic demand risk, and if the BTO model were used then the public sector should subsidise around 92% of building cost; and

Third, the BTL model has an advantage in concluding a contract, project management and operational flexibility in the view of the public sector. The BTL model also looks better to upgrade the service quality in an arterial rail project which is closely related with the service in other national arterial rail network. The incentive does not look enough for the private sector to upgrade the service quality in the BTO model for a project as a part of national arterial rail network, because the incentive in the BTO model is only increased passengers, but the demand in national arterial network is difficult to be increased by the effort of rail operator of small section. Though the BTL model needs strong governance or relationship for risk management between the private and the public sectors, it seems not to be an obstacle to the national arterial rail network which has many experiences.

On the other hand, the urban subway seems quite different from national arterial rail in choosing the optimal PPP model. Though the BTL model was also quantitatively better in the Seoul Metro 9 case, the quality of service seems to be much affected by the ability of the operator as can be seen in the Seoul Metro 9 case. Also, the complexity of subway PPP project makes the BTO model better in risk management. In the case of the Seoul Metro 9, the public sector preferred the BTO model because of the simplicity of risk management. The complexity of the BTL deal can be a reason to evoke the poor relationship between the private and the public sector (NAO, 2009). Also, it is expected for the private sector to maximise the creativity and to improve the service quality under the complex and competitive situations like the urban subway.

Consequently, the BTL model generally looks better for rail in South Korea, but the BTO model has strengths in service quality and risk management for urban subway. Thus, if the objective of the PPP is more focused on the improving of the service quality or on the effective risk management, the BTO model can be an alternative to the BTL model.

10.5 Appropriate traffic demand risk sharing

10.5.1 Role of traffic demand risk sharing in transport PPP

Demand or revenue risk is globally regarded as more difficult problem than construction and project management risk (Perkins, 2013). Traffic demand risk is the most disputable issue in the transport PPP in South Korea as well(Lee, 2005). Early PPP projects in transport in South Korea used the BTO model with a MRG condition, but much lower actual traffic than the forecasted made the public sector provide a large amount of subsidy by the MRG condition up to 90% of the expected revenue (see section 3.4.5 and 3.5). Thus, the Korean government abolished the MRG regulation in the case of unsolicited PPPs in 2006 and in the case of solicited projects in 2009 to strength the responsibility of the private sector in the BTO model which is the “financially freestanding” PPP model (see Table 3.2).

However, recently the BTO projects without the MRG condition have difficulties in finance. Even in cases where the contract was signed, the private sector which consists of construction companies has failed to entice sufficient financial investors (Lee, 2008a, Park, 2009). According to the round table report of the international transport forum (Perkins, 2013), the ability of the private sector to respond to traffic demand risk is limited than government. Some researchers argue that transferring traffic demand risk to the private sector is inappropriate because it depends on economic circumstances, fuel prices and regional development, so it is not easy to be managed by the private sector (Mackie and Smith, 2004).

Thus, many countries introduced revenue risk sharing, which is easily affected by traffic demand risk, to the transport PPP. Shadow toll (Britain and Portugal), annuity or availability payment (India and central Europe), debt guarantees (Poland, A2 motorway), and exchange rate guarantee (Chile, Colombia) are well known revenue risk sharing methods (Irwin, 2005). In the case of South Korea, minimum revenue was guaranteed to the private sector in the BTO model based on the traffic volume.

Though the traffic demand risk sharing is criticised in South Korea, it has several important roles in the PPP. First, traffic demand risk sharing makes the PPP more attractive to financial investors. As seen in the case studies, the financial investor wanted to avoid the high risk in the BTO model, but they were not fully satisfied about the low rate of profit in the BTL model. They wanted minimum revenue and more chance to make an additional profit. Second, traffic demand risk can be better managed by allocating the role of each sector appropriately. Traffic volume is affected by both sectors. Traffic demand risk can vary not only by the government policy such as regional development or toll policies but also by the effort of the private sector such as the improvement of service quality as seen in the urban rail case. Lastly, private financial market for the PPP can be developed. For traffic demand risk sharing, it needs to analyse the ability of each sector, rational traffic forecast, financial product for the PPP, etc.

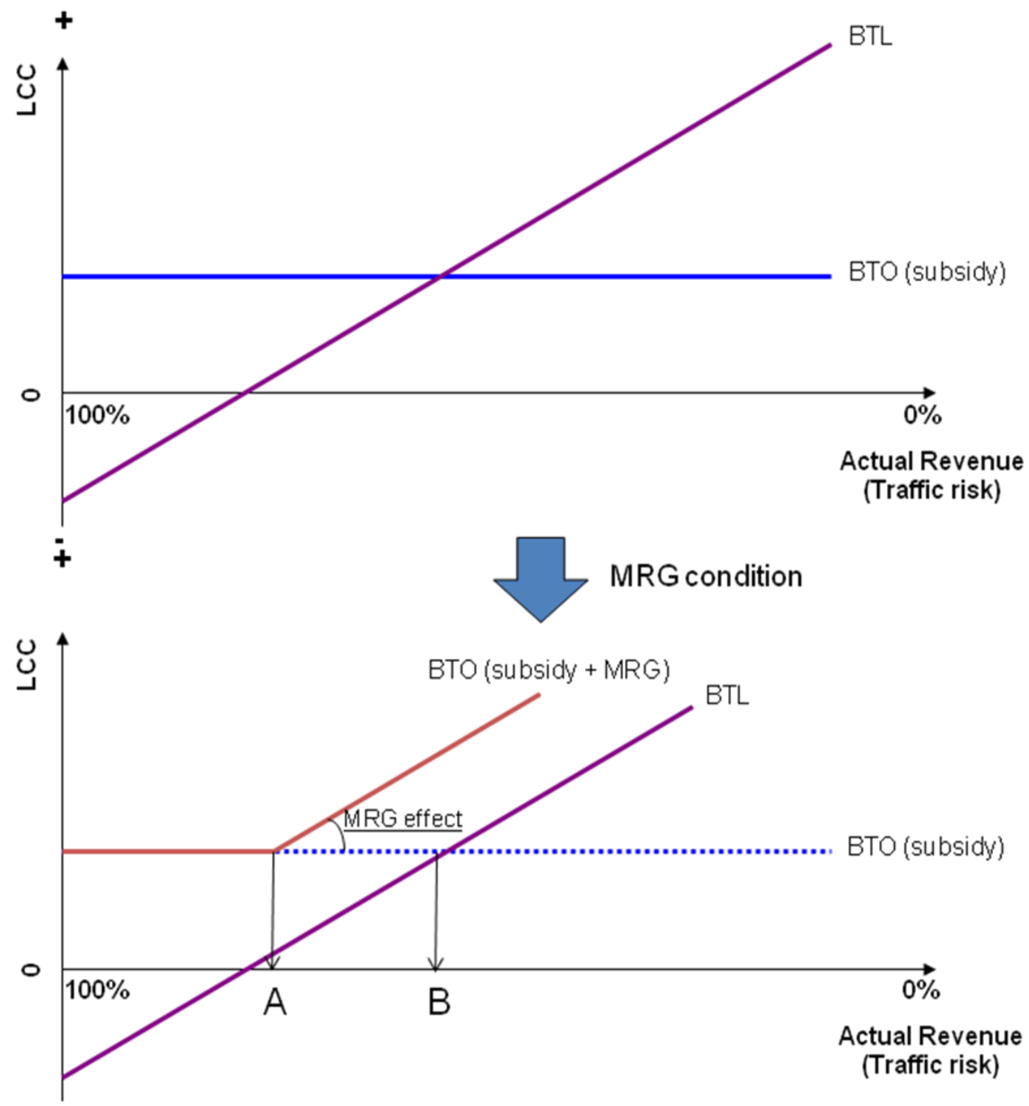
10.5.2 Appropriate traffic demand risk sharing in the BTO model

The MRG, which is abolished in 2009, is strongly requested again by the private sectors for the BTO model, but it is still opposed by the National Assembly, BAI and NGOs. The MRG can be an effective tool to develop the PPP and also rational policy to deal with the traffic demand risk. However, the criticisms on the MRG pointed out that the excessive burden was on the public sector and it could make the private sector exaggerate the traffic forecast (Lee, 2005). Thus, it needs to suggest an appropriate traffic demand risk sharing.

In South Korea, the BTO and the BTL models are the most common PPP models. In the BTO model, traffic demand risk is fully on the private sector in the BTO model if there is no MRG and it is fully on the public sector in the BTL model. Through the three case studies (Incheon Airport Expressway, Incheon Airport Railway, Seoul Metro 9) of the BTO model with MRG condition, it was found that revenue was flexible by actual traffic in the BTO model instead giving high rate of profit, but the revenue was fixed in the BTL model instead of providing low rate of profit to the private sector. In the Incheon Airport Expressway and Railway cases, the minimum revenue was guaranteed up to 90% for more than 20 years and it meant that most of traffic demand risk was on the public sector, but the rate of profit was as high as the BTO model without the MRG condition.

These two case studies showed that the maximum guaranteed revenue (point A in Figure 10.4) should not exceed the actual revenue (point B in Figure 10.4) when the LCC of the BTL option became the same as that of the BTO option without a MRG condition. The Figure 10.4 shows the change of the LCC of the BTO and the BTL option by actual revenue based on traffic demand risk. Here, the LCC is the capital expenditure of the public sector.

Figure 10.4 Change of the LCC of the BTO and the BTL option by actual revenue

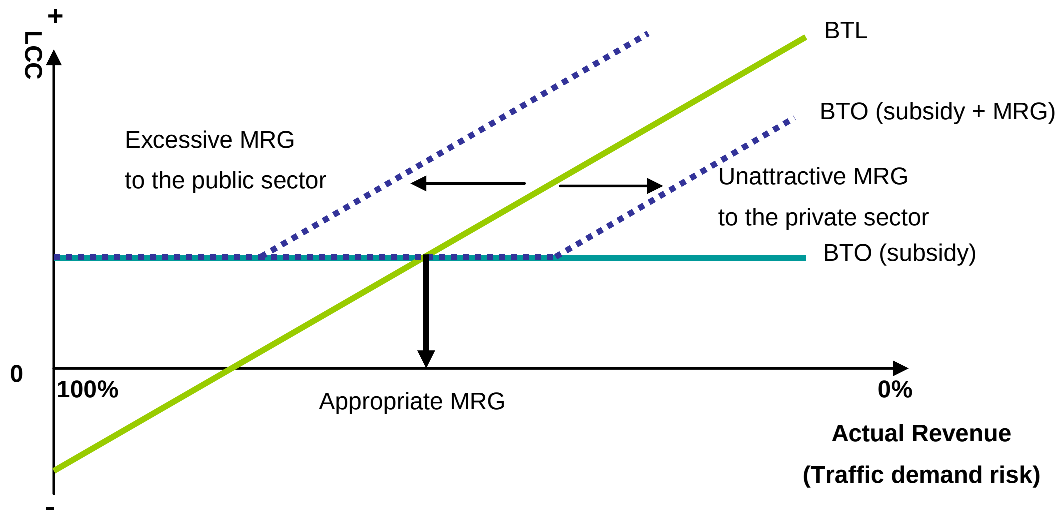


In the case of the Incheon Airport Expressway, the MRG was 90% (point A in Figure 10.4) of the expected revenue and it exceeded the revenue when the LCCs of BTL option and the BTO option were equal (point B in Figure 10.4, here 67.2%). As a result, the VFM of the BTL option was always higher than the BTO with a MRG option regardless of traffic demand risk (see details in section 5.5.1). It means that the public sector had to pay more in the BTO option than in the BTL option in which the full traffic demand risk was on the public sector. In the BTO model, the profit rate is higher than in the BTL model, because the traffic demand risk is on the private sector. However, the traffic demand risk was excessively transferred to the public sector in the Incheon Airport Expressway case by the MRG condition without reducing the profit rate. The same problem could be seen in the Incheon Airport Railway case. The level of MRG was 90% (point A in Figure 10.4), but the point B was only 46.4% (see the Figure 7.2).

If the level of MRG is lower than the point B in the Figure 10.4, then it can be beneficial to the public sector. However, it financially burdens the private sector and can be unattractive to the private sector. Thus, the appropriate MRG level in the BTO model can be suggested by analysing the change of LCC of the BTO and the BTL options by actual revenue (which is based on the traffic demand).

The Figure 10.5 shows the above mentioned new concept of appropriate traffic demand risk sharing simply.

Figure 10.5 Concept of appropriate MRG



10.6 Policy recommendation for South Korea government

10.6.1 Introduction of the BTL model for road

The BTL can be a better PPP model than the BTO for road, so the government needs to think over the introduction of the BTL model for road in South Korea. If the private sector collects revenue directly from the toll in the BTL model, then the private sector can pay the lease fee within the income from the operation. Moreover, the BTL model gives a chance for the public sector to make a profit and this profit can be used to upgrade service quality or decrease toll level.

Considering the quality of service in road was decided by the route of road rather than by the effort of the private sector, the benefit of the BTO model in the quality of service does not look significant. Especially, after abolishing the MRG regulation for the unsolicited project in 2006, only one BTO project started construction and 10 projects were delayed because of financing after starting negotiation or being signed (MLTM, 2011c). It means that the private sector, especially the financial investor, does not want to manage the traffic demand risk with its own responsibility. Though traffic demand risk is on the public sector in the BTL model, the inaccuracy of traffic forecast in expressway in South Korea seems not big enough to change the optimal PPP model as seen in the case studies of this thesis.

10.6.2 New approach to the BTO model for urban rail

The BTL model seems optimal for the national arterial rail like the Daegok-Sosa railway, but the BTO model can be better for urban rail which has a high traffic demand risk and a complexity of operation. Thus, the government needs to consider the BTO model as the alternative of the BTL model for urban rail, only if an appropriate demand risk is shared with the private sector.

The BTL model provides better VFM in rail in South Korea. Construction and operation costs were very high but tariff, which was the main source of revenue, was strictly restricted by the public sector with a political reason.

Thus, the BTO model was very difficult to be successful for rail if there was no MRG condition.
However, the BTO model can be effective to urban rail. It had many competitors in operation and much more complicated. Quality of service is very important factor to compete with other transport mode in urban area and the BTO model had a big advantage in upgrading service quality as seen in the Seoul Metro 9 case. Inaccuracy of traffic forecast was also higher in urban rail than other rail. The complexity of construction and operation of urban rail could make relationship between the private and the public sector difficult, and this may result in the failure of the BTL model like the case of the London Underground PPP. Problem is that the BTO model is too risky for the private sector to participate in. Though there are still many criticisms over the MRG, but an appropriate traffic risk sharing, which does not exceed the expenditure of the public sector in the BTL model as suggested in this thesis, can make the BTO model executed successfully.

10.6.3 Recommendation for an appropriate traffic demand risk sharing

Though there are many criticisms on MRG regulation in South Korea, but appropriate risk sharing seems essential in the PPP. The BTL model, in which the public sector has demand risk, can be better where the traffic demand is possible to be accurately forecasted. However, recent studies show that the uncertainty of economy is increasing and the deficit problem of the Government is the big issue not only in South Korea but also in the World (Obstfeld and Rogoff, 2009). Thus, the BTO model looks quite attractive to the public sector, though unstable economy is also risky to the private sector. Especially, traffic demand is basically not controlled by the private sector and is much more affected by the economy, transport policy, regional development, etc.

Most critics about the MRG in South Korea focused on the regulation itself, but the real problem about the MRG was the excessively high guaranteed level of MRG. In this study, appropriate traffic risk sharing level does not exceed the expenditure of the BTL model, so the BTO does not financially burden the public sector if the MRG condition is less than the level suggested in this study.

10.6 Conclusion

Through the five case studies, interviews and literature reviews, the main features of the PPP model in road and rail in South Korea were explored. In the view of the public sector, the BTL model was better to lessen the financial burden of the public sector, but if traffic demand risk is high then the BTO model could be better. The strength of the private sector was activated by the traffic demand in the BTO model but also by the competition between the private sector bidders in the BTL model (see Table 3.5 and 3.6). With regard to the project supervision, the BTL model was advantageous because of regular performance assessment. In the view of the private sector, the BTO was a high risk and high return model and the BTL was a low risk and low return model. Recently, the BTL where the public sector had traffic demand risk was easier to finance than the BTO model, but the BTO with MRG model was more preferable to the private sector. In the view of the end user, the service quality could be expected to be more improved in the BTO model when the project was separated from the rest of the transport network. However, if the project was a part of network, the BTL could be better. In the BTL model, the level of tariff could be reduced lower than the BTO model.

Through the case studies, an optimal PPP model for road in South Korea seemed the BTL model. The public sector could save expenditure and have a chance to make a profit by revenue in the BTL model. Quantitatively optimal PPP model for rail in South Korea was also the BTL model having a low rate of profit, but the BTO with MRG model could be better to the complicated and high risk project such as urban rail. The MRG regulation is much criticised in South Korea, but considering traffic forecast is difficult to be managed by the public sector, appropriate traffic demand risk sharing can be effective for a successful PPP. In this study, an appropriate MRG was suggested as the level which was less than the expenditure of the public sector in the BTL model in which traffic demand risk is fully on the public sector.

Based on the above results, the introduction of the BTL model for road, which has not been used yet, was suggested. The BTO with MRG model was recommended as an optimal PPP for urban rail South Korea. An appropriate traffic demand risk sharing was also presented for enhancing the transport PPP.

CHAPTER 11

Conclusions

11.1 Introduction

The aim of this study was to find the optimal PPP model, which is defined as the PPP model having higher VFM, for transport infrastructures. The most prevalent and standardised PPP models of South Korea are the BTO, which is a "financially free standing" model, and the BTL, which is a "service sold to the public sector" model. However, the BTO model has usually been used for transport infrastructures like road and rail while the BTL model was thought to be for those areas of public services without the prospect of profitability. In this thesis, it has been examined whether the BTL model could be the alternative to the BTO model for transport.

For comparing the BTL with the BTO model, the five case studies were undertaken in South Korea: the Incheon Airport Expressway and the Oksan-Ochang Expressway were for road; and the Incheon Airport Railway, the Daegok-Sosa Railway and the Seoul Metro 9 were for rail. Each case was assessed by the quantitative and the qualitative VFM tests. The quantitative VFM assessment followed the guidance of the Korean government and the qualitative VFM was assessed based on the interviews of the PPP experts in South Korea. Considering the uncertainty of input factors in the VFM assessment, the sensitivity of the VFM was also analysed. Especially, a traffic factor, which was the most disputable risk in transport PPP in South Korea, was studied through the stochastic analysis by the Monte Carlo Simulation method.

This chapter summarises the main conclusions on the research objectives that were set out by the case studies. Next, the contribution of the thesis to the PPP in transport in South Korea is considered. Finally, the limitation of the research and the implication for further study for the transport PPP are discussed.

11.2 Main conclusions on the research objectives

This research has dealt with the following research objectives through the literature review, interview and five case studies in South Korea: the main features of PPP model in road and rail in South Korea; the methodology for comparing the BTO and the BTO model; the optimal PPP model providing better VFM in road and rail in South Korea; and appropriate traffic demand risk sharing in road and rail in South Korea.

The main features of the PPP models in road and rail in South Korea

The BTO and the BTL models were compared with each other from three perspectives: the public sector, the private sector and the end user. The public sector reflects on the interests of tax payers who do not use the service and tax payers as end users. However, these two interests are different from each other, so the interest of end users was discussed separately in the thesis.

In the view of the public sector, the thesis found the financial burden of the public sector, the creativity and competitiveness of the private sector and the project supervision as decisive interests to choose the PPP. Thus, the features of the BTL and the BTO models were explored with the same categories. The BTL model was better to lessen the financial burden of the public sector for transport infrastructure with the income from the end user than the BTO model if traffic, which is the source of the income, was accurately forecasted. It was because the rate of profit in the BTL model, where the public sector had traffic demand risk, was lower than that in the BTO model. If the actual traffic was lower than anticipated, then the BTO model could be better. The private sector could be creative and competitive in the PPP regardless of PPP models. However, the thesis shows the creativity and competitiveness of the private sectors could be activated only when the private sector had the traffic demand risk in the BTO model and when there is enough competition among the private sector companies to bid in the BTL model. In supervising a project, there were few differences in the construction stage in the view of the public sector. However, the interviews of the PPP experts and literatures show that the public sector had more roles in the BTL model through the regular performance assessment to pay the lease fee, though the process of supervision could be more complicated. The supervision scheme was simpler in the BTO model, but the public sector was anticipated to have few roles in the operation of the facility. This characteristic can be a disadvantage in transport which is importantly affected by the policy of the government and sometimes needs to be managed in connection with other transport modes or networks by the public sector. Thus, the BTL model could be thought to be better in the view point of the supervision of the public sector.

In the view of the private sector, the most important factors for the PPP were the rate of profit, financing and the project management. It is difficult to say a specific PPP model is better in making a profit because the BTO was a high risk and high return model and the BTL was a low risk and low return model. Financing was pointed out as a big obstacle to the private sector, where the construction companies lead the project, particularly under the current difficult economic circumstances. However, it was discovered the BTL where the public sector had traffic demand risk was relatively easier to finance than the BTO model, so the private sector preferred the BTL model in the current unstable economic circumstances. Though the BTO with MRG model guaranteed stable revenue and offered a chance to make an additional profit to the private sector, there were opinions that the BTO with MRG model was the best to the private sector. Project management was also an important category to the private sector. The result of interviews shows the private sector was anticipated to be more active in the construction stage in the BTO model where the private sector had whole responsibility in operation.

In the view of the end user, the literatures and interviews on PPPs show that the interest in PPPs was on the improvement service quality, the communication with end users, and the user fee. The service quality could be expected to be more improved in the BTO model when the project was separated from the rest of the transport network, but if the project was a part of network, the BTL could be better because the public sector could manage and balance the quality of service in an integrated transport network. In terms of the communication with the end user, the private sector was anticipated to be more active in the BTO model only if there was no MRG condition. The user fee was a severely criticised category. The BTL model could reduce the toll or tariff level lower than the BTO model, so it was a benefit to end users.

The methodology for comparing the BTO and the BTL model

An appropriate methodology should be suggested to compare the BTL with the BTO model. There were several methodologies such as the FNPV and the FIRR for assessing the feasibility of BTO model, but the VFM assessment was the only methodology to be commonly used in the BTO and the BTL models. Especially, the VFM assessment was the official methodology of the Korean government and it tested the PPP not only quantitatively but also qualitatively.

For methodology for the quantitative assessment, the equation based on the LCC analysis suggested as follows:

$$VFM_{\ell o} = BTO\ (Subsidy) - BTL\ (Lease + Operating\ cost - Revenue)$$

For methodology for the qualitative assessment, the semi-opened interview was selected and the topic guidance on four issues was suggested: service quality, contract and management, risk management, and operational flexibility.

The optimal PPP model for road in South Korea

It was found that the BTL model could be better for road in South Korea instead of the BTO with following three reasons:

First, the BTL model gave better quantitative VFM. The private sector has traffic demand risk in the BTO model, so they can have much higher rate of profit. In the BTL model, the public sector has traffic demand risk and revenue is provided to the private sector by the performance assessment based on the availability. In most BTO cases, it was emphasised that the public sector could pay nothing or a small amount of subsidy to the private sector. However, the public sector can make a profit with the same revenue in the BTL model;

Second, it is not necessary to transfer the traffic demand risk to the private sector by using the BTO model. If the actual traffic is much lower than forecasted, then the BTO model can be better. However, the mean value of inaccuracy of traffic forecast in the 86 expressways in South Korea was only -5.32%. It meant that it might not be needed to transfer the traffic demand risk to the private sector with much higher rate of profit. In cases with the MRG condition, the BTO model was not better to improve the service quality and to manage the revenue risk than the BTL model as it heavily diluted the private sector incentives; and

Third, traffic demand in road was difficult to be affected by the private sector, so the BTO model cannot be expected to have advantages in upgrading service quality. Though the mean value of traffic forecast was relatively good, the variance was big. Therefore, it cannot be said that the traffic forecast is accurate. However, traffic demand in road is much affected by the route and the government policy such as regional development. It shows the BTO model is very limited in controlling traffic demand by its own effort though the private sector has the risk. Thus, the BTO model does not have strengths in upgrading service and managing revenue risks. The high demand risk borne by the private sector in the BTO model does not look manageable, so it makes financing difficult and it is a big obstacle in making a contract.

The optimal PPP model for rail in South Korea

The two case studies for the national arterial railway and one case study for the urban railway showed that the optimal PPP model could be different in the national arterial railway and the urban rail. The BTL model generally looked better for rail in South Korea, but the BTO model had strengths in service quality and risk management for urban subway. Thus, if the objective of the PPP was more focused on improving the service quality or on the effective risk management, the BTO model could be an alternative to the BTL model.

In the case of national arterial railway, the BTL model gave better quantitative VFM like road. Especially, the BTO model was difficult to be used for rail because of high construction cost and low revenue. It meant that the BTO model did not have enough revenue which could be collected from passengers to compensate for the investment of the private sector. In addition, the BTL model had an advantage in making a contract, project management and operational flexibility in the view of the public sector. The BTL model also looked better to upgrade the service quality in an arterial rail project which was closely related to the service in another national arterial rail network.

On the other hand, the urban subway was quite different from the national arterial rail in choosing the optimal PPP model. Though the BTL model was also quantitatively better in the Seoul Metro 9 case, the quality of service was expected to be much affected by the ability of the operator as seen in the Seoul Metro 9 case. The high complexity of urban railway such as a subway project made the BTO model better in risk management. Thus, the BTO model was expected to be better for the private sector to maximise the creativity and to improve the service quality under the complex and competitive situations like the urban subway.

Appropriate traffic demand risk sharing in South Korea

Traffic demand risk was the most disputable issue in the transport PPP in South Korea. There were many criticisms on the BTO projects because of overestimated traffic forecast and the excessive MRG. The MRG regulation was abolished in 2009, but it became the important reason, along with the financial crisis, to depress the PPP in South Korea. Thus, the private sectors are requesting an appropriate demand risk sharing like the MRG. In fact, the traffic demand is very difficult to be managed by the private sector (Mackie and Smith, 2004). Traffic is easily affected by the political decision of the government. Also it is much related to the rest of the transport network. Especially, in some cases like urban rail, the BTO model could be better to upgrade the quality of service and to manage the complex risk. Therefore, many countries have introduced demand risk sharing and this thesis discussed an appropriate traffic demand risk sharing in road and rail in South Korea.

Traffic demand risk was fully on the private sector in the BTO model and it was on the public sector in the BTL model. The appropriate MRG level to share the traffic demand risk properly could be different in each case, but the maximum MRG level in the BTO model could be found by comparing with the BTL model. The thesis suggested the government expenditure including the subsidy by the MRG condition in the BTO model should not exceed that of the BTL model even in the case that actual traffic was less than expected. Comparisons of the BTL and the BTO options could be used to determine an appropriate MRG level in the view of the public sector.

11.3 Contribution of the thesis

This thesis is the first research to compare the BTL model with the BTO model in road and rail in South Korea through the quantitative and the qualitative VFM assessments. The following four contributions to the PPP policy of South Korea were found through the research.

Firstly, this thesis shows that the BTL model can be the alternative to the BTO model best for transport infrastructures with incomes such as toll road in South Korea. In South Korea, it was commonly thought among policy makers that the BTO model was for the project with enough income such as transport infrastructure and the BTL model was for the project with little income such as a school or sewage facilities. However, the possibility was discovered that the BTL model could be better in transport infrastructures with revenue income.

Secondly, this research suggested the methodology for comparing the BTL with the BTO model for the first time. Since the BTO and the BTL models were introduced to South Korea, both models have been thought to constitute different PPP areas. Some arguments were raised to use the BTL model instead of the BTO model for transport, but there was no way to examine the feasibility. This thesis presented the possibility and way to compare both models.

Thirdly, it was found that the optimal PPP model could be different according to the kind of transport mode like road and urban rail. In South Korea, the PPP model for transport infrastructure was mainly the BTO model. However, this thesis suggests that the optimal PPP for road and national arterial rail could be the BTL model while the optimal PPP for urban rail could be the BTO model.

Lastly, the adequacy level of MRG in the BTO cases was examined and the rational guideline for an appropriate MRG was suggested through the comparison of the BTO with the BTL model for the first time in South Korea. The MRG of the BTO cases in South Korea was widely regarded as excessive, but the thesis examined several BTO cases for the first time and it was found that the MRG level in the case of Seoul Metro 9 was not a bad deal for the public sector. Also, the appropriate MRG, which has been the most controversial issue in South Korea, was newly suggested.

11.4 Limitation of thesis and future research

Through the literature reviews on the PPP models and five case studies in road and rail in South Korea, this thesis set out the main features of the BTO and the BTL models based on respective views of the public sector, the private sector and the end user. Considering the VFM, the optimal PPP model for road and rail in South Korea and the appropriate traffic demand risk sharing were suggested. Though the possibility of using the BTL model instead of the BTO model was shown, there are still several limitations for this to be used as the practical policy in transport in South Korea or in different countries.

Firstly, more statistical data in traffic forecast is needed to increase the fidelity of stochastic analysis. The traffic demand risk is an important factor to choose the PPP for transport, but only a few data were found for rail in South Korea. Since the urban rail and national arterial rail show quite different characteristics, it also needs to assess them separately in stochastic analysis, but there were not enough data. In the case of road, the general possibility of the optimal PPP model considering the traffic demand risk was found, but it seems difficult to be used in a specific project. If the data is diversified by the region (e.g. urban area and suburb area), the stochastic analysis is expected to be more practically used in a specific project.

Secondly, details of payment mechanism and performance assessment are needed to be studied more for introducing the BTL model to road in South Korea. This thesis only shows the possibility of the BTL model instead of the BTO model. For using the BTL model in road, specific payment mechanism such as incentives and standard performance assessment about the service quality, assessment measures, etc. should be prepared in advance.

Thirdly, a concrete decision tool, usually called the MCDA (Multi-Criteria Decision Analysis), needs to integrate the results of the quantitative assessment and the qualitative assessment. This thesis shows the importance of the qualitative factors in the VFM, and it was assessed by the expert interviews. However, it does not suggest how to weigh on the quantitative assessment and the qualitative assessment. For practical purpose, rational MCDA method, like the AHP (Analytic Hierarchy Process) which is common in the pre-feasibility test in infrastructure projects in South Korea (Park, 2001), needs to be studied more.

Lastly, PPPs need to be studied more at different country levels. As can be seen in Chapter 2, many developing countries preferred the financially free standing PPP model like BTO or BOT. However, the UK preferred the service sold to the public sector model, usually used in the DBFO model. The basic difference between the DBFO and the BOT models lies in the fact that for the former, the government pays off the contractually defined “unique monthly payment” to the sponsors on a regular basis during the whole duration of contract (after the start of the exploitation period). On the other hand, the BOT contracts are most often funded by the user of the facility (Turina and Car-Pušić, 2006). This shows the similarity of comparison of the BTL and the BTO models in South Korea. Thus, if several social and economic factors are considered, the result of this thesis can be used in some other countries or can be expanded to the comparison among different countries.

APPENDIX 1 Transport PPP projects in the UK

Project	Category	Sector	Capital Value £'m
A249 Stockbury to Sheerness	PFI	Roads	100
A1 Darrington to Dishforth	PFI	Roads	245
A1(M) Alconbury to Peterborough DBFO	PFI	Roads	169.4
A13 Thames Gateway	PFI	Roads	411
A130 (A12-A127)(LA)	PFI	Roads	97.5
A19 Dishforth to Tyne Tunnel DBFO	PFI	Roads	29.4
A30/A35 Exeter to Bere Regis DBFO	PFI	Roads	75.7
A419/A417 Swindon to Gloucester DBFO	PFI	Roads	49
A50/A564 Stoke-Derby Link DBFO	PFI	Roads	20.6
A69 Carlisle to Newcastle DBFO	PFI	Roads	9.4
Birmingham Northern Relief Road (M6 Toll)	PFI	Roads	485
Brent - Street Lighting	PFI	Street Lighting	8.5
British Transport Police - New Police Stations	PFI	Underground Rail	13
London Underground - Connect	PFI	Underground Rail	468
Croydon Tramlink	PFI	Tram/Light Rail	205
Dartford-Thurrock Crossing	PFI	Roads	180
Deep Tube Lines - Bakerloo, Central & Victoria Lines (BCV)	PPP	Underground Rail	5,381.00
Deep Tube Lines - Jubilee, Northern & Piccadilly Lines (JNP)	PPP	Underground Rail	5,526.00
Docklands Light Railway (DLR) - Extension to City Airport	PFI	Tram/Light Rail	165
Docklands Light Railway (DLR) - Extension to Lewisham	PFI	Tram/Light Rail	202
Doncaster Interchange	PFI	Buses	26
Islington - Street Lighting	PFI	Street Lighting	12.17
Luton Airport Parkway	PFI	Railways|	20
M1 - A1 Link Road (Lofthouse to Bramham)	PFI	Roads	214
M40 Junctions 1 to 15	PFI	Roads	130

Manchester - Street Lighting	PFI	Street Lighting	35.2
Manchester Metrolink Extension 1	PFI	Tram/Light Rail|	160
Midland Metro Line One	PFI	Tram/Light Rail	145
Newcastle & North Tyneside - Street Lighting	PFI	Street Lighting	44.4
Northern Line Trains	PFI	Underground Rail	409
Nottingham Express Transit Phase 1	PFI	Tram/Light Rail	200
Portsmouth - Highway Maintenance	PFI	Roads	60
London Underground - Power Supply	PFI	Underground Rail	134
London Underground - Prestige	PFI	Underground Rail	192
Second Severn Crossing	PFI	Roads	331
Staffordshire - Street Lighting	PFI	Street Lighting	31.1
Stoke - Street Lighting	PFI	Street Lighting	22.6
Sub Surface Lines (SSL) - District, Circle, Metropolitan, East London & Hammersmith & City	PPP	Underground Rail	6,687.00
Sunderland - Street Lighting	PFI	Street Lighting	27.35
Wakefield - Street Lighting	PFI	Street Lighting	19.5
Walsall - Street Lighting	PFI	Street Lighting	18.6
M77 Glasgow Southern Orbital DBFO Roads Project	PFI	Roads	135
Inverness Airport Terminal	PFI	Airports	9.5
M6 DBFO Project	PFI	Roads	96
Skye Bridge	Joint Venture	Roads	23.6
A92 Dundee to Arbroath	PFI	Roads	61.5
A55 Llandygai to Holyhead Trunk Road	PFI	Roads|	100
Lloyd George Avenue and Callaghan Square	PFI	Roads	45

Newport Southern Distributor Road	PFI	Roads	57.1
Sirhowy Enterprise Way Road Scheme	PFI	Roads	34.3
Docklands Light Railway (DLR) - Extension to Woolwich	PFI	Tram/Light Rail	238.4
London Borough of Ealing - Street Lighting Project	PFI	Street Lighting	34.3
South Tyneside Borough Council - Streetlighting Project	PFI	Street Lighting	35.1
Redcar and Cleveland Borough Council - Streetlighting Project	PFI	Street Lighting	20.3
Lambeth - Street Lighting Project	PFI	Street Lighting	17.22
Dorset Streetlighting Installations, Illuminated Traffic Signs and Bollards PFI	PFI	Street Lighting	29.3
Norfolk County Council - Street Lighting PFI Project	PFI	Street Lighting	37.6
Derby City Council - Street Lighting Installations & Illuminated Traffic Signs PFI	PFI	Street Lighting	38.4
Leeds Street Lighting PFI Project	PFI	Street Lighting	104.9
London Borough of Barnet - PFI Street Lighting Improvements	PFI	Street Lighting	28
London Borough of Enfield - PFI Street Lighting Improvements	PFI	Street Lighting	24
M25 DBFO (Design, Build, Finance and Operate) Project	PPP	Roads	1,316.00
Northern Ireland Department for Regional Development - Roads Service DBFO - Package 1	PFI	Roads	139.2
Carlisle Northern Development Route - A595	PFI	Roads	150
Northern Ireland Department for Regional Development - Roads Service DBFO - Package 2	PFI	Roads	316
MoD - Future Provision of Marine Services (FPMS)	PFI	Shipping	127.57
M80 Stepps to Haggs DBFO	PFI	Roads	251.4
South Coast Councils - Street Lighting & Illuminated Signs Maintenance Contract.	PFI	Street Lighting	225

APPENDIX 2 Korean PPP projects

Korea BTO Projects

unit : billion KRW

Road(33)				
Current Phase	Project Name	Total Project Cost	Construction Commencement	Construction Completion
In Operation (14)	Incheon Int'l Airport Expressway	1,335	Nov-95	Nov-00
	Gwangju 2nd Beltway Section 1	173	Jun-97	Nov-00
	Cheonan-Nonsan Expressway	995	Dec-97	Dec-02
	Woomyunsan Tunnel	140	Aug-99	Jan-04
	New Daegu-Busan Expressway	1,317	Feb-01	Jan-06
	Seoul Beltway	1,048	Jun-01	Jun-08
	Ilsan Bridge	149	Aug-03	Jun-08
	Machang Bridge	189	Apr-04	Jun-08
	Seoul-Chuncheon Expressway *	1,001	Aug-04	Aug-09
	Incheon Bridge *	524	Jul-05	Oct-09
	Yongin-Seoul Expressway *	484	Oct-05	Jun-09
	Busan-Ulsan Expressway	807	Aug-06	Dec-08
	West Suwon-Pyungtaek Expressway *	608	Jun-05	Oct-09
	3rd Gyeongin Connection (Shiheung-Namdong)	481	Feb-06	Nov-09
Under Construction(5)	Busan-Geojae Connection Road*	1,000	Dec-04	Dec-10
	Myungji Bridge *	252	Jan-05	Jan-10
	Bukhang Bridge	230	Apr-07	Oct-11
	Gangnam Beltway	568	Jul-07	
	Daegu Highway	244	Dec-07	
Preparing for Construction(4)	Songhyun-Bulro Expressway *	755		

	Gyungin(Anyang-Sungnam) 2nd Expressway *	465		
	Pyungtaek-Sihung Expressway *	640		
	Changwon-Busan Expressway *	286		
Under Negotiation(8)	Busan New Port 2nd Rear Highway *	278		
	Youngcheon-Sangju Expressway *	1,098		
	Youngdong 2nd Expressway *	809		
	Suwon-Gwangmyung Expressway *	634		
	Seoul-Munsan Expressway *	695		
	Seoul-Pocheon Expressway *	888		
	Hwado-Yangpyung Expressway *	292		
	Seoul-Gwangmyung Expressway *	731		
RFP Announced(2)	West Suwon-Eiwang Expressway *	251		
	Ulsan Bridge *	239		

1) The table above does not include PPP projects managed by local governments.
2) * indicates unsolicited projects.

Rail(10)				
Current Phase	Project Name	Total Project Cost	Construction Commencement	Construction Completion
In Operation (2)	Incheon International Airport Railroad	2,282	Apr-01	Dec-09
	Seoul Subway Line #9	480	Jun-06	Sep-09
Under Construction(4)	New Bundang Subway	608	Jul-05	Jul-10
	Yongin LRT	397	Dec-05	Jul-10
	Busan Gimhae LRT	482	Feb-06	Oct-10
	Uijungbu LRT	247	Aug-07	

Under Negotiation(4)	Seoul-Hanam LRT	247		
	Gwangmyung LRT *	306		
	Busan Choeup LRT	131		
	Ui Shinseul LRT *	396		

1) The table above does not include PPP projects managed by local governments.
2) * indicates unsolicited projects.

Ports(17)				
Current Phase	Project Name	Total Project Cost	Construction Commencement	Construction Completion
In Operation(4)	Mokpo New Port Phase 1-1	47	Jan-01	Jun-04
	Mokpo New Port Phase 1-2 *	13	Feb-02	Jun-04
	Incheon North PortPhase 1-1	93	Mar-03	Jan-07
	Busan New Port Phase 1	1,149	May-01	May-09
Under Construction(10)	Gunsan Biung Port *	51	Jul-03	Jun-07
	Incheon North Multipurpose Port	132	Aug-03	Feb-08
	Ulsan New Port Phase 1-1	163	Jul-04	Jun-09
	Masan Port Phase 1-1	136	Dec-05	Dec-11
	Phohang Youngilman New Port Phase 1-1	145	Aug-05	Aug-09
	Incheon North General Port	83	Nov-05	May-09
	Pyungtaek East Port	106	Sep-06	Sep-09
	Pyungtaek Port Quay for Grains	119	Jul-07	
	Gunjang Port Quay for Merchandise	80	Aug-07	
	Busan New Port Phase 2-3	512	Oct-07	Oct-11
Preparing for Construction (2)	Gwangyang Port Yeocheon Quay *	45		
	Gwangyang Port Phase 3-3 Quay for Container *	427		
Under Negotiation (1)	Busan New Port Phase 2-4 *	421		

1) The table above does not include PPP projects managed by local governments.
2) * indicates unsolicited projects.

Airports(7)				
Current Phase	Project Name	Total Project Cost	Construction Commencement	Construction Completion
In Operation(7)	Incheon Airport Cargo Terminal	154	May-98	
	Incheon Airport Refuel System	10	Mar-98	Oct-02
	Incheon Airport Cogeneration Plant	138	Apr-98	Oct-02
	Incheon Airport Equipment Facilities	16	Jul-99	Oct-00
	Incheon Airport Cargo Warehouse	18	Jan-99	Oct-00
	Incheon Airport in-flight Food Facility	74	May-99	Nov-00
	Incheon Airport Flight Maintenance Facility	98	Mar-00	Jun-02

1) The table above does not include PPP projects managed by local governments.

Logistics Centers(5)				
Current Phase	Project Name	Total Project Cost	Construction Commencement	Construction Completion
Under construction(1)	Honam Multi Freight Terminal	199	Dec-02	Dec-10
Under Construction(2)	Youngnam Area Inland Cargo Base	136	Mar-07	May-09
	Central Peninsula Cargo Complex Terminal	111	Dec-06	
Preparing for Construction (2)	Extension of Gunpo Cargo Complex Terminal *	251		
	Metropolitan Area Northern Cargo Base *	152		

1) The table above does not include PPP projects managed by local governments.
2) * indicates unsolicited projects.

Environmental Facilities (7)

Current Phase	Project Name	Total Project Cost	Construction Commencement	Construction Completion
In Operation (1)	Seoul Metropolitan Area Resource Facilities for Reclaimed Landfill and Gas Reclamation	772	Mar-04	06.12/2006
Under Construction(2)	Yongin Sewage Disposal Facilities *	518	Dec-05	Jun-08
	North Jeolla Province Environmental Facilities*	589	Feb-05	Jun-08
Preparing for Construction (2)	Anseong Sewage Disposal Facilities *	377		
	Pohang Jangyang Waste Disposal Facilities *	188		
Under Negotiation(2)	Ulsan City Waste Treatment Facilities *	840		
	Wang-gung livestock Wastewater Treatment Facilities*	89		

1) The table above does not include PPP projects managed by local governments.
2) * indicates unsolicited projects.

BTL Projects to be announced in 2008			
Source of Fund	Facility Type	Total Project Cost*	No. of Project
Central Government	Railway	7,716	12
	University Facility	268	1
	Sub-Total	7,984	13
Local Government (Subsidized by central government)	Sewage System	10,505	15
	Cultural Facility	1,038	3
	Welfare Facility	124	2
	Science Museum	137	1
	Sub-Total	11,804	21
Local Government	Elementary/Middle School	9,071	23
Total		28,859	57

BTL Projects to be announced in 2007			
Source of Fund	Facility Type	Total Project Cost*	No. of Project
Central Government	National University	3,282	2

	Railway	13,259	1
	IT Network	2,367	1
	Military Housing	4,985	8
	Vocational College	707	1
	Marine Museum	1,028	1
	Sub-Total	25,628	14
Local Government (Subsidized by central government)	Sewage System	11,732	15
	Cultural Facility	939	3
	Welfare Facility	669	2
	cience Museum	227	1
	Sub-Total	13,567	21
Local Government	Elementary/Middle School	16,294	42
Total		55,489	77

BTL Projects to be announced in 2006			
Source of Fund	Facility Type	Total Project Cost*	No. of Project
Central Government	National University	544	2
	Railway	10,523	2
	Military Housing	12,956	23
	Vocational College	592	1
	Sub-Total	24,615	28
Local Government (Subsidized by central government)	Sewage System	21,589	29
	Cultural Facility	1,568	9
	Welfare Facility	454	1
	Science Museum	450	2
	Sub-Total	24,061	41
Local Government	Elementary/Middle School	23,817	58
Total		72,493	127

BTL Projects to be announced in 2005			
Source of Fund	Facility Type	Total Project Cost*	No. of Project
Central Government	National University	5,427	10
	Military Housing	3,583	6
	Vocational College	398	1
	Sub-Total	9,408	17
Local Government (Subsidized by central government)	Sewage System	10,528	17
	Cultural Facility	3,986	12
	Welfare Facility	598	2
	Sub-Total	15,112	31
Local Government	Elementary/Middle School	13,404	38
Total		37,924	86

APPENDIX 3 Summary of Interview on the PPP in South Korea

1. The purpose of an interview

Not only in the UK but also in South Korea, the qualitative VFM in the process of the PPP procurement is assessed based on the opinions of experts on projects. The purpose of this interview is to assess the qualitative VFM of the five PPP cases in South Korea; Incheon Airport Expressway, Oksan-Ochang Expressway, Incheon Airport Railway, Daegok-Sosa Railway and Seoul Metro 9.

The current VFM guidance has not enough evidence to affect the result of the VFM with qualitative assessment. This is the main reason that the qualitative VFM assessment is being used as only referential factor to choose the PPP. However, the quantitative assessment between PPP models can be less decisive than between the PPP and PSC, because the BTL and BTO options shares many more common factors in the quantitative assessment than the PPP and PSC options. It means that the role of the reasonable qualitative can be more important and more details should be backed up in qualitative assessment through the interview.

2. Main contents

For the qualitative VFM assessment to compare the BTL with the BTO model, the interviews are divided into four parts; (1) General comparison between the BTL and BTO, (2) Finding qualitative factors which can be compared in different PPP models, (3) Assessment of qualitative characteristics based on the factors found in (2) in each PPP case and (4) Analysis of qualitative characteristics of the BTL and BTO model in road and rail.

Mostly the qualitative VFM assessment follows the VFM guidance, but this guidance for comparing the PPP option with the PSC option. Especially, this qualitative VFM assessment is the first try to compare the different PPP models each other in different transport projects. Thus, it needs to analyse the general characteristics of the BTL and BTO model firstly through the interview of PPP experts beside the literature reviews.

Secondly, the qualitative factors can be different in comparing the PPP with the PSC and in comparing the BTL with the BTO model. These factors need to be found based on the current qualitative VFM guidance and also more factors can be added through the interview.

Third and fourth parts are about the concrete PPP cases. Based on the factors in the form of issues and questions found in the second part, each factor will be assessed.

The characteristic of the BTO and BTL in road can be different when it used in rail, and it is difficult to find the difference through the quantitative VFM assessment in which most factors are same. Thus, the qualitative analysis is needed in road and rail lastly.

3. The way of interview

There can be various methods such as survey, literature review, etc. to prove the result of qualitative assessment, but comparing the BTL with the BTO has not been done before. Thus, the face to face method seems more effective because the comparison concept and various possible contract conditions in different PPP models should be cleared and explained to the interviewee even though they are experts in the PPP field.

The case for the Seoul Metro 9 was added to this research after the first interview, so telephone interview is done for the Seoul Metro 9.

4. The schedule for the interview

4.1. Date

- the first interview : 6 Nov. 2010 ~ 21 Nov. 2010 (2 weeks)
- the second interview : 13 May 2011~14 May 2011 (by phone)

4.2. Place : South Korea (face to face)

4.3. Interviewee

	Field	Interviewee
①	General	Director of Metropolitan road division, Ministry of Land, Transport and Maritime affairs
②		Deputy Director of Project evaluation division, Ministry of Strategy and Finance
③		Chief of PPP policy unit, Korea Development Institute
④		Head of Road policy centre, Korea Research Institute for Human Settlements
⑤		Research fellow of Centre for transport and climate change, Korea Transport Institute
⑥		Head of office of construction management, SCMA (Seoul Regional Construction Management Administration)
⑦		Manager of BAI (The Board of Audit and Inspection)
⑧		Head of infrastructure division, KB (Kookmin Bank) Asset Management
⑨	Incheon Airport Expressway	Director of Airport policy division, Ministry of Land, Transport and Maritime affairs
⑩		Head of construction planning office, Korea Highway Corporation
⑪		Head of Strategy team, New Airport Hiway. Ltd
⑫	Incheon Airport Railway	Deputy Director of Railway division, Ministry of Land, Transport and Maritime affairs
⑬		Staff of Strategy and Planning team, AREX
⑭		Staff of KORAIL
⑮	Oksan-Ochang Expressway	Deputy director of Urban road division, Ministry of Land, Transport and Maritime affairs
⑯		Staff of GS construction Ltd.
⑰		Staff of Korea Highway Corporation
⑱	Sosa-Wonsi Railway	Director of Railway policy division, Ministry of Land, Transport and Maritime affairs
⑲		Staff of DAEWOO construction Ltd.
⑳		Staff of Construction office, Korea Railway Network Authority
㉑	Seoul Metro 9	Deputy director of SMG
㉒		Staff of VEOLIA RAPT.
㉓		Staff of MLTM

5. Topic guidance for the interview of the PPP experts

< General comparison between the BTL and BTO >

1.1. (General)What are the characteristics and differences of the BTL and BTO?
1.2. The PPP can have various conditions like a MRG in contract, so the BTL and BTO can become similar by the contracted condition when it makes a contract between the public and private sector. What do you think makes the BTL and the BTO different decisively?
1.3. What is the advantage and disadvantage of the BTL and BTO
1.4. In the UK which is the most advanced country in the PPP field, the most prevalent PPP is the “service sold to the public sector” model which is the BTL model in Korea. On the other hand, many developing countries prefer the financially free standing model like the BTO. What do you think of the reason of choosing different PPP model?
1.5. Do you think there is any difference between the BTL and BTO in the construction stage of a transport infrastructure project? If yes, what is the difference and which model is benefit to the public sector, private sector and the end users?
1.6. Do you think there is any difference between the BTL and BTO in the operation stage of a transport infrastructure project? If yes, what is the difference and which model is benefit to the public sector, private sector and the end users?
1.7. (BTL possibility)The BTL and BTO, both models are being used in rail projects in South Korea. Please, compare the advantage and disadvantage of both models in rail.
1.8. Do you think that the BTL model can be used instead of the BTO model in road? If say yes, what is the reason and if say no, what is the reason?

< Finding qualitative factors which can be compared in different PPP models >

1.9. Do you know about the issues in the qualitative VFM guidance of Korea and do you think it is appropriate to assess the qualitative VFM of a PPP project?

1.10. Current qualitative VFM guidance seems not to be dealt seriously in the reason that experiences about the PPP are not enough in South Korea. Do you agree with this opinion? If no, what is the reason and solution?
1.11. The VFM guidance of the UK suggests 10 issues and 49 questions. Are there any issues or questions to be used in qualitative VFM assessment in South Korea?
1.12. Quantitative VFM seems difficult to deal with the interests of private sector and the end user, so their views look necessary to be considered in the qualitative VFM assessment. Do you agree with this opinion and if yes, how these interests can be included in the qualitative VFM assessment?
1.13. Do you think that current qualitative VFM guidance can be used to compare the BTL with the BTO? If no, how this guidance should be modified?
1.14. What issues and questions in current qualitative VFM guidance can be used to compare the BTL with BTO model in a transport project? Please, add or omit issues and questions to current guidance for comparing the PPP with the PSC.
1.15. Please comment on the modified issues and questions which are suggested in this study to compare the BTL with the BTO for the qualitative VFM assessment.

< Analysis of qualitative characteristics of the BTL and BTO model in road and rail >

1.16. Do you think the appropriate PPP model can be different in road and rail? If yes, which PPP model is effective to road and rail in the view of the public sector, private sector and the end users? If no, why do you think the difference between the BTL and BTO is little to use the PPP in road and rail?
1.17. There are many risks such as construction risk, operation risk and demand risk to do the PPP project. In the view of the public sector, what risks exist to choose the BTL model instead of the BTO model and which PPP model is more risky in road and rail?
1.18. In the view of the private sector, what risks exist to choose the BTL model instead of the BTO model and which PPP model is more risky in road and rail?

1.19. In the view of the end users, what risks exist to choose the BTL model instead of the BTO model and which PPP model is more risky in road and rail?
1.20. The operation seems more complicated in rail than road. Do you think different PPP model can affect the operation and what is the reason?
1.21. Do you think the different PPP model can affect the service quality in road or rail. If yes, which PPP model is more sensitive to the service quality?

< Assessment of qualitative characteristics in each PPP case >

1.22. What is the benefit of using the current PPP model in this project in the point of the service quality? Is it possible to improve the service quality including the level of toll or tariff if the different PPP model were used in this project?
1.23. What is the benefit of the current PPP model in making a contract with the private sector and managing the project? If the different PPP model were used, can be more effective in making a contract and managing the project?
1.24. Do you think that the risk management of this project was (is) appropriate through the payment mechanism or the contract? If you think so, what is the reason and if you don’t think so, what is the reason?
1.25. Most PPP projects last for more than 20 years, so it is not easy to renovate or upgrade new technology which is not developed yet and consider the change of circumstances. Do you think the current PPP model is appropriate to cope with this kind of operational change? If you do not think so, what is the reason?

APPENDIX 4 Result of interview for the qualitative VFM assessment

1 General comparison between the BTL and BTO

1.1 The most decisive factor which makes the BTO and BTL different

Commonly all interviewed experts agreed that the most important factor making the BTO and BTL different was the traffic demand risk. In the BTO model, the private sector has the demand risk while the public sector has the demand risk in the BTL model. They recognised that the gap between the BTO and the BTL model could get closer if the level of the MRG in the BTO model is getting high. In the opposite way, the BTL model can be similar with the BTO model if the demand risk is shared with the private sector through the payment mechanism such as a shadow toll in the PFI of the UK. Thus, there was no discrepancy in the opinion that the most decisive point discriminating the BTL model with the BTO model is that who mainly has the traffic demand risk.

Some experts pointed out that the BTO model could be used in the facility with the profitability through the revenue collecting from the end users only and the BTL model was usually used in the facility without the profitability. This seems related with the PPP circumstances of South Korea.

1.2 The possibility of using the BTL model instead of the BTO projects

All interviewed PPP experts agreed that it was legally possible to use the BTL model instead of the BTO model in the transport PPP. However, there were subtle differences in practical approach between the public sector and private sector. Researchers and experts from the private sector said that the BTL model of which revenue paid by the Government could be an alternative to the BTO project which fell in difficulties because of financing, but the Government officials including the MOSF were reluctant to use the BTL model instead of the BTO model in facilities expected to have enough profitability. The Government officials from the MLTM concerned that the Government had to have the whole demand risk if the BTL model was used instead of the BTO model. They said that the formal reason to use the BTL model in rail currently was to achieve the better VFM, but unveiled real feelings that it seemed to be very difficult to find the difference of the service quality between the BTL and the PSC. A Government official from the MOSF worried that the Government debt could be increased when the BTL model was used in the current BTO projects. He said the MOSF was less interested in how much the Government could make a profit by adopting the BTL model, because it had high uncertainties in revenue based on the traffic forecasting.

Also, an expert said that the Korean Government preferred the BTO model to the BTL model if the project had enough profitability, because the PPP policy of South Korea mainly focused on saving budget.

1.3 The advantage and disadvantage of different PPP models in transport

The Korean Government has introduced the BTL model to several railway projects since 2005, and comparing two different PPP models in rail can be easy to understand the characteristic of the BTL and the BTO. Thus many interviews of this part were basically done based on rail experience.

An expert criticised to use the BTO model in transport such as road and rail, because the demand risk the private sector has in the BTO model is much more affected by the Government policy or planning than the private sector's effort. He questioned whether the BTO model in transport was right, and argued that the BTL model was more appropriate in transport PPP. However, he agreed that the BTO model could urge more creativity and efficiency to the private sector to make more profit if there was no MRG (Minimum Revenue Guarantee). It is also pointed out that the private sector did more active try to be involved in from the design and construction stage in the BTO model.

Many experts said that the BTL model was easier to finance than the BTO model in which the private sector had more demand risk. This is the big advantage of the BTL model in the current tough financial circumstances. However, an expert from the financial investor said they prefer the BTO with the MRG model to the BTL model, because the financial investor expects the opportunity to make more profit in the PPP investment. Of course they agreed to want to avoid high risk of the BTO model, but they also hoped to have more profit than that of the BTL model which is quite low compared with the other investment chance. The BTO with MRG was the best to the financial investor, because the minimum profit was guaranteed and an additional chance to make more profit could be provided.

Opinions on some factors were different with each stake holders. In the wise of making a contract, the Government officials said that the BTL was more complicated in making a contract to regulate the standard of the service quality in the written form. The private sectors said that the BTO model was harder to be prepared to assess the risk and to negotiate the public sector. The views on the advantageous PPP model in construction stage were somewhat different. Most interviewees thought that the difference between the BTL and the BTO model in construction stage was little. However, some experts argued that the BTO model needed more resources in the construction stage, because they worried more things in operation stage after construction in the BTO model. The flexibility of the contract was also an important issue. The Government officials said that the BTL model would be more appropriate to cope with the change of operational circumstances such as regional development or advanced technology. The Government can request something to change in the BTL model through the payment mechanism in which lease fee is regularly paid by the Government. On the contrary, the private sectors said that the BTO model would be more sensitive to that kind of change. If there is an important change in the operational circumstances, the private sector can not help dealing with that change in the BTO model, in which the revenue risk is on the private sector. To this view, a researcher pointed out that the interest of the private sector was on the profit, so they would cope with only the operational change related with their profit in the BTO model. About the service quality, most interviewees consented that the operation company might try harder to achieve higher service quality in the BTO model. However, some researchers said that the BTL model could be better to the end user in the view of the level of tariff or toll.

2 Qualitative characteristics of the PPP models in different transport mode

2.1 The relation of the PPP model and transport mode in the contract stage

Problems in a contract stage were pointed out that the transaction cost and unclearness in terms and conditions. Transaction cost is about the time cost such as time spending on negotiation and the direct cost such as a consulting or initial design cost of the private sector. With respect to time cost, many interviewees said that the most decisive problem was delay of the making a contract because of the discrepancy between the public and private sector in an appropriate profit under the current tough global financial circumstances. Some projects have failed to finance from the financial investor even after making a contract with the public sector, so the projects were delayed without a specific time schedule. Thus, the BTL model generally looked easier in contract stage than the BTO model and many experts agreed with this view. A researcher pointed out that rail is more complicated in construction and operation than road, so it could take more time to get an agreement in performance level in the BTL model in which details of performance should be written on a contract. Of course, he agreed that the difference of complexity between road and rail was not too big and the difference depended on terms and conditions of each PPP project, so it was difficult to say that the generally BTO model was better to rail.

2.2 The relation of the PPP model and transport mode in the design and construction stage

Most experts said that the difference between the PPP models in a construction stage could be neglected whether the project was road or rail. These views looked to be related with the current Korean PPP market in which the private sectors mostly consisted of major construction companies. Especially, many of them said that both PPP models in road case had to follow the standard road specification regulated by the Government, so it was not easy to find difference between the BTL and the BTO model. Rail was more complicated in construction than road. Experts in rail showed their opinion that bedding construction could be similar with road, so there was little difference between two PPP models. However, they argued that other facilities and equipments such as electrified structures, operational facilities and a train were various and they were much related with the operation, so the BTO model could be expected to response actively to end users demand even in a design stage. A researcher said that the Seoul Metro subway no.9 which was newly opened in 2009 was a good example. The bedding construction of the Seoul Metro no.9 was done by the public sector, and the other facilities and equipments were procured through the BTO. The private sector newly introduced general and fast train system, workerless station, etc and this concept was adopted from the design stage. After all, the BTO model in Seoul Metro no. 9 could provide the possibility of introducing more effective and recent technology from a design and construction stage in rail.

2.3 The relation of the PPP model and transport mode in the operation stage

Some interviewees argued that the private sector had more strength on the operation of transport facilities than the public sector. They said that the difference in road and rail between the private and public sector was not easy to find in the construction stage, because it was construction companies that constructed road and rail whatever the procurement model is. Their arguments were that the responsibility in operation stage made the competitiveness of private sector in the PPP high. Operational responsibility of the private sector in the BTL model is regulated based on the performance agreement between the public and private sector. While the responsibility in the BTO model is on the private sector and their performance is indirectly assessed by the end users in the form of revenue. Thus, better PPP model in the operation stage seems to depend on which sector between the public sector and the end users is better to get higher service quality and to strengthen the operational responsibility of the private sector.

Many experts said that the demand in transport was more affected by the route than the service quality, because the competition between the transport infrastructures is quite much restricted from the planning stage of the project. The Government prevents excessive investment to the transport infrastructures through the feasibility test such as the benefit cost analysis. However, most interviewees agreed that the service quality in rail such as comfort, train schedule, on time was relatively more important than it was compared with that of road. Generally, the private sector pays more attention to the service quality in the BTO model, in which they collect the revenue from the end users directly. Many researchers consented that the BTO model could be more appropriate to rail in the view of service quality.

On the other hand, some other experts argued that the service quality should be considered with the level of tariff or toll. They said that the possibility of lowering the level of tariff or toll is higher in the BTL model.

Several researchers said that the rail systems should be divided into the city metro rail and national arterial rail. They argued that the characteristics of the metro and arterial rail quite different. In South Korea, metro rail can be constructed and operated independently, but the arterial rail projects are mostly parts of the national rail networks and the operation should be related with the existing rail network. Considering two different characteristics of the metro and arterial rail, they said that the BTL model was better to the arterial rail and the BTO model was better to the metro rail in the view of operation.

3 Qualitative assessment for each PPP cases in case of using different PPP model instead of current model

Basically a qualitative VFM assessment is done by the public sector and it is assessed in the view of the public sector. However, it should include different views of the private sector and end users for a successful PPP deal. These views can be considered in the achievability and serviceability. Following assessment was done through the PPP experts interviews based on the modified VFM guidance for comparing the BTO and BTL proposed in the transferring report.

3.1 The Incheon Airport Expressway (BTO with MRG model)

< Serviceability >

With respect to the serviceability, 8 interviewees said that this project was done by the BTO with MRG model, and the level of MRG was 90% at first introduced, so it was difficult to expect for the private sector to make an effort to improve the service quality (Ⓐ). A Government officer who was in charge of this project argued that even if the BTL model had been used, there had been little difference with the BTO model in the serviceability wise (Ⓑ). He argued that most factors in service quality such as speed, physical condition, driving etiquette, etc. seemed to be decided not by the effort of the private sector but by the geographic route, a physical standard of expressway, and transport culture. He pointed out that the service factor which can be managed by the private sector looked to affect little for the end users to choose the road even in the BTO case without MRG condition. An officer of BAI (Board of Audit and Inspection) said that when he collected issues on the PPP, people could not feel any strength of private sector in this project and complained excessive toll price (Ⓒ). Others said that though there was little difference in the service quality, but the toll price could be lower in the BTL model, so the BTL model could be better in the wise of service quality.

< Contract and management >

An interviewee argued that there was no the MRG condition when the BTO contract was first made, so it lasted for two years to reach to agreement between the public and private sector. Thus, he said that if the BTL model had been used at that time, this time could have been reduced (Ⓓ). In the view of the Government, the BTL model had more benefit to cut the negotiation time and to manage the project by the public sector's needs.

< Incentivising good risk management >

All interviewees said that there was no incentive to the good risk management of the private sector in the Incheon Airport Expressway project which was done by the BTO model with the MRG. They argued that it was difficult to say the BTL model was better to incentivise the good risk management, but it had more opportunities to incentivise through the performance assessment. In this BTO case, risks in construction stage were hedged by the general insurance for construction and there was no risk hedge in operation stage. The private sector has whole responsibility in operation and they are judged by only the revenue which was collected by the end users. However, the MRG regulation guaranteed 90% of expected revenue, so there was no reason for the private sector to make an effort to manage risk well. With regard to this view, a researcher said that this project looked better to choose the BTL model instead of the BTO with MRG model (Ⓔ).

< Operational flexibility >

With regard to the operational flexibility, opinions of the private sector and the public sector were quite different. The interviewee from the private sector said that the private sectors would react to the change of circumstances by the public sector's request in the BTL model (Ⓕ). They argued that the public sector could not be more sensitive to this kind of change than the private sector. However, an interviewee from the public sector pointed out that the private sector had whole responsibility in operation in this project, so it looked to take longer for the private sector to introduce the electronic toll charging system which was already used to the other expressways (Ⓒ). The Government guaranteed the operation cost, but the contents of operation cost were not checked or reviewed at all. Thus, he criticised that the real traffic was much lower than the forecasted, so the private sector was difficult to expect to earn more revenue than the guaranteed level in this BTO with MRG model even if they had made an effort to attract users or cut the operating cost through the introduction of new technology.

3.2 The Incheon Airport Railway (BTO with MRG model)

< Serviceability >

This project was also done by the BTO with MRG model, and the level of MRG was 90% at first, so most interviewees agreed that the private sector was not expected to make an effort to improve the service quality (Ⓐ). Several experts argued that even if the BTL model had been used, there had been little difference with the BTO with MRG model in the serviceability. However, an expert argued that the BTO model, even if it had the MRG, could have many benefits than the BTL model in rail, because an operation investor could creatively involve in the project from design and construction stage (Ⓑ). In the BTL model, an operator investor did not need to make an effort to induce the creative and competitive ideas to the service quality. The only thing they have to do might be to have an ability to fulfil the demand of the Government. Especially, many experts agreed that this project needed huge financial investment and the competition was limited to a few construction companies. They made only one consortium to bid, so it was difficult to expect for them to be creative and competitive compared with the public sector when the BTL had been used.

< Contract and management >

Most interviewees agreed that if the BTL model had been used instead of the BTO with MRG model which was adapted to this project, the time spent on negotiation could have been reduced (Ⓓ). In the view of the public sector, the BTL model had more advantages in managing the project to cope with the needs of public sector. However, an expert opposed to this opinion, because there was no experience of performance assessment in operation not only in road but also in rail, so it could take much time for the public sector to make the criteria and standard of performance (Ⓒ). Also this might be worse in rail which is more complicated in operation than road.

< Incentivising good risk management >

All interviewees said that there was no incentive to the good risk management of the private sector in the Incheon Airport Railway project which was done by the BTO model with the MRG (Ⓔ). The private sector has whole responsibility in operation like the Incheon Airport Expressway. Though they were more sensitive to the end users than road, but their performance was not assessed at all by the public sector and there was no reason for the private sector to make an effort to manage risk well because their revenue was guaranteed regardless of the result of risk management. An interviewee said that if the BTL model had been used in this project, the private sector might have more burdens in operation (Ⓕ). She pointed out that good risk management regularly was checked in the BTL model through the performance assessment, but the public sector did not want to interfere with the risk management of the private sector beyond their responsibility in the BTO model.

< Operational flexibility >

With regard to the operational flexibility, an interviewee said that it was decided by the conditions of each project contract rather than by the PPP model and many other experts agreed with this opinion (Ⓖ). In case of considering the difference of PPP models of which the terms and conditions are similar, the private sector alleged that they were more sensitive to the change of circumstances or technology in the BTO model. However, a Government official mentioned that the private sector were only interested in making a profit, so they might be adapt the technology or innovative skill only when it could make an additional profit in the BTO model. Even though the private sector could save operating cost or increase revenue, it might be included to the private sector as an incentive in the BTO model, so there would be little to increase the VFM in the view of the Government. Consequently, he argued that the BTL model seemed to have more benefit in the operational flexibility (Ⓗ).

3.3 The Oksan-Ochang Expressway (BTO model)

The Oksan-Ochang Expressway is the BTO without the MRG project suggested by the private sector. The private sector requested the construction subsidy of the Government and this suggestion was rejected because of low VFM compared with the PSC option. The Government proposed to reduce the subsidy and profit, and the consortium of construction companies accepted it but they have difficulties in financing.

< Serviceability >

Most interviewees agreed that there would be little difference between the BTL and the BTO model in the serviceability (Ⓐ). They argued that the service in road seemed routine and it was decided not by the effort of the private sector but by the geographic route. An officer of BAI (Board of Audit and Inspection) also pointed out that the Oksan-Ochang Expressway was not expected to be congested at first as newly constructed road which was designed for decades later, so people would be more interested in toll price (Ⓑ). Others said that though there was little difference in the service quality, but the toll price could be lower in the BTL model, so the BTL model could be better in the wise of service quality.

< Contract and management >

This project without the MRG condition is having much difficulty in financing because of high demand risk of the private sector beside general financial situation wanting avoid long-term risk. Thus, most interviewees consented that choosing the BTL model would be helpful to finance and make a contract (Ⓒ). Many of them also mentioned that the management of road in operation is about the maintenance, so there would be very little different in management in both PPP models.

< Incentivising good risk management >

All interviewees said that incentivising good risk management is available to both PPP models through the conditions of contract. However, the most important difference between the BTL and BTO model is who is in charge of traffic demand risk. Thus, this was about the good management in demand risk which is on the private sector in the BTO model and on the private sector in the BTL model. In this BTO project, the private sector has whole responsibility of demand risk, so there is no incentivising from the Government and the private sector is compensated for the traffic demand by the collected revenue from the end users. An interviewee argued that the BTL model seemed better to manage the demand risk in road, because the traffic demand in road was much affected not by the effort of an operator but by the road route which was decided by the Government (Ⓓ). He alleged that it was better to incentivise good risk management which could be controlled by the private sector through the performance assessment in the BTL model.

< Operational flexibility >

With regard to the operational flexibility, opinions of the private sector and the public sector were quite different like other projects. Interviewees from the private sector said that the private sectors would be passive to the need of operational change in the BTL model (Ⓔ). They argued that considering the public sector tended to cope with these changes later compared with the private sector, the BTO model would be better. Like other projects, the public sector argued that the private sector would not be interested in the change with no profit and even though they would change, it might not be related with the VFM measured in the view of public sector (Ⓕ). Thus, they said that the BTL model could be better in the operational flexibility.

3.4 The Daegok-Sosa Railway (BTL model)

The Daegok-Sosa Railway is the solicited BTL project. The VFM test has been done and now is in negotiation with the Government. This project is the part of arterial railway network, and it can not be operated separately with other trains. It is one of the most important reasons to choose the BTL model.

< Serviceability >

With respect to the serviceability, most interviewees thought the private sector could be difficult to improve the serviceability whatever the PPP model is, because this project was a part of national rail network. An interviewee said that the construction and operation should be separated in rail, because the there could be no difference in construction as a part of national rail network, but the private sector could compete with other rail route for better service quality in operation if the BTO model would be used. An interviewee from KORAIL said that the creativity of the private sector beyond the performance demand from the public sector was not clear to improve the service quality timely (Ⓐ). He argued that the service quality might be affected by who operated it rather than by which PPP model was used. Especially, the Daegok-Sosa line is a part of national rail network and it can be operated with other public operating rail. Thus, he said that the BTL model can be advantageous in the service quality such as connecting or transferring to other trains and lowering the tariff through sharing common facilities or equipments with the public operator. However, all of them agreed that the tariff could be lower in the BTL model, so the BTL model could be better in the perspective of VFM.

< Contract and management >

Most interviewees agreed that the BTL model would be easy to finance, so it could make a contract easy (Ⓑ). For this project, it would need subsidy from the Government in case of using the BTO model. Even though the Government could provide the construction or operation subsidy, the BTO model would be difficult to make a contract because of the recent experience of much lower traffic demand in rail than anticipated if there were no MRG condition.

With regard to the management, an experience is an important factor for the public sector to manage the project. The BTL model is firstly used for rail, but an interviewee from the MLTM said that the private sector has already experiences in train operation, so it did not seem to have difficulty in operation even in the BTL model (Ⓒ). Interviewees from the public sector pointed out that there might be little difference in construction stage in both PPP models, but agreed that the BTL model looks easier to be supervised in operation stage than the BTO model by the public sector (Ⓓ).

< Incentivising good risk management >

All interviewees knew that the BTL model could incentivise good risk management through the performance assessment linked to the Government payment. However, a Government official in charge of this project said that the private sector did not make an effort to improve the service or suggest creative idea for better VFM (Ⓔ). They just followed the guideline of the Government and were passive in the BTL model. Most interviewees consented that this project is a part of national rail network, so even though the BTO model was used, incentivising good risk management might be limited (Ⓕ).

< Operational flexibility >

Most interviewees from the public sector said that basically this project was much related with other national rail network, so the BTL model could have benefit to the public sector to cope with the future change of circumstances (Ⓖ). Respondents of the public sector argued that the need for an operational change such as train time and equipment by the public sector was expected to be high (Ⓗ).

3.5 Seoul Metro 9 (BTO with MRG model)

< Service quality >

Most interviewees agreed that the private sector seems to be more sensitive to the end users in the BTO model (Ⓐ). However, several respondents pointed out that the advantage of the BTO model in service quality could be realised only when there was no MRG condition (Ⓑ). They argued that if a BTO project had a MRG condition, the revenue would be guaranteed to the private sector and efforts to improve service quality could be decreased. Also, an interviewee said that the service quality of the Seoul Metro 9 could be upgraded because there were enough competitions among subway operators (Ⓒ). The interviewee pointed out that there were more competitors in the Seoul Metro 9 than other railways (Ⓓ).

< Contract and Management >

Many interviewees said that financing was a key issue to make a contract and the BTL model looked easier to induce the private investment because there was no demand risk on the private sector (Ⓔ). An interviewee of the investment bank said that a financial investor could prefer the BTO with the MRG model than the BTL model (Ⓕ).

With regard to the project management, many interviewees agreed that the difference between the BTL and the BTO in project management would be little (Ⓖ). Instead, some of them pointed out that the ability of the private and public sector was more important than a kind of PPP model (Ⓗ).

< Risk management >

Most Interviewees said that the appropriate risk management is variable by terms and conditions (Ⓘ). Several respondents said that the simplicity of risk management in the BTO model is a very strong advantage (Ⓙ).

< Operational flexibility >

Interviewees from the private sector alleged that they were more sensitive to the change of circumstances or technology in the BTO model (Ⓚ). A respondent from the public sector said that the private sector was only interested in making a profit, so the technology or innovative skill might be only adapted when it could make an additional profit in the BTO model. Respondents from the public sector argued that it was easy to request operational change in the BTL model through performance assessment. They argued that, even the in case of affecting the profit of the private sector, the public sector can have more options to be involved in the operation stage than in the BTO model (Ⓛ).

APPENDIX 5 Forecasted and actual traffic in rail of South Korea since 2000

Project	Length (km)	Open (year)	Forecasted passengers (passengers /day, 2010*)	Actual passesngers (passengers /day)
Suseo-Ogum	3.0	2009	16,610	16,813
Seoul subway 7(Jangam-Onsu)	46.9	2000	2,596,000	926,000
Seoul subway 6(Eongam-Bonghwa)	35.1	2001	1,634,000	529,000
Seoul subway 9(Gaehwa-Nonhyun)	27.0	2009	312,438	260,452
Incheon Gyulhyeon-Dongmak	21.9	2000	1,890,000	218,551
Incheon Dongmak-Internatnional business centre	6.5	2009	81,783	11,376
Daejeon metro 1	22.6	2005	181,000	94,991
Gwangju metro 1	20.1	2007	263,659	47,931
Daegu metro 2	29.0	2005	152,000	143,705
Busan metro 3(Suyoung-Daejeo)	18.3	2005	322,678	75,000
Uijeongbu-Dongan electrified double track rail	23.0	2007	191,984	139,513
Suwon-cheonan 2 electrified double track rail	55.6	2007	114,165	240,006
Janhhang line renovation (1st stage)	75.6	2009	39,234	19,693
Incheon airport railway	61.7	2010	421,592	47,791
Ori-Suwon electrified double track rail	19.5	2007	108,518	28,041
Cheongryangli-Deokso electrified double track rail	18.0	2010	96,916	155,921
Deokso-Wonju electrified double track rail	90.4	2009	55,511	38,326
Cheonan-Onyangoncheon electrified double track rail	16.5	2009	33,056	43,152
KTX(1st stage)	238.6	2004	226,155	195,363

* Traffic forecast in 2000 was calculated by the linear analysis based on past and future traffic forecast trend. Source: MLTM (2010)

APPENDIX 6 Monte-Carlo Simulation by MS Excel 2003

1. Basic Procedure

1.1 Random number generation by using the formula *=RAND( )*

When the formula *=RAND()* is entered in a cell, a number, that is equally likely to assume any value between 0 and 1, can be get. Thus, around 25 percent of the time, a number less than or equal to 0.25 can be get; around 10 percent of the time a number that is at least 0.90 can be get, and so on. In the thesis, random numbers of 10,000 are generated by using this function of the MS Excel 2003.

1.2 Simulation of values of a discrete random variable

The key to the simulation is to use a random number to key a lookup from the probability of inaccuracy of traffic forecasting in road and rail in South Korea. In the case of road, random numbers greater than or equal to 0 and less than 0.046 will yield an inaccuracy of -95%; random numbers greater than or equal to 0.046 and less than 0.207 will yield an inaccuracy of -80%; by the same method, the rest of random numbers yield to the probability of an inaccuracy of traffic forecasting in road. In the case of rail, the same method is used based on the probability of inaccuracy of traffic forecasting in rail in South Korea. In Figure A, 10,000 random numbers were generated by copying from C2 to C10001 the formula RAND(). 10,000 iterations of inaccuracy of traffic forecasting were undertaken by copying from B2 to B10001 the formula *VLOOKUP(C2,lookup,2)*. Here, the *lookup* is the table range from F2:G13

1.3 Calculation of the VFM

The VFM for comparing the BTL with the BTO is calculated by the following formula in Chapter 4 based on the generated inaccuracy of traffic forecasting.

$$VFM_{\ell o} = BTO\ (Subsidy) - BTL\ (Lease + Operating\ cost - Revenue)$$

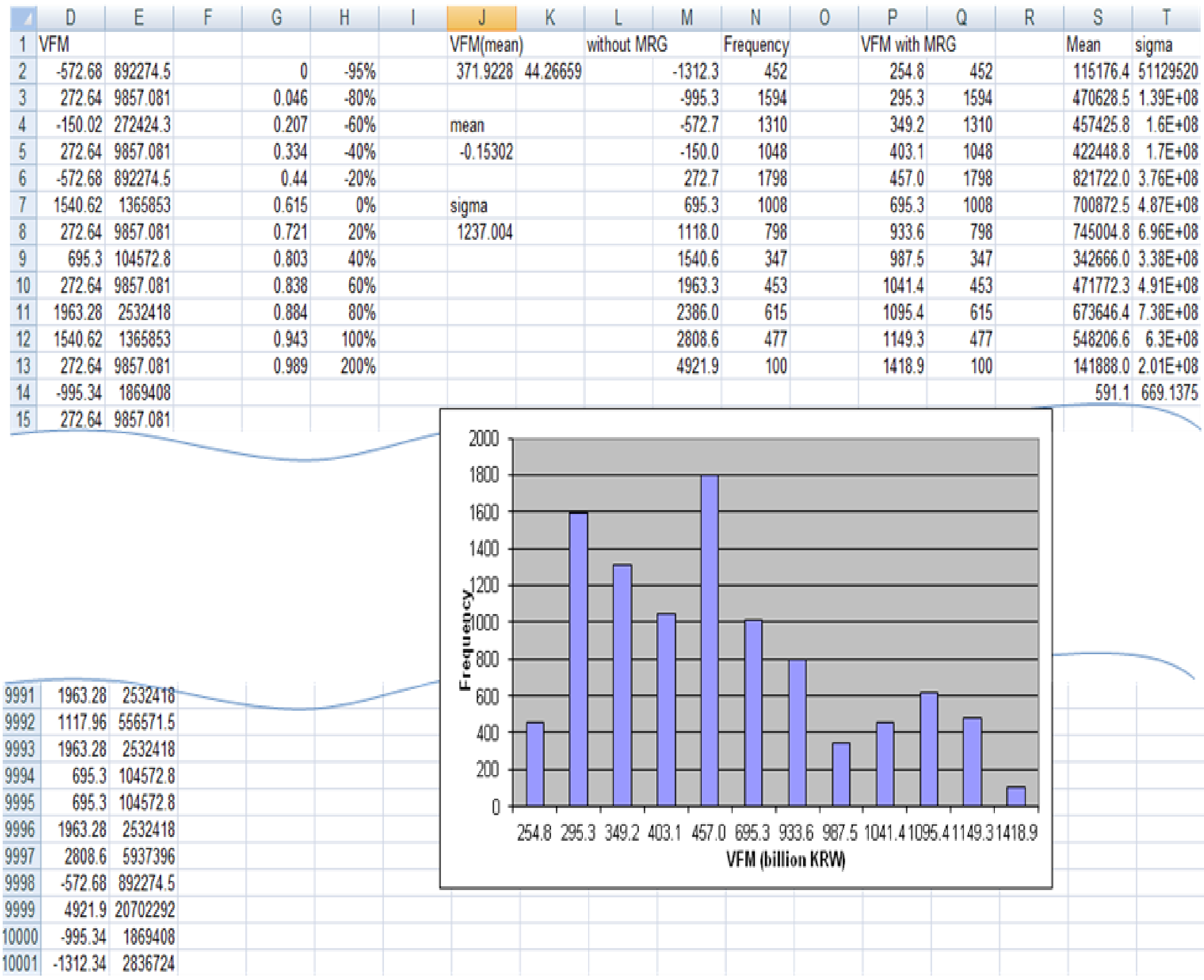
In this formula, the inaccuracy of traffic forecasting affects the revenue.

1.4 Probability of VFM based on the inaccuracy of traffic forecasting

By using the Frequency function of the Excel, the values of VFM, which were calculated by randomly generated inaccuracy of traffic forecasting based on the discrete probability of the inaccuracy of traffic forecasting in road and rail in South Korea, can be counted. Total iteration is undertaken 10,000 times, so the frequency divided by 100 is the probability of VFM based on the inaccuracy of traffic forecasting.

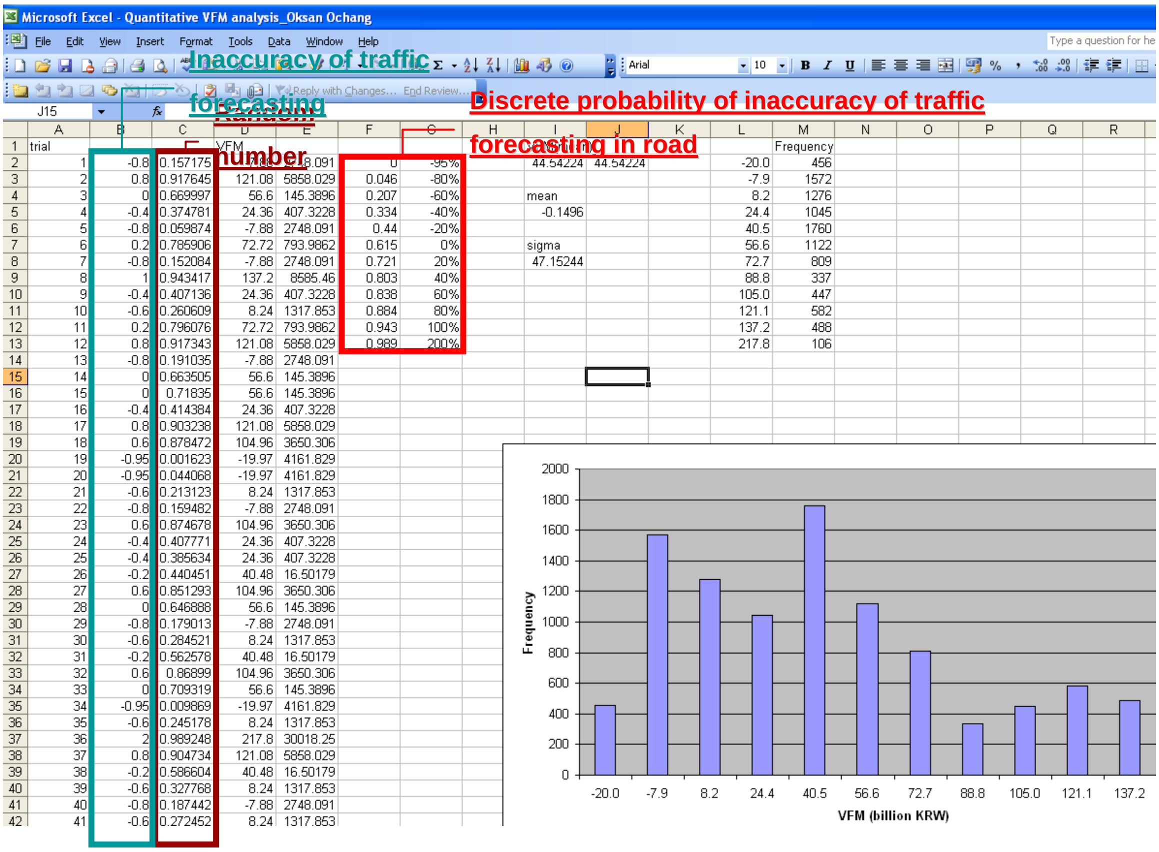
2. Monte-Carlo Simulation for 5 cases

2.1. Incheon Airport Expressway

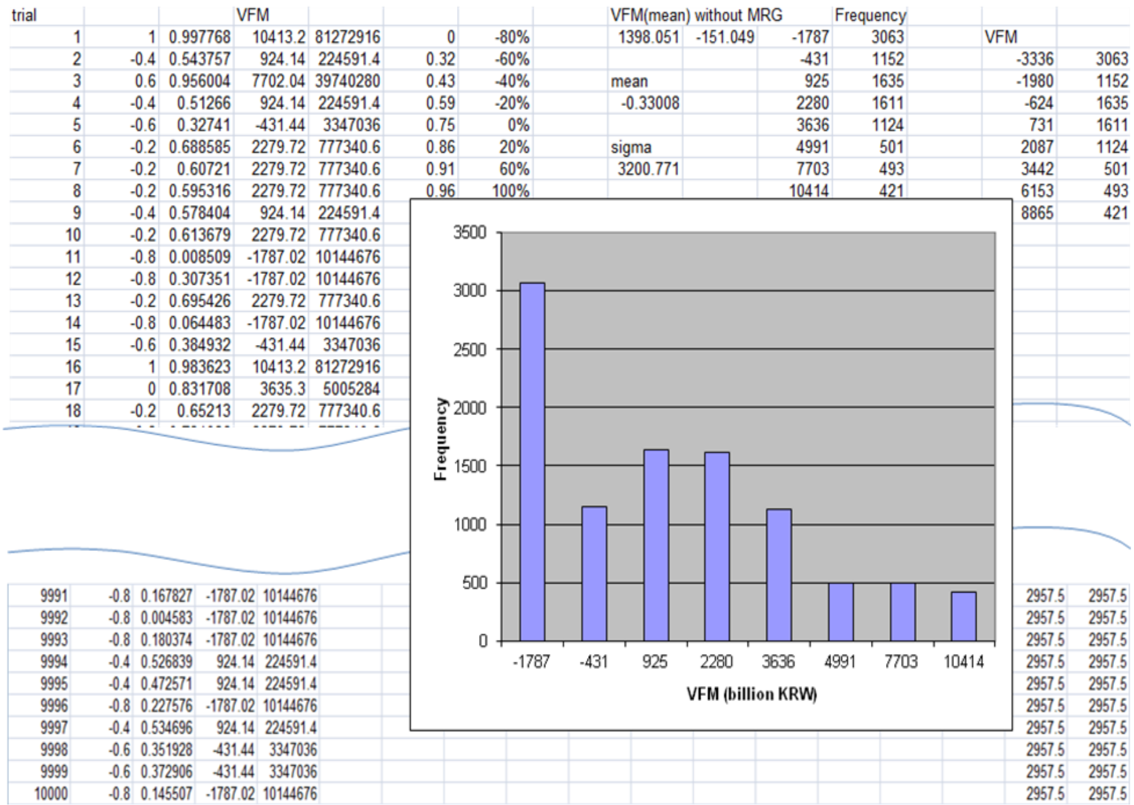


	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	VFM						VFM(mean)		without MRG		Frequency		VFM with MRG			Mean	sigma
2	-572.68	892274.5		0	-95%		371.9228	44.26659		-1312.3	452		254.8	452		115176.4	51129520
3	272.64	9857.081		0.046	-80%					-995.3	1594		295.3	1594		470628.5	1.39E+08
4	-150.02	272424.3		0.207	-60%		mean			-572.7	1310		349.2	1310		457425.8	1.6E+08
5	272.64	9857.081		0.334	-40%		-0.15302			-150.0	1048		403.1	1048		422448.8	1.7E+08
6	-572.68	892274.5		0.44	-20%					272.7	1798		457.0	1798		821722.0	3.76E+08
7	1540.62	1365853		0.615	0%		sigma			695.3	1008		695.3	1008		700872.5	4.87E+08
8	272.64	9857.081		0.721	20%		1237.004			1118.0	798		933.6	798		745004.8	6.96E+08
9	695.3	104572.8		0.803	40%					1540.6	347		987.5	347		342666.0	3.38E+08
10	272.64	9857.081		0.838	60%					1963.3	453		1041.4	453		471772.3	4.91E+08
11	1963.28	2532418		0.884	80%					2386.0	615		1095.4	615		673646.4	7.38E+08
12	1540.62	1365853		0.943	100%					2808.6	477		1149.3	477		548206.6	6.3E+08
13	272.64	9857.081		0.989	200%					4921.9	100		1418.9	100		141888.0	2.01E+08
14	-995.34	1869408														591.1	669.1375
15	272.64	9857.081															
9991	1963.28	2532418															
9992	1117.96	556571.5															
9993	1963.28	2532418															
9994	695.3	104572.8															
9995	695.3	104572.8															
9996	1963.28	2532418															
9997	2808.6	5937396															
9998	-572.68	892274.5															
9999	4921.9	20702292															
10000	-995.34	1869408															
10001	-1312.34	2836724															

2.2. Oksan-Ochang Expressway

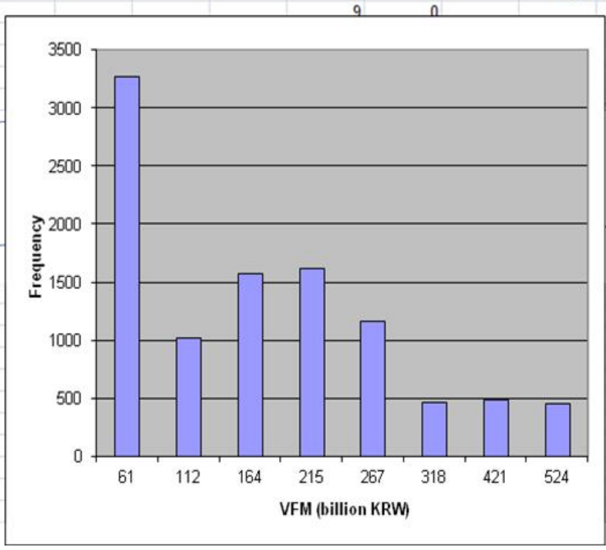


2.3. Incheon Airport Railway



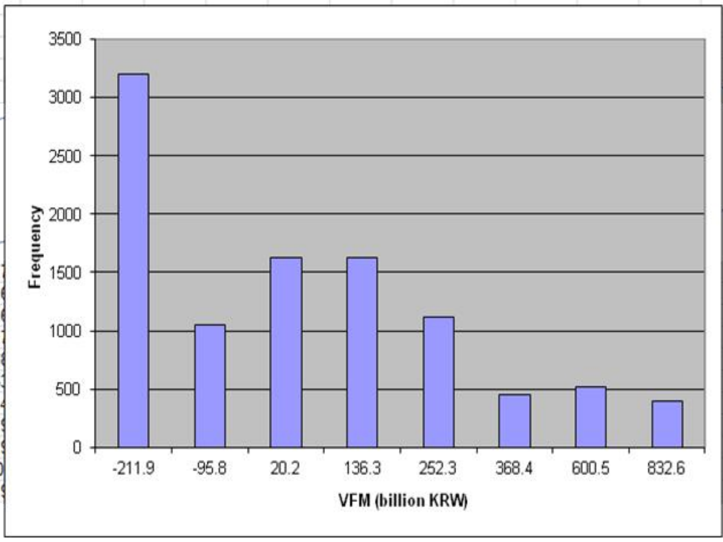
2.4. Daegok-Sosa Railway

1			VFM				VFM(mean)					
2	-0.6	0.395724	111.98	4653.931	0	-80%	180.1997	180.1997	0	0	VFM	Frequency
3	0.2	0.8855	317.74	18917.33	0.32	-60%			1	0	61	3266
4	-0.2	0.717792	214.86	1201.334	0.43	-40%	mean		2	0	112	1015
5	-0.4	0.471739	163.42	281.5593	0.59	-20%	-0.33476		3	0	164	1569
6	-0.8	0.123445	60.54	14318.45	0.75	0%			4	0	215	1607
7	0	0.854181	266.3	7413.257	0.86	20%	sigma		5	0	267	1161
8	-0.2	0.717135	214.86	1201.334	0.91	60%	122.9577		6	0	318	460
9	-0.6	0.409897	111.98	4653.931	0.96	100%			7	0	421	477
10	-0.4	0.549758	163.42	281.5593					8	0	524	445
11	-0.2	0.720365	214.86	1201.334					9	0		
12	-0.8	0.1522	60.54	14318.45								
13	1	0.978757	523.5	117855.1								
14	-0.2	0.619617	214.86	1201.334								
15	-0.8	0.157254	60.54	14318.45								
9991	0.6	0.959823	420.62	57801.91								
9992	-0.8	0.297754	60.54	14318.45								
9993	-0.6	0.387257	111.98	4653.931								
9994	-0.8	0.129466	60.54	14318.45								
9995	-0.8	0.095962	60.54	14318.45								
9996	-0.2	0.605222	214.86	1201.334								
9997	-0.8	0.134839	60.54	14318.45								
9998	-0.8	0.127024	60.54	14318.45								
9999	-0.6	0.414247	111.98	4653.931								
10000	1	0.962933	523.5	117855.1								
10001	-0.2	0.684178	214.86	1201.334								



2.5. Seoul Metro 9

trial			VFM				VFM(mean) without MRG		Frequency	VFM with MRG			VFM(mean) with MRG
1	-0.4	0.553062	20.18	1319.635	0	-80%	56.50678	-211.9	3200	-153.9	3200	-492480	86.97376
2	-0.2	0.705466	136.24	6357.386	0.32	-60%		-95.8	1050	-95.8	1050	-100590	
3	0	0.813099	252.3	38334.98	0.43	-40%	mean	20.2	1631	86.4	1631	140918.4	
4	0.6	0.955006	600.48	295906.9	0.59	-20%	-0.3374	136.3	1631	145.5	1631	237310.5	
5	-0.2	0.669422	136.24	6357.386	0.75	0%		252.3	1121	252.3	1121	282828.3	
6	1	0.978685	832.6	602320.7	0.86	20%	sigma	368.4	457	359.1	457	164090.4	
7	-0.4	0.543879	20.18	1319.635	0.91	60%	272.8775	600.5	517	600.5	517	310448.2	
8	0	0.757449	252.3	38334.98	0.96	100%		832.6	393	832.6	393	327211.8	
9	-0.4	0.575372	20.18	1319.635									
10	-0.8	0.07537	-211.94	72063.67									
11	-0.8	0.200549	-211.94	72063.67									
12	0	0.767443	252.3	38334.98									
13	-0.8	0.252552	-211.94	72063.67									
14	-0.8	0.197253	-211.94	72063.67									
9990	-0.6	0.351135	-95.88	23221.7									
9991	-0.8	0.13394	-211.94	72063.6									
9992	-0.8	0.008692	-211.94	72063.6									
9993	-0.6	0.330114	-95.88	23221.7									
9994	-0.2	0.684966	136.24	6357.38									
9995	-0.4	0.502157	20.18	1319.63									
9996	0.2	0.862403	368.36	97252.4									
9997	0	0.807164	252.3	38334.9									
9998	0	0.764891	252.3	38334.9									
9999	1	0.97237	832.6	602320									
10000	0	0.81325	252.3	38334.9									



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